DOCUMENT 00 01 01

CITY OF SAN BRUNO

Public Works Department
City of San Bruno
567 El Camino Real
San Bruno, CA 94066

PROJECT SPECIFICATIONS

SNEATH AND LAKE PUMP STATION REHABILITATION PROJECT

Project Nos. 11003 & 11004

Advertisement Date: Wednesday, February 25, 2026

Pre-Bid Conference: Tuesday, March 10, 2026 Time: 10:00 AM (PDT) (Mandatory)

Bid Opening: Thursday, March 26, 2026 Time: 2:00 PM (PDT)

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SEALS PAGE

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N/A

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N/A

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CITY OF SAN BRUNO
San Mateo County, California

NOTICE INVITING SEALED BID PROPOSALS FOR

SNEATH AND LAKE PUMP STATION REHABILITATION PROJECT
Project Nos. 11003 and 11004

1. **NOTICE:** The City of San Bruno (the "City") will receive sealed bids on the proposal forms furnished by the City and in accordance with the plans and specifications on or before **Thursday, March 26, 2026 at 2:00 PM (PDT)** by the Office of the City Clerk, located at 567 El Camino Real, San Bruno, California 94066, for the following public work:

2. **PROJECT DESCRIPTION:**

   The work includes, but is not limited to: rehabilitation of the Lake and Sneath Potable Water Pump Stations. Work includes, but is not limited to the mechanical piping, new HVAC new electrical and instrumentation, existing electrical/instrumentation improvements, building refurbishment and improvements to meet current codes, civil site improvements and new generators. There is a building addition at the Lake Pump Station. A temporary bypass pumping system is necessary.

   All work items shall be constructed in accordance with the contract plans and specifications. Bidding Documents contain the full description of the Work.

3. **TEMPORARY CONSTRUCTION STORAGE/STAGING REQUIREMENTS:** If approved by the City, construction equipment and materials may be stored within the public right-of-way but must be moved every five (5) days as construction progresses. Material storage at the construction site shall be limited to what is needed for five (5) days construction. No construction material shall be stored over the weekend unless approved by the City Engineer. Operating reflector barricades shall be required for all equipment and material left on the street overnight. At the end of each workday all loose material, parts and debris must be cleaned up and discarded and any stored materials shall be neatly stacked and organized. Failure to comply with these requirements shall result in liquidated damages in the amount of **$250** per **Calendar Day**.

4. **CONSTRUCTION SITE / OFF-SITE STAGING AREA SCREENING REQUIREMENTS:** The construction site and any off-site staging areas must be secured by temporary chain linked fencing, with a minimum height of 72 inches, unless the building code requires additional protection. The chain link fence is to be made of galvanized steel and must include a top and bottom rail. The fencing must be adequately anchored to prevent movement and the effects of wind. No visible gaps in

the fencing are allowed, including between panels or under them. Gates must be sliding or in-swinging and close tightly with no gaps in or around them.

When the construction site or off-site staging area is adjacent to any public right-of-way, the fence adjacent to the right-of-way shall have a visual/dust barrier or screening. The screen is to be constructed of green knitted polyethylene or canvas securely fixed to the inside face of the fencing and shall be maintained in a taut condition throughout the project. No twisted wire is to protrude on the exterior side of the fence. No tears or rips greater than 2" in any dimension will be allowed. Any screening that is torn or ripped or fencing or barricades that have been defaced will be replaced at the contractor's expense within 48 hours.

In addition to the required screening, any wood barricades or temporary chain link fencing facing a public roadway shall be setback two (2) feet from any property line or sidewalk, if site conditions allow. All areas visible from the public right-of-way shall be maintained free of weeds and litter.

Any construction site or staging area fencing facing a public roadway shall include a sign, securely installed on the fence that is made of durable and waterproof materials that provides the following information: the name and emergency contact telephone number of the general contractor. The sign lettering shall be large enough to be read from 10 feet away and the sign shall not extend above the top of the fence. The sign language and graphics need to be approved by City staff prior to installation.

Failure to comply with these requirements shall result in liquidated damages in the amount of **$250** per **Calendar Day.**

5. **STATEMENT OF QUALIFICATIONS:** Each Bidder shall be required to submit, in accordance with Document 00 21 00 (Instructions to Bidders) and Document 00 45 13 (Statement of Qualifications (SOQ) for Construction Work), a Statement of Qualifications.

6. **CONTRACT TIME:** All work under this contract shall be completed within **300 Working Days** from the Notice to Proceed effective date. The City shall assess liquidated damages in the amount of **$500** per **Working Days** for delays in completion of the project, as provided in the Contract Documents.

7. **REQUIRED CONTRACTOR'S LICENSE(S):** A California Class **"A"** contractor's license is required to bid on this contract. Joint ventures must secure a joint venture license prior to award of this Contract.

8. **MANDATORY PRE-BID CONFERENCE:** The City will conduct a mandatory in-person Pre-Bid Conference on **Tuesday, March 10, 2026 at 10:00 AM PDT**. Please RSVP to 650-616-7065. The Pre-Bid Conference is estimated to last approximately one hour. Only those contractors who attend the Pre-Bid Conference will be allowed to submit bids for this project.

9. **PROCUREMENT OF BIDDING DOCUMENTS:** Bidders may obtain bidding documents electronically from the Public Works Department bidding website (https://www.sanbruno.ca.gov/Bids.aspx). Physical copies may be obtained directly

from Barker Blue. For information pertaining to the bidding documents, please contact Barker Blue at (866) 347-1011.

10. **INSTRUCTIONS:** Bidders shall refer to Document 00 21 00 (Instructions to Bidders) for required documents and items to be submitted in sealed envelopes for deposit at the Office of the City Clerk, 567 El Camino Real, San Bruno, California 94066, no later than the time and date set forth in Paragraph 1 above.

11. **BID SECURITY:** Cash, cashier's check or certified check, payable to the order of the City of San Bruno, of not less than ten percent (10%) of the bid, or a bond in said amount payable to the City of San Bruno and signed by the Bidder and a corporate surety shall accompany the bid.

12. **BID PREPARATION COST:** Bidders are solely responsible for the cost of preparing their bids.

13. **SUBSTITUTION OF SECURITIES:** The City will permit the successful bidder to substitute securities for any retention monies withheld to ensure performance of the contract, as set forth in Document 00 61 16 (Escrow Agreement For Security Deposits In Lieu Of Retention) and fully incorporated herein, in accordance with Section 22300 of the California Public Contract Code.

14. **PREVAILING WAGE LAWS:** The successful bidder must comply with all prevailing wage laws applicable to the project, and related requirements contained in the contract documents.

    a. No contractor or subcontractor may be listed on a bid proposal for a public works project (submitted on or after March 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5 [with limited exceptions from this requirement for bid purposes only under Labor Code section 1771.1(a)].

    b. No contractor or subcontractor may be awarded a contract for public work on a public works project (awarded on or after April 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.

    c. This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

15. **SUBSTITUTIONS:** Bidders must base their bids on products and systems specified in the contract documents or listed by name in the addenda. Except as provided below, the City will consider substitution requests only for "or approved equal items." Bidders wanting to use "or approved equal items" may submit Document 00 63 25 (Substitution Request Form) no later than 7 days after the issuance of the Notice of Award.

    a. Exception - None

16. **RESERVATION OF RIGHTS:** The City specifically reserves the right, in its sole discretion, to reject any or all bids, to re-bid, or to waive inconsequential defects or minor irregularities in the bids not involving time, price or quality of the work.

17. **QUESTIONS** regarding the Project Plans or Specifications, bid process, and contractual issues may be directed to Camila Arcayena, Associate Engineer, at (650) 754-2388.

-END OF DOCUMENT-

DOCUMENT 00 21 00

INSTRUCTIONS TO BIDDERS

1. RECEIPT OF BIDS

Sealed bid proposals will be received by City of San Bruno at the Office of the City Clerk, located at 567 El Camino Real, San Bruno, California, no later than **Thursday, March 26, 2026 at 2:00 PM PDT**. **The bid proposal shall be in two opaque sealed 10" x 13" envelopes labeled Bid Proposal, Sneath and Lake Pump Station Rehabilitation Project, Project Nos. 11003 and 11004, Envelope "A" and Envelope "B" containing the following documents:**

Envelope A – Bid Submittals

1) **00 41 00** Bid Proposal (Notarized)
2) **00 41 70** Addenda Acknowledgement
3) **00 43 13** Proposal Guarantee (Bid Bond), Cash, Cashier's or Certified Check
4) **00 43 36** Subcontractor List
5) **00 45 14** Bidder Registration and Certification
6) **00 45 19** Non-collusion Affidavit (Notarized)

Envelope B – **00 45 13** Statement of Qualifications (SOQ) for Construction Work

All bid envelopes will be time-stamped to reflect their submittal time. The City will reject all bids received after the specified time and will return such bids to the bidders unopened. Bidders must submit bids in accordance with this Document. Bidder's failure to submit all required documents strictly as required entitles the City to reject the bid as non-responsive. Bidder shall provide written responses to any questions or requests for information made by the City as part of the bid evaluation process after submission of the bid.

2. BID FORMS

The City will reject as non-responsive any bid not submitted on the required forms. Bids must be complete and legible. Bidders must complete all bid items and supply all information required by the bidding documents. The City reserves the right in its sole discretion to reject any bid as non-responsive as a result of any error or omission in the bid. Bidders may not modify the bid forms or qualify their bids. Bidders must submit clearly and distinctly written bids. Bidders must clearly make any changes in their bids by crossing out original entries, entering new entries, and initialing new entries. The City reserves the right to reject any bid not clearly written.

3. BID SECURITY

Bidders must submit with their bids either cash, a cashier's check, or certified check from a responsible bank in the United States, or corporate surety bond furnished by a surety authorized to do business in the State of California, of not less than ten percent

(10%) of the total bid price payable to the City of San Bruno. All bidders choosing to submit a surety bond must submit it on the required form, Document 00 41 00 (Bid Proposals). The City will reject as non-responsive any bid submitted without the necessary bid security.

The City may retain bid securities and bid bonds of all bidders for a period of 90 days after award or full execution of the contract, whichever occurs first. Upon full execution of the contract, and upon request by bidder, the City will return to the respective unsuccessful bidders their bid securities and bid bonds.

4. SUBCONTRACTORS LIST

All bidders must submit with their bids the required information on all subcontractors in Document 00 43 36 (Subcontractor List) for those subcontractors who will perform any portion of the work, including labor, rendering of service, or specially fabricating and installing a portion of the work of improvement according to detailed drawings contained in the plans and specifications, in excess of one half of one percent of the total bid, pursuant to Section 4104 of the Public Contract Code. Violation of this requirement may result in the bid being deemed non-responsive and not being considered.

5. MANDATORY PRE-BID CONFERENCE

The City will conduct a mandatory Pre-Bid Conference on **Tuesday, March 10, 2026 at 10:00 AM PDT at the San Bruno City Hall, 567 El Camino Real, San Bruno.** Please RSVP to 650-616-7065. Each bidder may be represented at the Pre-Bid Conference. Each representative shall sign an attendance sheet identifying the bidder represented.

a. The City reserves the right to schedule and organize the Pre-Bid Conference to minimize disruption to surrounding facilities and congestion. See also Document 00 31 32, para. 5.1. Any bidder wishing to investigate subsurface conditions or otherwise conduct invasive investigations, explorations, test, or studies at this site shall schedule such examinations with the City by obtaining an approved Encroachment Permit from the City's Public Works Department prior to the investigation. An Encroachment Permit is not required for Bidders who intend only to observe site conditions and not conduct such examinations.

b. Bidders are encouraged to submit written questions in connection with the Pre-Bid Conference. The City will transmit to all parties recorded as having received bidding documents such addenda as the City in its discretion considers necessary in response to written questions. Bidders shall not rely on oral statements. Oral statements will not be binding or legally effective.

6. OTHER REQUIREMENTS PRIOR TO BIDDING

Submission of bid signifies bidder's careful examination of the bidding documents and the complete understanding of the nature, extent, and location of the work to be performed. As a condition to bidding, bidder must complete tasks listed in Document 00 52 00 (Contract Agreement), Article 5. Submission of a bid shall constitute bidder's express representation to the City that bidder has fully completed these tasks.

7. EXISTING DRAWINGS AND GEOTECHNICAL DATA

Bidders may examine any available existing conditions information (e.g., record documents, specifications, studies, drawings of previous work on site) by giving the City reasonable advance notice, as well as applicable environmental assessment information (if any) regarding the project. Document 00 31 32 (Geotechnical Data and Existing Conditions) applies to all supplied existing conditions information and geotechnical reports and all other information supplied regarding existing conditions either above ground or below ground. The City will make copies available for a fee of printing and handling. A bidder must give 2 days advanced notice if copies are desired.

8. ADDENDA

Bidders must direct all questions about the meaning or intent of the bidding documents to City's Department of Public Works, Administration & Engineering, in writing. Interpretations or clarifications considered necessary by the City in response to such questions will be issued by addenda mailed, faxed, or delivered to all parties recorded by the City as having received bidding documents. The addenda will be written and will be issued to each bidder to the address or fax number supplied to the City by the bidder. The City may not answer questions received less than 10 days prior to the date for opening Bids. Only questions answered by formal written addenda will be binding. Oral and other interpretations or clarifications will be without legal effect. However, the City may, upon inquiry by the bidder, orally direct bidder's attention to specific provisions of the contract documents which cover the subject of the inquiry.

In addition:

a. The addenda may also be issued to modify the bidding documents as deemed advisable by the City.

b. The addenda shall be acknowledged by number with signature in Document 00 41 70 (Addenda Acknowledgement) and shall be part of the contract documents. A complete listing of the addenda may be secured from the City.

9. SUBSTITUTIONS

Bidders must base their bids on products and systems specified in the contract documents or listed by name in the addenda.

a. Except as provided in paragraph 9.c below, the City will consider substitution requests only for "or approved equal" items. Bidders wanting to use "or approved equal items" may submit Document 00 63 25 (Substitution Request Form) no later than 7 days after the issuance of the Notice of Award. After that date, the City will not accept "or approved equal" substitution requests. To assess "or approved equal" acceptability of product or system, submittals of substitutions shall contain the information required in Document 00 43 25 and set forth in Section 01 60 00 (Product Requirements) of the contract documents. Insufficient information will be grounds for rejection of substitution. The City shall, within a reasonable period of time after having received a request for substitution, issue in writing its decision as to whether the proposed substitute item is an "or approved equal" item for

compatibility to City systems, durability, or quality. The City's decision shall be conclusive on all bidders.

b. Approved substitutions shall be listed in the addenda and become part of the contract documents.

c. Substitutions may be requested after submitting bids and Award of Contract only in accordance with Section 01 60 00 (Product Requirements) of the contract documents.

d. As a limitation on bidder's privilege to substitute "or approved equal" items, the City has found that certain items are designed as City standards and certain items are designed to match existing items in use on a particular public improvement either completed or in the course of completion. As to such items, the City will not permit substitution. As a further limitation on bidder's privilege to substitute items, the City has found that certain necessary items are only available from one source. As to such items, the City will not permit substitution. **[NONE]**

10. WAGE RATES

Copies of the general prevailing rates of per diem wages for each craft, classification, or type of worker needed to execute the contract, as determined by Director of the State of California Department of Industrial Relations, are on file at the City's office and are deemed included in the bidding documents. Upon request, the City will make copies available to any interested party. Also, the bidders shall post the applicable prevailing wage rates at the job site. The California Department of Industrial Relations is at http://www.dir.ca.gov/

11. EQUAL EMPLOYMENT OPPORTUNITY

Bidder shall comply with all applicable federal, state, and local laws, rules, and regulations in regard to nondiscrimination in employment because of race, color, ancestry, national origin, religion, sex, marital status, age, medical conditions, disability, or any other reason.

12. PLANS

Complete sets of bidding documents must be used in preparing bids. The City assumes no responsibility for errors or misinterpretations resulting from use of incomplete sets of bidding documents. The drawings in the bidding documents are reduced scale reproductions. The amount of reduction is indicated by a note or scale bar on the drawings. Copies of full-scale drawings, including individual drawings, may be obtained from the City for the cost of reproduction, plus shipping and handling. Full-size drawings will only be made available to bidders who previously obtained a complete set of bidding documents. No return of full-size drawings is required, and no refund will be made.

13. DETERMINATION OF APPARENT LOW BIDDER

a. City will open each Bidder's Envelope A at the time and place indicated in Document 00 10 00 (Notice Inviting Bids), initially evaluate them for

responsiveness, and determine an Apparent Low Bidder as specified herein. City will not open Envelopes B publicly, and except for the Apparent Low Bidder's Envelope B (or as otherwise provided in this Document 00 21 00), they will remain unopened.

b. Apparent Low Bid will be determined as provided in Document 00 41 00 (Bid Proposal). All bidders are required to submit bids on all bid items, including any alternates.

c. For the Apparent Low Bidder only, City will open Envelope B and evaluate the Apparent Low Bidder for responsiveness to the requirements of Document 00 45 13 and for responsibility.

d. If Apparent Low Bidder is determined to be non-responsive or non-responsible, then City may proceed to the next Apparent Low Bidder's Bid pursuant to any procedures determined in its reasonable discretion, and proceed for all purposes as if this Apparent Low Bidder were the original Apparent Low Bidder.

14. EVALUATION OF BIDDER RESPONSIBILITY

The City will evaluate bidder's responsibility and compliance with the requirements of the contract documents. The City will notify Apparent Low Bidder in writing of any deficiencies found and will provide Apparent Low Bidder the opportunity to respond in writing with reasonable clarifications, but will not allow any changes to the bid price and amount.

15. BID EVALUATION

The City reserves the right, in its sole discretion, to waive any inconsequential defects or minor irregularities in the bids. The City also reserves the right, in its sole discretion, to reject any or all bids and to re-bid the project. The City reserves the right, in its sole discretion, to reject any or all nonconforming, non-responsive, unbalanced, or conditional bids, and to reject the bid of any bidder if the City believes that it would not be in the best interest of the project to make an award to that bidder, whether because the bid is not responsive or the bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by the City. For purposes of this paragraph, an "unbalanced bid" is one having nominal prices for some work items and enhanced prices for other work items.

a. In evaluating bids, the City will consider bidders' qualification, whether or not the bids comply with the prescribed requirements, unit prices and other data, as may be requested in Document 00 41 00 (Bid Proposal) or prior to the Notice of Award.

b. Subject to any pre-qualification process for the bidders, the City may otherwise conduct reasonable investigations and reference checks of bidder, proposed subcontractors, suppliers and other persons and organizations, as the City deems necessary to assist in the evaluation of any bid. The City shall also have the right to communicate directly with bidder's surety regarding bidder's bonds.

c. Discrepancies between the multiplication of units of work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum or any column of figures and the correct sum thereof will be resolved in favor of the

correct sum. Discrepancies between written words and figures will be resolved in favor of the words.

d. Quantities stated in the bidding documents are approximate only and are subject to correction upon final measurement of the work, and are subject further to the rights reserved by the City to increase or diminish the amount of work under any classification as advantages to design or as construction needs require.

e. Bids shall be deemed to include the written responses of the Bidder to any questions or requests for information of Owner made as part of Bid evaluation process after submission

f. The City may determine whether a bidder is qualified, responsive or responsible in its sole discretionary judgment.

16. AWARD

If the contract is to be awarded, it will be awarded to the lowest responsible, responsive bidder. Such Award, if made, will be made within ninety (90) days after the opening of the Bid Proposals. Following completion of all required City procedures and receipt of all City approvals, the City will issue Document 00 51 00 (Notice of Award) to the successful bidder.

17. BID PROTEST

Any bid protest must be submitted in writing to the City's Public Works Department, Administration & Engineering (Attention: City Engineer), before 5:00 p.m. of the 5th calendar day following issuance of Document 00 50 50 (Notice of Intent to Award for Construction). Time of receipt will be determined by City staff. City will use reasonable efforts to deliver by email or facsimile a copy of the Notice of Intent to Award to all bidders who submitted Bid Proposals no later than the business day after issuance, although any delay or failure to do so will not extend the bid protest deadline described above.

a. The initial protest must contain a complete statement of the basis for the protest.

b. The protest must refer to the specific portion of the document that forms the basis for the protest.

c. The protest must include the name, address, and telephone number of the person representing the protesting party.

d. Only bidders who the City determines are otherwise responsive and responsible (i.e., other than as to the specific subject of the protest) are eligible to protest a bid; protests from any other bidder will not be considered. In order to determine whether a protesting bidder is responsive and responsible, City may evaluate all information contained in any protesting bidder's Bid Proposal, and conduct the same investigation and evaluation as City is entitled to take regarding an Apparent Low Bidder.

e. The party filing the protest must concurrently transmit a copy of the initial protest document and any attached documentation to all other parties with a direct financial

interest that may be adversely affected by the outcome of the protest. Such parties shall include all other bidders who appear to have a reasonable prospect of receiving an award depending upon the outcome of the protest.

f. The procedure and time limits set forth in this paragraph are mandatory and are bidder's sole and exclusive remedy in the event of a bid protest. Bidder's failure to comply with these procedures shall constitute a waiver of any right to further pursue the bid protest, including filing a Government Code Claim or legal proceedings. A bidder may not rely on a protest submitted by another bidder, but must timely pursue its own protest.

18. POST-NOTICE OF AWARD REQUIREMENTS

After Notice of Award is issued, the successful bidder must execute and submit the following documents as indicated below:

a. Submit the following documents to the City by 5:00 p.m. of the 10th working day following the Notice of Award. Execution of the contract agreement by the City depends upon approval of these documents, and any other document identified in the City's Notice of Award:

   1) Document 00 52 00 (Contract Agreement): To be executed by successful bidder. Submit three originals, each bearing an original signature.

   2) Document 00 61 13.13 (Construction Performance Bond): To be executed by successful bidder and surety, in the amount set forth in Document 00 61 13. Submit one original.

   3) Document 00 61 13.16 (Construction Labor and Material Payment Bond): To be executed by successful bidder and surety, in the amount set forth in Document 00 61 13.16. Submit one original.

   4) Insurance certificates and endorsements required by Document 00 72 00 (General Conditions) Article 4. Submit one original set.

   5) Any other item described in Document 00 51 00 (Notice of Award).

b. The City shall have the right to communicate directly with Apparent Low Bidder's proposed performance bond surety to confirm the performance bond. The City may elect to extend the time to receive faithful performance and labor and material payment bonds.

c. Successful bidder's failure to submit the documents required herein, in a proper and timely manner, entitles the City to rescind its award, and to cause bidder's bid security to be forfeited as provided herein.

19. FAILURE TO EXECUTE AND DELIVER DOCUMENTS

If the bidder to whom the contract is awarded shall, within the period described in Paragraph 18 of this Document 00 21 00, fails or neglects to execute and deliver all required contract documents and file all required bonds, insurance certificates, and other documents, the City may, in its sole discretion, foreclose on bidder's deposit

surety bond, or deposit bidder's cashier's check or certified check for collection, and retain the proceeds thereof as liquidated damages for bidder's failure to enter into the contract documents. Bidder agrees that calculating damages the City may suffer as a result of bidder's failure to execute and deliver all required contract documents would be extremely difficult and impractical and that the amount of bidder's required bid security shall be the agreed and presumed amount of the City's damages. In addition, upon such failure, the City may determine the next Apparent Low Bidder and proceed accordingly.

20. MODIFICATION OF COMMENCEMENT OF WORK

The City expressly reserves the right to modify the date for the commencement of work under the contract and to independently perform and complete work related to the project. The City accepts no responsibility to the contractor for any delays attributed to its need to complete independent work at the site.

21. WITHDRAWAL OF BIDS

Bidders may withdraw their bids at any time prior to the bid opening time fixed in this Document, only by written request for the withdrawal of the bid filed with the City at the City's office. Bidder or its duly authorized representative shall execute a request to withdraw the bid. The submission of a bid does not commit the City to award a contract for the project, to pay costs incurred in the preparation of a bid, or to procure or contract for any goods or services.

22. INELIGIBLE CONTRACTORS AND SUBCONTRACTORS

The City shall not accept a bid from a bidder who is ineligible to bid or work on, or be awarded, a public works project pursuant to California Labor Code Section 1777.1 or 1777.7. Bidders and the contractor who is awarded the project contract shall not utilize, or allow work by any subcontractor who is ineligible to bid or work on, or be awarded, a public works project pursuant to California Labor Code Section 1777.1 or 1777.7. (See California Public Contract Code Section 6109.) The California Division of Labor Standards Enforcement publishes a list of debarred contractors and subcontractors on the Internet at www.dir.ca.gov/DLSE/debar.html.

23. PUBLIC RECORDS ACT REQUESTS

a. Per the Public Records Act, the City will make available to the public the bidder's Statement of Qualifications (if Envelope B is opened), all correspondence and written questions submitted during the bid period, all bid submissions opened in accordance with the procedures of this Document, and all subsequent bid evaluation information. All submissions not opened will remain sealed and eventually be returned to the submitter. Except as otherwise required by law, the City will not disclose trade secrets or proprietary financial information submitted that has been designated confidential by bidder(including but not limited to the SOQ). Any such trade secrets or proprietary financial information that a bidder believes should be exempted from disclosure shall be specifically identified and marked as such. Blanket-type identification by designating whole pages or sections shall not be permitted and shall be invalid. The specific information must be clearly identified as such.

b. Upon a request for records regarding this bid, the City will notify bidder involved within 10 days from receipt of the request when the records will be made available for inspection. If the bidder timely identifies any "proprietary, trade secret, or confidential commercial or financial" information that bidder determines is not subject to public disclosure, and requests the City to refuse to comply with the records request, bidder shall take all appropriate legal action and defend the City's refusal to produce the information in all forums; otherwise the City will make such information available to the extent required by applicable law, without restriction.

c. Information disclosed in the SOQ and the attendant submissions are the property of the City unless bidder makes specific reference to data that is considered proprietary. Subject to the requirements in the Public Records Act, reasonable efforts will be made to prevent the disclosure of information except on a need-to-know basis during the evaluation process.

24. CONSTRUCTION PAYMENT BOND AND CONSTRUCTION LABOR AND MATERIALS BOND SURETY

Documents 00 61 13.13 (Construction Performance Bond) and 00 61 13.16 (Construction Labor and Material Payment Bond) shall be executed by a surety insurer admitted in the State of California by the Department of Insurance. The City shall verify surety's admission by either: (1) printing out information from the website of the Department of Insurance confirming that the surety is an admitted surety insurer; or, (2) obtaining a certificate from the County Clerk confirming that the surety is an admitted insurer. The City shall attach such verification to Documents 00 61 13.13 and Document 00 61 13.16.

25. CONFORMED CONSTRUCTION DOCUMENTS

Following Award of Contract, the City may prepare a conformed set of contract documents reflecting addenda issued during bidding, which will, failing objection, constitute the approved set of contract documents.

26. DEFINITIONS

All abbreviations and definitions of terms used in this Document are set forth in Document 01 42 16 (Definitions).

-END OF DOCUMENT-

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DOCUMENT 00 24 13

SCOPE OF BIDS

1. WORK COVERED BY CONTRACT DOCUMENTS:

A. Work comprises of the construction of the City of San Bruno **Sneath and Lake Pump Station Rehabilitation Project** located in San Bruno, California.

B. The Work of this Contract comprises construction of all the Work indicated, described in the Specifications, or otherwise required by the Contract Documents.

C. Unless provided otherwise in the Contract Documents, all risk of loss to Work covered by Contract Documents shall rest with Contractor until Final Acceptance of the Work.

D. Cost of maintenance of systems and equipment prior to Final Acceptance will be considered as included in prices Bid and no direct or additional payment will be made therefore.

2. BID ITEMS:

A. Any Bid item may be deleted from the Work and Contract Sum, in total or in part, prior to or after award of Contract without compensation in any form or adjustment of other Bid items or prices therefore.

B. Payment of all items is subject to provisions of Contract Documents, including without limitation Section 01 20 00 (Measurement and Payment Procedures).

C. For all Bid items, furnish and install all Work, including connections to existing systems, indicated and described in Specifications and all other Contract Documents. Work and requirements applicable to each individual Bid item, or unit of Work, shall be deemed incorporated into the description of each Bid item (whether Lump Sum or Unit Price).

D. Mobilization/demobilization consists of furnishing transportation, labor, materials, equipment, and incidentals necessary to prepare the site of work accordance to project plans and as directed by the Engineer. This includes accomplishing all necessary schedule preparation, public notification, clearing and grubbing, cleaning, survey layout, removing cat-tracks, fees, and permits; and establishment of bonds, insurance, dust control, storm water pollution prevention.

E. All Bid items shall include full compensation for furnishing Transportation, Labor, Materials, Tools, Equipment, Excavation, Shoring, Backfill and Compaction, Bypass Pumping, Traffic Control, Storm Water Pollution Prevention (SWPPP), Debris Removal and Disposal, and any other incidental costs necessary to complete in place as a fully functioning system in accordance with project plans, specifications, and permits.

3. ALLOWANCES:

A. Allowance Work shall be done as Change Orders and as specified in Section 01 26 00 (Contract Modification Procedures). Identify Allowance Items (See Document 00 41 00 – Bid Proposal) work on the Progress Schedules and on Applications for Payment.

B. The Amount given on Document 00 41 00 under each Allowance Item is the sum of money set aside for each Allowance Item. These amounts shall be included in the Contract Sum on the Bid Form.

C. If the cost of Work done under any Allowance Item is less than the amount given on the Bid Form under that Allowance Item, the Contract Sum shall be reduced by the difference between the amount given in the Bid Form and the cost of Work actually done.

D. Scope of Allowances: NONE

4. ALTERNATES: [If Any]

5. DESCRIPTION OF BID ITEMS AND BASIS OF PAYMENT:

Bid Item No. 1 – Mobilization/Demobilization

A. Bid Item for "Mobilization/Demobilization" includes payment for all work, equipment, and materials and incidentals necessary for Contractor's mobilization and demobilization.

B. No measurement will be made. Payment shall be "Lump Sum" and shall be full compensation for, but not limited to, the following:

1. Preparatory work and operations, including, but not limited to those necessary for the movement of personnel, lead compliance plan, equipment, supplies, and incidentals to the project site.

2. Costs of obtaining bonds and insurance.

3. Cost of preparation, obtaining, coordination, and compliance with all permits.

4. Cost of preparation, submission, and re-submission of submittals and deferred submittals.

5. Cost of procurement of project signs (2) at each street with construction activity.

C. Payments for Mobilization/Demobilization will be made as follows:

1. When the total monthly partial payment estimate of the amount earned, not including the amount earned for mobilization/demobilization, is ten percent (10%) or more of the original contract amount, fifty percent (50%) of the

contract item price for mobilization/demobilization will be included in the estimate for payment.

2. When the total monthly partial payment estimate of the amount earned, including the amount earned for mobilization/demobilization, is ninety-five percent (95%) of the final contract amount, one hundred percent (100%) of the contract item price for mobilization/demobilization will be included in the estimate for payment.

D. Bid Item for "Mobilization/Demobilization" shall not exceed 5 percent of the total bid price.

Bid Item No. 2 – Traffic and Pedestrian Control

A. Bid Item for "Traffic and Pedestrian Control" includes payment for furnishing transportation, labor, materials, temporary traffic control signs, tools, equipment, and incidentals, and for doing all work involved in Traffic and Pedestrian Control and described in Section 01 51 00 (Temporary Facilities and Controls), and as directed by the Engineer.

B. No measurement will be made. Payment shall be "Lump Sum" and shall be full compensation for, but not limited to, the following:

1. Coordinating with various agencies and businesses.

2. Preparing traffic and pedestrian control plans for City's review and approval prior to project construction.

3. Placing, moving, removing, storing, and maintaining No-Parking signs, temporary signs, changeable message signs, temporary traffic signs, Construction Area signs at project limits and all cross streets, and other traffic control devices, including flagging.

4. Loading, hauling, removing, covering, and uncovering construction signs.

5. Placing and removing any temporary striping as may be required.

6. Maintaining streets and sidewalks to provide safe passage for pedestrians and vehicles.

C. Payment for Traffic and Pedestrian Control will be based on the total percent complete of the Bid items of work completed and accepted for payment.

Bid Item No. 3 – Sheeting, Shoring, and Bracing

The lump sum price for this item consists of any/all costs to provide adequate excavation support. Pursuant to the provisions of California Labor Code Section 6707, each bid submitted shall contain, in the bid item indicated, the amount included in its bid for adequate sheeting, shoring, and bracing, or equivalent method, for the protection of life and limb in trenches and open excavation, which shall conform to applicable safety orders. By listing this sum, the Bidder warrants

that its action does not convey tort liability to the Owner, the Design Consultant, the Construction Manager, and their employees, agents, and subconsultants.

Bid Item No. 4 – Site Excavation, Grading, and Material Import/Export

The lump sum price for this item shall consist of furnishing transportation, labor, materials, tools, equipment, and all incidental work. Work includes, but is not limited to, excavation, benching, compaction, subgrade preparation, backfill, and testing required to construct all structures, and provide grades in conformance with the Contract Documents.

Bid Item No. 5 – Pump Station Wood Framing, Siding, Roofing, Flashing, and all Ancillary Components

The lump sum price for this item shall consist of furnishing transportation, labor, materials, tools, equipment, and all incidental work. Work includes, but is not limited to, all building wall and roof construction and rehabilitation to provide a complete architectural system.

Bid Item No. 6 – Pump Station Structural Concrete

The lump sum price for this item shall consist of furnishing transportation, labor, materials, tools, equipment, and all incidental work. Work includes, but is not limited to, all reinforced concrete for building footings, slabs, and equipment supports.

Bid Item No. 7 – Pump Station Doors and Hatches

The lump sum price for this item shall consist of furnishing transportation, labor, materials, tools, equipment, and all incidental work. Work includes, but is not limited to, all building doors and hatches.

Bid Item No. 8 – Pump Station Mechanical and Yard Piping

The lump sum price for this item shall consist of furnishing transportation, labor, materials, tools, equipment, and all incidental work. Work includes, but is not limited to, all trench excavation, backfill, compaction, pipe, pipe fittings, bolts, nuts, gaskets, pipe supports, couplings, valves, valve boxes, and vaults.

Bid Item No. 9 – Site Paving, Flatwork, Bollards, Fencing, Gates, and Drainage Infrastructure

The lump sum price for this item shall consist of furnishing transportation, labor, materials, tools, equipment, and all incidental work. Work includes, but is not limited to, all sidewalk, curbs, gutters, driveway, fencing, gates, drain inlets, slot drains, and bollards

Bid Item No. 10 – Sneath Lane CMU Retaining Wall

The lump sum price for this item shall consist of furnishing transportation, labor, materials, tools, equipment, and all incidental work. Work includes, but is not

limited to, formwork, concrete, grout, concrete masonry blocks, reinforcement, and drainage infrastructure.

Bid Item No. 11 – Lake Drive Concrete Retaining Wall

The lump sum price for this item shall consist of furnishing transportation, labor, materials, tools, equipment, and all incidental work. Work includes, but is not limited to, formwork, concrete, grout, concrete masonry blocks, reinforcement, and drainage infrastructure.

Bid Item No. 12 – Bypass Pumping and Temporary Piping

The lump sum price for this item shall consist of furnishing transportation, labor, materials, tools, equipment, and all incidental work. Work includes, but is not limited to, all potable water bypass pumping, temporary piping, fuel, maintenance and operation, for the duration of all pump station downtime associated with the phasing of the permanent infrastructure construction.

Bid Item No. 13 – Pump Station HVAC

The lump sum price for this item shall consist of furnishing transportation, labor, materials, tools, equipment, and all incidental work. Work includes, but is not limited to, all vents, fans, air condition units, heaters, related instrumentation and controls, and startup and testing.

Bid Item No. 14 – Disposal of all Demolition Materials

The lump sum price for this item shall consist of furnishing transportation, labor, materials, tools, equipment, and all incidental work. Work includes, but is not limited to, all legal transportation and disposal of any/all materials deemed to be demolished or replaced as part of the project's improvements.

Bid Item No. 15 – Pump Station Electrical, Instrumentation, Control, and all associated Equipment and Hardware

The lump sum price for this item shall consist of furnishing transportation, labor, materials, tools, equipment, and all incidental work. Work includes, but is not limited to, all electrical systems, equipment, utility meter disconnects, breakers, transfer switch, panelboard, transformer, control panels, standby engine generators, communication systems, instrumentation, wire, conduit, trenching, lighting, seismic anchorage design, and system startup and testing.

Bid Item No. 16 – Pump Station System Integration and Programming

The lump sum price for this item shall consist of furnishing transportation, labor, materials, tools, equipment, and all incidental work. Work includes, but is not limited to, furnishing system integration and programming, coordination, startup and testing for a complete and operational system as defined in the Contract Documents.

-END OF DOCUMENT-

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DOCUMENT 00 31 32

GEOTECHNICAL DATA AND EXISTING CONDITIONS

1. REPORT AND INFORMATION

1.1 **Existence of Reports:** City, its consultants, and prior contractors may have collected documents providing a general description of the Site and conditions of the Work. These documents may consist of geotechnical reports for and around the Site, contracts, contract specifications, tenant improvement contracts, as-built drawings, utility drawings, and information regarding Underground Facilities. These reports, documents and other information are not part of the Contract Documents.

1.2 **Inspection of Reports:** Bidders may inspect geotechnical reports and information regarding existing conditions at the Site. These documents are available for review at the City's Public Works Department, Administration & Engineering, located at 567 El Camino Real, San Bruno, CA 94066 and copies may be obtained for the cost of reproduction and handling upon Bidder's payment for the costs. These reports, documents and other information are not part of the Contract Documents. Nevertheless, by submitting a Bid, Bidder accepts full responsibility for reviewing, knowing and understanding the contents of all of these materials.

1.3 **Inclusion in Project Manual:** Geotechnical reports may be included in the Project Manual and information regarding existing conditions may also be included in the Project Manual, but neither shall be considered part of the Contract Documents.

1.4 **Available Documentation:** The following documentation is available for review through the City for this Contract:

a. None

2. USE OF INFORMATION ON EXISTING CONDITIONS

2.1 **Aboveground Existing Conditions:** Under no circumstances shall City be deemed to make a warranty or representation of existing aboveground conditions, as-built conditions, or other aboveground actual conditions verifiable by reasonable independent investigation. These conditions are verifiable by Bidder by the performance of its own independent investigation that Bidder must perform prior to bidding and Bidder must not rely on the information supplied by City regarding existing conditions. Bidder represents and agrees that in submitting its Bid, it is not relying on any information regarding existing conditions supplied by City.

2.2 **Underground Facilities:** Information supplied regarding existing Underground Facilities at or contiguous to the Site is based on information furnished to City by others (e.g., the builders of such Underground Facilities or others). Except as expressly set forth in this Document, City does not assume responsibility for the accuracy, completeness or thoroughness of this information, and Bidder is solely responsible for any interpretation or conclusion drawn from this information.

Except as expressly set forth in this Document, City will be responsible only for the general accuracy of information regarding Underground Facilities, and only for those Underground Facilities that are owned by City. This express assumption of responsibility applies only if Bidder has conducted the independent investigation required of it and discrepancies were not apparent.

3. LIMITED RELIANCE PERMITTED ON CERTAIN GEOTECHNICAL INFORMATION

3.1 **Geotechnical Data:** Except as expressly set forth in this Document, City does not warrant, and makes no representation regarding, the accuracy or thoroughness of any geotechnical data. Bidder represents and agrees that in submitting its Bid, it is not relying on any geotechnical data supplied by City, except as specifically set forth herein.

A. Bidder may rely upon the general accuracy of the "technical data" contained in the geotechnical reports and drawings identified above, but only insofar as it relates to subsurface conditions, provided Bidder has conducted the independent investigation required of it and discrepancies were not apparent. The term "technical data" in the referenced reports and drawings shall be limited as follows:

1. The term "technical data" shall include actual reported depths, reported quantities, reported soil types, reported soil conditions, and reported material, equipment, or structures that were encountered during subsurface exploration.

2. The term "technical data" does not include, and Bidder may not rely upon, any other data, interpretations, opinions or information shown or indicated in such drawings or reports that otherwise relate to subsurface conditions or described structures.

3. The term "technical data" shall not include the location of Underground Facilities.

4. Bidder may not rely on the completeness of reports and drawings for the purposes of bidding or construction. Bidder may rely upon the general accuracy of the "technical data" contained in such reports or drawings.

5. Bidder is solely responsible for any interpretation or conclusion drawn from any "technical data" or any other data, interpretations, opinions, or information contained in supplied geotechnical data.

4. INVESTIGATIONS

4.1 Before submitting a Bid, each Bidder shall be responsible to obtain such additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site or otherwise, which may affect cost, progress, performance or furnishing of Work or which relate to any aspect of the means, methods, techniques, sequences or procedures of construction to be employed by Bidder and safety

precautions and programs incident thereto or which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price and other terms and conditions of Contract Documents. Bidders shall advise City in writing during the Bid period of any questions, suppositions, inferences or deductions Bidders may have for City's review and response.

4.2 City has provided time in the period prior to bidding for Bidder to perform these investigations.

5. ACCESS TO SITE FOR INVESTIGATIONS

5.1 During the Pre-Bid Site Visit(s), City will provide each Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies, as each Bidder deems necessary for submission of a Bid. Bidders must fill all holes and clean up and restore the Site to its former conditions upon completion of such explorations, investigations, tests, and studies. Such investigations may be performed only under the provisions of Document 00 21 00 (Instructions to Bidders) and Document 00 72 00 (General Conditions) including, but not limited to, proof of insurance and obligation to indemnify against claims arising from such investigation work. Each Bidder shall supply all equipment required to perform any investigations as each Bidder deems necessary. City has the right to limit the number of pieces of machinery operating at one time due to safety concerns.

-END OF DOCUMENT-

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DOCUMENT 00 41 00

BID PROPOSAL

THIS BID IS SUBMITTED BY (Please print clearly):

Legal Name of Firm:_____ Date_____

Business Address:_____

TO: City of San Bruno, Public Works Department

The undersigned, hereinafter referred to as the "Bidder", declares that the only person or parties interested in the Bid Proposal are those named herein; that this Bid Proposal is in all respects fair and without fraud; that it is made without collusion with any official or employee of the City of San Bruno (the "City") and that the Bid Proposal is made without any connection or collusion with any person making another proposal on this contract.

1. In submitting this bid, Bidder represents the following:

   (a) Bidder acknowledges receipt of Pre-Bid Conference minutes, if any.

   (b) Bidder has visited the site and performed all tasks, research, investigation, reviews, examinations, and analysis and given notices, regarding the project and the site, as set forth in Document 00 52 00 (Contract Agreement), Article 5.

   (c) Bidder has given the City prompt written notice of all conflicts, errors, ambiguities, or discrepancies that it has discovered in or among the contract documents and actual conditions and the written resolution thereof through addenda issued by the City is acceptable to Bidder.

2. The Bidder agrees that if this Bid Proposal is accepted, he will, within ten (10) working days after Notice of Award, execute the contract with the City in the form of Document 00 52 00 (Contract Agreement). The Bidder will deliver to the City the insurance certificates, performance and payment bonds herein required within ten (10) working days after the Bidder has received the Notice of Award. The Bidder will, to the extent of the Bid Proposal, furnish all labor, tools, equipment, and other means of construction to do the work and to furnish all materials necessary to complete the work and to furnish all materials necessary to complete the work in the manner, in the time, and according to the methods as specified in the contract documents and as may be required by the Engineer thereunder. Upon receipt by the City of the satisfactorily executed contract, insurance certificates, performance and payment bonds, a written Notice to Proceed will be sent to the Contractor. The Bidder further agrees to commence work within ten (10) calendar days after the Notice to Proceed. All work shall be completed within the time period specified from the date of the Notice to Proceed. In the event the Bidder is awarded the contract and fails to perform the work herein specified, within the time specified for completion, liquidated damages shall be paid to the City in the amount set forth in the contract agreement, for each calendar day beyond the time herein provided for the completion of such

work. Sundays and legal holidays will be excluded in determining the number of days in default.

3. All items of the work shall be considered complete and in place, and no additional compensation shall be granted. All of the work required to provide a complete and operational system shall be considered to be included in the listed tasks and no compensation shall be granted for additional items. Compensation for any item of work required by these contract documents but not specifically described in any bid item shall be included in the bid item most clearly related to said item of work.

4. The TOTAL BID PRICE is for all work satisfactorily completed and includes any and all sales and use taxes and levies that may be applicable.

5. The Bidder shall complete the bid schedule in clearly legible figures, the unit price and an item total for the item in the respective spaces provided for this purpose. In the case of unit basis items, the amount set forth under the "TOTAL" column shall be an extension of the unit price bid and the estimated quantity for the item. In case of a discrepancy between the unit price and total set forth for the item, the unit price shall prevail and the total for the item, and therefore the "TOTAL BASE BID AMOUNT", shall be adjusted accordingly, and the bid award shall be made on the basis of the corrected total base bid amount.

6. **BASIS OF BID COMPARISON & DETERMINATION OF LOW BIDDER:**

   Bids are required for the Entire work. The Amount of the Bid for Comparison and Determination of Low Bidder will be the Total of the Base Bid.

7. All bids must be submitted in ink on the bid forms provided. Erasures are not acceptable. Changes must be lined out and corrections inserted adjacent and initialed by the Bidder's authorized representative. Bid modifications, corrections or additions received beyond the bid deadline shall not be considered. Telephone or facsimile bids shall not be accepted. Signatures must be original signatures and be notarized where required.

8. The City reserves the right to: (1) reject any or all bids; (2) waive inconsequential defects or minor irregularities in the bid documents or minor variances from the bid specification; and (3) correct arithmetic errors on the bid schedule.

9. Bidder accepts all of the terms and conditions of the contract documents, Document 00 10 00 (Notice Inviting Bids), and Document 00 21 00 (Instructions to Bidders). This bid will remain subject to acceptance for 90 days after the day of bid opening.

10. Bidder agrees that, in accordance with Document 00 72 00 (General Conditions), liquidated damages for failure to complete all work in the contract within the time specified in Document 00 52 00 (Contract Agreement) shall be as set forth in Document 00 52 00 (Contract Agreement).

BID SCHEDULE

All bid items, including lump sums and unit prices, must be filled in completely. Bid items are described in Document 00 24 13 (Scopes of Bids). Quote in figures only, unless words are specifically requested.

ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	ITEM TOTAL
Base Bid					
1	Mobilization / Demobilization (not exceed 5 percent of the total bid price)	1	LS	$	$
2.	Traffic and Pedestrian Control	1	LS	$	$
3.	Sheeting, Shoring, and Bracing	1	LS	$	$
4	Site Excavation, Grading, and Material Import/Export	1	LS	$	$
5.	Pump Station Wood Framing, Siding, Roofing, Flashing, and all Ancillary Components	1	LS	$	$
6.	Pump Station Structural Concrete	1	LS	$	$
7.	Pump Station Doors and Hatches	1	LS	$	$
8.	Pump Station Mechanical and Yard Piping	1	LS	$	$
9.	Site Paving, Flatwork, Bollards, Fencing, Gates, and Drainage Infrastructure.	1	LS	$	$
10.	Sneath Lane CMU Retaining Wall	1	LS	$	$
11.	Lake Drive Concrete Retaining Wall	1	LS	$	$
12.	Bypass Pumping and Temporary Piping	1	LS	$	$
13.	Pump Station HVAC	1	LS		
14.	Disposal of all Demolition Materials	1	LS	$	$
15.	Pump Station Electrical, Instrumentation, Control, and all associated Equipment and Hardware	1	LS	$	$
16.	Pump Station System Integration and Programming	1	LS	$	$
Base Bid Price	**$_____**				

TOTAL BID PRICE FOR BID COMPARISON & DETERMINATION OF LOW BIDDER – BASE BID TOTAL (IN NUMBERS):

_____

_____

IN WITNESS WHEREOF, the Bidder named herein on the date affixed hereto has duly executed the Proposal.

BIDDER:

By:_____
Authorized Signature

Name:_____

Address:_____

_____

Attest:_____
Notary Public, State of California

Date:_____

-END OF DOCUMENT-

DOCUMENT 00 41 70

ADDENDA ACKNOWLEDGEMENT

The Bidder has examined all addenda (if any) during the bid period and acknowledges receipt of the following:

ADDENDUM NO. _____ DATE RECEIVED:_____

ADDENDUM NO. _____ DATE RECEIVED:_____

ADDENDUM NO. _____ DATE RECEIVED:_____

ADDENDUM NO. _____ DATE RECEIVED:_____

ADDENDUM NO. _____ DATE RECEIVED:_____

-END OF DOCUMENT-

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DOCUMENT 00 43 13

PROPOSAL GUARANTEE (Bid Bond)

KNOW ALL PERSONS BY THESE PRESENTS that

_____, as BIDDER, and _____, as SURETY, are held and firmly bound unto City of San Bruno, as Owner, in the penal sum of _____dollars ($_____) which is ten percent of the total amount bid by BIDDER to Owner for the project listed below. For the payment of which sum, BIDDER and SURETY agree to be bound, jointly and severally, firmly by these presents.

WHEREAS, the said Principal is submitting a Bid for City Project Numbers **11003 and 11004** in San Bruno, CA.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH that, whereas BIDDER is about to submit a bid to Owner for the above stated project. If said bid is rejected, or if said bid is accepted and a contract is awarded and entered into by BIDDER in the manner and time specified, then this obligation shall be null and void, otherwise it shall remain in full force and effect in favor of Owner.

IN WITNESS WHEREOF the parties hereto have set their names, titles, hands, and seals this _____day of _____, 20_____.

BIDDER _____

_____

_____

SURETY _____

_____

_____

Subscribed and sworn to this_____ day of _____, 20_____.

NOTARY PUBLIC _____

-END OF DOCUMENT-

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DOCUMENT 00 43 36

SUBCONTRACTOR LIST

In compliance with the provisions of Section 4100-4113 of the Public Contracts Code of the State of California, and any amendments thereof, the undersigned bidder has set forth below the name and location of the place of business of each subcontractor who will perform work or labor or render service to the undersigned in or about the construction of the work, and each subcontractor who, under subcontract will specially fabricate and install a portion of the work or improvement according to detailed drawings contained in the plans and specifications, for such work to be performed under the project documents to which the attached bid is responsive, and the portion of the work which will be done by each subcontractor and for each subcontract in excess of one-half of one percent (0.5%) of the undersigned's Total Bid Price. Bids submitted without this form will be considered non-responsive. If the bidder does not intend to use any subcontractors, write "none" in the first row "Subcontractor Name" space.

1. _____ _____ _____
   Subcontractor Name | Contractor License No. | Division of Work
   _____ _____
   Address | Phone No.

2. _____ _____ _____
   Subcontractor Name | Contractor License No. | Division of Work
   _____ _____
   Address | Phone No.

3. _____ _____ _____
   Subcontractor Name | Contractor License No. | Division of Work
   _____ _____
   Address | Phone No.

4. _____ _____ _____
   Subcontractor Name | Contractor License No. | Division of Work
   _____ _____
   Address | Phone No.

5. _____ _____ _____
   Subcontractor Name | Contractor License No. | Division of Work
   _____ _____
   Address | Phone No.

6. _____ _____ _____
   Subcontractor Name | Contractor License No. | Division of Work
   _____ _____
   Address | Phone No.

(Attached Additional Sheet if more than six (6) Subcontractors)

NOTE: The Contractor shall not, without the consent of the City of San Bruno, sublet or subcontract in excess of fifty percent (50%) of his Total Bid Price. Pursuant to Section 4107 of the California Public Contract Code, the Contractor shall not:

a. Permit any subcontract or subcontractor to be substituted, assigned, transferred, or to be performed by anyone other than the subcontractor listed in this Document 00 43 36.
b. Sublet or subcontract any portion of the work in excess of one-half of one percent (0.5%) of his bid for which a subcontractor was not listed on this Document 00 43 36.

The Contractor's attention is invited to other provisions of Public Contracts Code related to the imposition of penalties for a failure to observe its provisions by using unauthorized subcontractors or by making unauthorized substitutions.

-END OF DOCUMENT-

DOCUMENT 00 45 13

STATEMENT OF QUALIFICATIONS ("SOQ") FOR CONSTRUCTION WORK

1. GENERAL INFORMATION

A. Statement of Qualifications. In Document 00 10 00 (Notice Inviting Bids) the City of San Bruno ("City") has indicated that it will receive sealed Bids for the construction of the Contract for the **"Sneath and Lake Pump Station Rehabilitation Project, Project Nos. 11003 and 11004"**. The Contract will require the Contractor to construct the Project, all in accordance with the scope of Work set forth in the Contract. **All bids must contain the completed "Contractor Statement of Qualifications Questionnaire" included herein as pages 00 45 13- 3 through 00 45 13-12 and other items required by this Document 00 45 13 (together, the "SOQ").**

B. Minimum Qualifications

1. Bidders must be duly licensed in accordance with the California Business & Professions Code in the classification identified in Document 00 10 00 (Notice Inviting Bids) and have a history of work performance sufficient to meet the requirements of a responsible bidder in California Public Contract Code Section 1104.

2. Bidder must have:

   a. A minimum of **Five (5)** years of experience as a continuously operating entity engaged in the performance of similar work.

   b. Within the past five (5) years, completed five (5) pump station projects for public agencies of a similar nature and complexity **(pump station rehabilitation, electrical and instrumentation improvements, HVAC work, and mechanical and yard piping),** with a contract dollar amount of at least **$1,000,000** each, or **$3,000,000** in the aggregate.

3. Bidder's compliance with these minimum qualification requirements will, among other factors identified in the SOQ Questionnaire, also be measured by the experience of the supervisory personnel who will have responsible charge of the various major components of the Work. The qualifications of the Key Personnel are to be submitted with the SOQ, by providing the information described in paragraph 2.B of this Document 00 45 13.

2. REQUIRED CONTENTS OF SOQ

A. Completed Questionnaire. Bidder shall include a completed Statement of Qualification Questionnaire in the form included herein. Bidder shall make sure its answers to the Questionnaire describe for itself and its Key Personnel proposed, their construction project experience. Add supplementary information if necessary.

B. Resumes of Proposed Key Personnel. As part of the questionnaire, bidder shall provide a resume for each named Key Personnel of Bidder, to include the following:

- Name and proposed assignment of Key Personnel; do not include home addresses or phone numbers;
- Years of experience;
- Education - degrees, schools and years obtained;
- Professional Registrations;
- Fluency in English (Yes/No);
- Experience directly related to public works projects;
- At least two client references, including contact names, addresses and telephone numbers, and
- Description of projects of a similar nature worked on in the past five (5) years.

C. Capability to Provide Required Performance and Payment Bonds. Bidder shall include a letter from a surety duly admitted, licensed to do business in the State of California, and in compliance with CCP §995.660, that the surety has agreed to provide Bidder with the required performance and payment bonds in accordance with the requirements set forth in Documents 00 63 13.13 (Construction Performance Bond) and 00 63 13.16 (Construction Labor and Material Payment Bond). Such performance and payment bonds shall be in the minimum penal sums provided therein. Bidder agrees that Surety's issuance of the letter authorizes City to verify with the surety that the surety, based upon the Bid prices, will issue the required bonds under the conditions stated.

D. Financial Capacity. Include audited or reviewed financial statements for the three most recently completed fiscal years for Bidder. Also include audited or reviewed financial statements for the three most recently completed fiscal years for any parent company(ies) of Bidder (if applicable).

E. Litigation History. Questionnaire includes description of litigation history for the past three years, including names of involved parties, nature of dispute, and disposition.

F. Safety Programs and History. Questionnaire includes description of Bidder's safety programs implemented for construction projects; and history of safety violations, injuries and/or deaths associated with Bidder's projects for the past five (5) years.

3. GENERAL CONDITIONS

A. Explanations to SOQ. Any explanation requested by a Bidder regarding the meaning or interpretation of this Document 00 45 13 must be requested in writing and with sufficient time allowed for a reply to reach Bidder before the submission of its SOQ. Oral explanations or instructions will not be binding. Any information provided to any prospective Bidder concerning this Document 00 45 13 will be furnished to all prospective Bidders as an Addendum to the Bidding Documents.

B. Definitions. Except as set forth herein, all abbreviations and definitions of terms used in this document 00 45 13 are as set forth in Document 00 72 00 (General Conditions) or Section 01 42 16 (References and Definitions).

STATEMENT OF QUALIFICATION QUESTIONNAIRE

THAT MUST BE SUBMITTED WITH BID

FOLLOWS ON NEXT PAGE

CONTRACTOR STATEMENT OF QUALIFICATION QUESTIONNAIRE

[THIS QUESTIONNAIRE MUST BE SUBMITTED WITH BID PROPOSAL]

Bidders shall complete the entire Statement of Qualification Questionnaire and submit it in accordance with Document 00 21 00 (Instructions to Bidders) and Document 00 45 13 (Statement of Qualifications (SOQ) for Construction). Failure to complete this Questionnaire or inclusion of any false statement(s) shall be ground for immediate disqualification.

CONTACT INFORMATION

Company Name:_____

Owner of Company:_____

Contact Person:_____

Address:_____

Phone:_____Fax_____

PART A: GENERAL INFORMATION

1. Does Bidder possess a valid and current California Contractor's **" A "** license for the work proposed?

   Yes___ No___

2. Does Bidder have a minimum of **$2,000,000** comprehensive general liability insurance coverage?

   Yes ___ No ___

3. Has Bidder's Contractor's License been revoked or suspended by any governmental agency at any time in the last five (5) years?

   Yes ___ No ___

4. Has Bidder been "default terminated" by an owner (other than for convenience), or has a Surety completed a contract for Bidder within the last five (5) years?

   Yes ___ No ___

5. Has Bidder been cited more than twice for failure to pay prevailing wages in the last five (5) years?

   Yes, ___ No ___

6. Has Bidder, at any time within the past five (5) years been issued any written warnings, citations or notice to discharge any employee due to failure or refusal to carry out directions or due to incompetence or disorderly or improper conduct by any employee or workmen on any project?

   Yes ___ No ___

7. Has Bidder attached copies of its reviewed or audited financial statements and accompanying notes for the latest three years?

   Yes ___ No ___

Bidder shall be immediately disqualified if any answer to questions 1, 2 or 7 is "No".

Bidder shall be immediately disqualified if any answer to questions 3, 4, 5, or 6 is "Yes".

PART B: SAFETY, PREVAILING WAGE, DISPUTES AND BONDS

SAFETY

1. Has Cal/OHSA, Federal OSHA, the EPA, or any Air Quality Management District cited Bidder in the past five (5) years?

   Yes ___ No ___ If yes, attach description of each citation.

2. How often does Bidder require documented safety meetings be held for:

   Field Supervisor Weekly ____ Bi-Weekly ____ Monthly ____ Less Than Monthly ____

   Employees Weekly ____ Bi-Weekly ____ Monthly ____ Less Than Monthly ____

   New Hires Weekly ____ Bi-Weekly ____ Monthly ____ Less Than Monthly ____

   Subcontractors Weekly ____ Bi-Weekly ____ Monthly ____ Less Than Monthly ____

3. How often does Bidder conduct documented safety inspections?

   Quarterly _____ Semi-annually _____ Annually _____ Other _____

4. Does Bidder have home office safety representatives who visit/audit the job site?

   Quarterly _____ Semi-annually _____ Annually _____ Other _____

5. What is Bidder's Interstate Experience Modification Rate? _____.

   (A rating in excess of 1.00 may constitute grounds for disqualification as non-responsible; however, Bidder may provide additional information to explain a rating above 1.00. Bidders with a rating in excess of 1.50 shall be deemed to be non-responsible and their bid rejected.)

6. Has Bidder, at any time within the past five (5) years:

   a. Received any citation or been assessed penalties for safety violations from any governmental agency?

      Yes ___ No ___

      If yes, attach description of each citation.

   b. Experienced on any of its projects an accident that resulted in death or a serious injury involving medical treatment by an emergency medical care provider and/or hospitalization, to any person?

      Yes ___ No ___

      If yes, provide detail in Part G: Safety Program and History of this Questionnaire.

PREVAILING WAGE PROVISIONS

7. Has Bidder been fined, penalized or otherwise found to have violated any prevailing wage or labor code provision within the past five (5) years? If yes, attach description of each occurrence.

   Yes _____ No _____

LICENSE PROVISIONS

8. Has Bidder changed names or license numbers in the past five (5) years? If so, please state reason for change.

   Yes _____ No _____

   Reason: _____

   _____

   _____

DISPUTES

9. Has Bidder had any claims, litigation, or disputes ending in mediation or arbitration, or termination for cause associated with any project in the past five (5) years? If yes, attach description of each instance including details of total claim amount, settlement amount, and owner's name and phone number.

   Yes _____ No _____

10. In the last five (5) years has your firm, or any firm with which any of your company's owners, officers or partners was associated, been debarred, disqualified, removed or otherwise prevented from bidding on, or completing, any government agency or public works project for any reason? If yes, attach description of each instance including details and owner's name and phone number.

    Yes _____ No _____

11. In the last five (5) years has your firm been denied an award of a public works contract based on a finding by a public agency that your company was not a responsible bidder? If yes, attach description of each instance including details and owner's name and phone number.

    Yes _____ No _____

12 At any time in the last five (5) years, has your firm been assessed and paid liquidated damages after completion of a project, under a construction contract with either a public or private owner? If yes, attach description of each instance including details and owner's name and phone number.

    Yes _____ No _____

BONDING

13. Bonding Capacity – Provide documentation from Bidder's surety identifying the following:

    Name of bonding company/surety: _____

    Name of Surety Agent:_____

    Surety Agent address: _____

    Surety Agent phone number:_____

    Is surety a California-admitted surety? Yes _____ No _____

    Is surety listed in the current edition of the California Department of the Treasury's Listing of approved sureties? Yes _____ No _____

    What is Bidder's total bonding capacity? _____

    What percent does Bidder pay for bonds? _____

14. At any time during the past five (5) years, has any surety company made any payments on your firm's behalf as a result of a default, to satisfy any claims made against a performance or payment bond issued on your firm's behalf in connection with a construction project, either public or private?

    Yes _____ No _____

    If yes, attach description of each instance including details and provide surety's name and contact information.

PART C: EXPERIENCE OF PRIME CONTRACTOR

The unique nature of this Project requires prior similar experience for the firm and the Key Personnel assigned. Summarize similar project experience below and provide the detailed project information requested:

Prime Contractor. List **five (5)** public agency projects of similar nature and complexity**,** completed within the past **five (5)** years **(examples of applicable projects),** with a contract dollar amount of at least **$**_____ each, or **$**_____ in the aggregate, and indicate who were the superintendent and project manager. (This may be provided on separate sheets.)

Project Name/Public Agency	Construction Cost	Year Completed	Name of Project Superintendent	Name of Project Manager

List Key Personnel that will be assigned to this proposed Contract:

Project Manager: _____

Project Superintendent: _____

Attach resumes of these key personnel in accordance with the information listed in Paragraph 2.B of Document 00 45 13.

Recent Projects.

Bidder shall provide information about **five (5)** of its most currently completed projects. Names and references must be current and verifiable. If a separate sheet is used, it must contain all of the following information:

1. Project Name: _____

   Location: _____

   Owner: _____

   Owner Contact (name and phone): _____

   Architect/Engineer: _____

   Architect/Engineer Contact (name and phone number): _____

   Const. Mgr. or Project Mgr. (name and phone number): _____

   Description of Project, Scope of Work Performed: _____

   _____

   Total Construction Cost: _____

   Total Change Order Amount: _____

   Did Change Orders exceed 10% of original contract sum? _____ If yes, please explain on separate sheet.

   Original Scheduled Date of Completion: _____

   Time Extensions Granted (number of Days): _____

   Actual Date of Completion: _____

   Number of Stop Notices filed by Subcontractors or Suppliers: _____

2. Project Name: _____

   Location: _____

   Owner: _____

   Owner Contact (name and phone): _____

   Architect/Engineer: _____

   Architect/Engineer Contact (name and phone number): _____

Const. Mgr. .or Project Mgr. (name and phone number): _____

Description of Project, Scope of Work Performed: _____

_____

Total Construction Cost: _____

Total Change Order Amount: _____

Did Change Orders exceed 10% of original contract sum? _____ If yes, please explain on separate sheet.

Original Scheduled Date of Completion: _____

Time Extensions Granted (number of Days): _____

Actual Date of Completion: _____

Number of Stop Notices filed by Subcontractors or Suppliers: _____

3. Project Name: _____

Location: _____

Owner: _____

Owner Contact (name and phone): _____

Architect/Engineer: _____

Architect/Engineer Contact (name and phone number): _____

Const. Mgr. or Project Mgr. (name and phone number): _____

Description of Project, Scope of Work Performed: _____

_____

Total Construction Cost: _____

Total Change Order Amount: _____

Did Change Orders exceed 10% of original contract sum? _____ If yes, please explain on separate sheet.

Original Scheduled Date of Completion: _____

Time Extensions Granted (number of Days): _____

Actual Date of Completion: _____

Number of Stop Notices filed by Subcontractors or Suppliers: _____

4. Project Name: _____

   Location: _____

   Owner: _____

   Owner Contact (name and phone): _____

   Architect/Engineer: _____

   Architect/Engineer Contact (name and phone number): _____

   Const. Mgr. or Project Mgr. (name and phone number): _____

   Description of Project, Scope of Work Performed: _____

   _____

   Total Construction Cost: _____

   Total Change Order Amount: _____

   Did Change Orders exceed 10% of original contract sum? _____ If yes, please explain on separate sheet.

   Original Scheduled Date of Completion: _____

   Time Extensions Granted (number of Days): _____

   Actual Date of Completion: _____

   Number of Stop Notices filed by Subcontractors or Suppliers: _____

5. Project Name: _____

   Location: _____

   Owner: _____

   Owner Contact (name and phone): _____

   Architect/Engineer: _____

   Architect/Engineer Contact (name and phone number): _____

   Const. Mgr. or Project Mgr. (name and phone number): _____

Description of Project, Scope of Work Performed: _____

_____

Total Construction Cost: _____

Total Change Order Amount: _____

Did Change Orders exceed 10% of original contract sum? _____ If yes, please explain on separate sheet.

Original Scheduled Date of Completion: _____

Time Extensions Granted (number of Days): _____

Actual Date of Completion: _____

Number of Stop Notices filed by Subcontractors or Suppliers: _____

PART D: FINANCIAL INFORMATION

1. Has Bidder ever reorganized under the protection of bankruptcy laws?

   Yes _____ No _____ If yes, please state when _____

2. If Bidder has had the general liability carrier identified in Document 00 45 14 (Bidder Registration and Safety Experience Form) for less than 5 years, please provide additional information below for balance of the last 5 years:

   Agency Name: _____

   Contact Name: _____

   Phone Number: _____

   Carrier: _____

   Carrier: _____

3. Has Bidder ever had insurance terminated or refused to renew by a carrier?

   Yes _____ No _____

   If yes, explain on a separate signed sheet marked with correlating cross-reference to this paragraph of the Questionnaire.

PART E: SURETY AND INSURANCE CAPABILITY

1. Has Bidder attached a letter from a surety duly licensed to do business in the State of California agreeing to provide the required bonds per paragraph 2.C of Document 00 4513?

   Yes _____ No _____

2. Has Bidder attached a letter from an insurance company agreeing to provide insurance coverage per Specification Section 00 72 00, General Conditions, Number 4, **INSURANCE**?

   Yes _____ No _____

PART F: LITIGATION HISTORY (Add additional sheets if necessary)

Bidder shall provide a description of construction project related litigation history for the past three years, including names of involved parties, nature of dispute, and disposition.

_____

_____

_____

_____

_____

_____

_____

_____

PART G: SAFETY PROGRAM AND HISTORY (Add additional sheets if necessary)

1. Provide a brief description of Bidder's safety programs implemented for construction projects:

_____

_____

_____

_____

2. For the past five (5) years, provide a history of all safety violations, injuries, and/or deaths associated with all of Bidder's projects:

_____

_____

_____

_____

_____

_____

PART H: CERTIFICATION

Bidder hereby declares under penalty of perjury that all the information provided in this questionnaire is true and correct.

_____

SIGNATURE

_____

TITLE

-END OF DOCUMENT-

DOCUMENT 00 45 14

BIDDER REGISTRATION

INSTRUCTIONS

In order to register to undertake work for the City of San Bruno, Bidder **must**:

1) Fill out this registration form completely; do not leave blanks.

2) Provide certificates of insurance or a letter evidencing coverage complying with Paragraph 4.1 of Document 00 72 00 (General Conditions).

INDEPENDENT CONTRACTOR REGISTRATION

Full Corporate Name of Company: _____

Street Address: _____

Mailing Address: _____

Email Address: _____

Phone: _____ Fax: _____

Contractor's License # _____ Class _____

Fed I.D. # _____

Department of Industrial Relations (DIR) Contractor ID # _____

Name of Principal Contact: _____

Type of Business:
_____ Sole Proprietor _____ Partnership
_____ Non-Profit 501(c) (3) _____ Corporation
_____ Other (please explain:_____)

INSURANCE

Workers' Compensation:

Carrier: _____

Address: _____

Phone and Fax: _____

Policy Number: _____

General Liability:

Carrier: _____

Address: _____

Phone and Fax: _____

Policy Number: _____

Policy Limits: $ _____

Automobile Liability:

Carrier: _____

Address: _____

Phone and Fax: _____

Policy Number: _____

Policy Limits: $ _____

BIDDER CERTIFIES, UNDER PENALTY OF PERJURY, THAT THE FOREGOING INFORMATION IS CURRENT AND ACCURATE AND AUTHORIZES THE CITY OF SAN BRUNO, AND ITS AGENTS AND REPRESENTATIVES TO OBTAIN A CREDIT REPORT AND/OR VERIFY ANY OF THE ABOVE INFORMATION.

Bidder: _____
(Business Name)

By: _____
(Signature)

Its: _____
(Title)

Date: _____

BIDDER CERTIFICATION

TO BE EXECUTED BY ALL BIDDERS AND SUBMITTED WITH BID

The undersigned Bidder certifies to the City of San Bruno (the "City") as set forth in sections 1 through 5 below.

1. STATEMENT OF CONVICTIONS

By my signature hereunder, I hereby swear, under penalty of perjury, that no more than one final, unappealable finding of contempt of court by a Federal Court has been issued against Bidder within the past two years because of failure to comply with an order of a Federal Court or to comply with an order of the National Labor Relations Board.

2. CERTIFICATION OF WORKER'S COMPENSATION INSURANCE

By my signature hereunder, as the Contractor, I certify that I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for worker's compensation or 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 of this Contract.

3. CERTIFICATION OF PREVAILING WAGE RATES AND RECORDS

By my signature hereunder, as the Contractor, I certify that I am aware of the provisions of Section 1773 of the California Labor Code, which requires the payment of prevailing wage on public projects. Also, that the Contractor and any subcontractors under the Contractor shall comply with California Labor Code §1776, regarding wage records, and with California Labor Code §1777.5, regarding the employment and training of apprentices. It is the Contractor's responsibility to ensure compliance by any and all subcontractors performing work under this Contract.

4. CERTIFICATION OF COMPLIANCE WITH PUBLIC WORKS CHAPTER OF LABOR CODE

By my signature hereunder, as the Contractor, I certify that I am aware of Sections 1777.1 and 1777.7 of the California Labor Code and Contractor and Subcontractors and am eligible to bid and work on public works projects.

5. CERTIFICATION OF ADEQUACY OF CONTRACT AMOUNT

By my signature hereunder, as the Contractor, pursuant to Labor Code Section 2810(a), I certify that, if awarded the Contract based on the undersigned's Bid, the Contract will include funds sufficient to allow the Contractor to comply with all applicable local, state, and federal laws or regulations governing the labor or services to be provided. I understand that the City will be relying on this certification if it awards the Contract to the undersigned.

BIDDER: _____
(Business Name)

Date: _____, 20____

By: _____
(Signature)

Name:_____
(Print Name)

Its: _____
(Title)

-END OF DOCUMENT-

DOCUMENT 00 45 19

NON-COLLUSION AFFIDAVIT
Public Contract Code §7106

NON-COLLUSION AFFIDAVIT TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID

STATE OF CALIFORNIA)
) ss.
COUNTY OF _____)

_____, being first duly sworn,
(Name of Principal of Bidder)

deposes and says that he or she is _____
(Office of Affiant)

of _____, the party
(Name of Bidder)

making the foregoing Bid, that the Bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the Bid is genuine and not collusive or sham; that Bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham Bid, and has not directly or indirectly colluded, conspired, connived or agreed with any bidder or anyone else to put in a sham Bid, or that anyone shall refrain from bidding, and that the Bidder has not in any manner, directly or indirectly, sought by agreement, communication or conference with anyone to fix the Bid price of Bidder or any other bidder, or to fix any overhead, profit or cost element of the Bid price, or of that of any other bidder, or to secure any advantage against the City of San Bruno, or anyone interested in the proposed contract; that all statements contained in the Bid are true; and further, that Bidder has not, directly or indirectly, submitted its Bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, Bid depository, or to any member or agent thereof to effectuate a collusive or sham Bid.

Executed under penalty of perjury under the laws of the State of California:

_____
(Name of Bidder)

_____
(Signature of Principal)

Subscribed and sworn before me _____

This _____ day of _____, 20____

Notary Public of the State of _____

In and for the County of _____

My Commission expires _____ (Seal)

NOTE: If Bidder is a partnership or a joint venture, this affidavit must be signed and sworn to by every member of the partnership or venture.

NOTE: If Bidder [including any partner or venturer of a partnership or joint venture] is a corporation, this affidavit must be signed by the Chairman, President, or Vice President and by the Secretary, Assistant Secretary, Chief Financial Officer, or Assistant Treasurer.

NOTE: If Bidder's affidavit on this form is made outside the State of California, the official position of the person taking such affidavit shall be certified according to law.

-END OF DOCUMENT-

DOCUMENT 00 50 20

BID ADDENDUM NO. _____

PROJECT TITLE: SNEATH AND LAKE PUMP STATION REHABILITATION PROJECT

PROJECT NOS. 11003 & 11004

DATE: _____

TO: All Prospective Bidders and Plan Holders of Record

BY THIS NOTICE, the City of San Bruno hereby amends the referenced project bid documents as follows:

Additions are shown in underline. Deletions are shown in ~~strikeout~~.

1. Revisions, Modifications.
2. Revisions, Modifications.

This Bid Addendum No. ____ shall become part of the Contract Documents and all provisions of the Contract shall apply thereto. This Bid Addendum has been provided to all plan holders of record**. For a bid to be considered as responsive for the purposes of an award of contract, this Bid Addendum shall be acknowledged in the appropriate section of the Bid Form, Document 00 41 70 (Addenda Acknowledgement).**

ISSUED BY: _____ Date: _____
Name, Title

Attachments:

-END OF DOCUMENT-

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This message is intended only for the use of the individual or entity to which it is addressed. It may contain information that is privileged, confidential and exempt from disclosure under applicable law. If the reader of this message is not the intended recipient, or the employee or agent responsible for delivering the message to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, please notify us immediately by telephone, and return the original message to us at the address below via U.S. Postal Service. The postage cost will be refunded to you. Thank you.

567 El Camino Real, San Bruno, California 94066-4299
Voice: (650) 616-7065 Fax: (650) 794-1443
http://sanbruno.ca.gov

DOCUMENT 00 50 50

CITY OF SAN BRUNO

NOTICE OF INTENT TO AWARD FOR CONSTRUCTION

DATE POSTED: _____

PROJECT TITLE: **SNEATH AND LAKE PUMP STATION REHABILITATION PROJECT**

PROJECT NO: **11003 & 11004**

Matthew Lee, the Public Works Director of the City of San Bruno, intends to recommend to the City Council the Award of the above-referenced project to _____.

This notice constitutes compliance with Section 00 21 00 of the project manual. Any protests regarding the award of this contract must be submitted in writing to the City's Public Works Department, Administration & Engineering (Attention: City Engineer), before 5:00 p.m. of the 5th calendar day following issuance this Notice of Intent to Award.

OWNER: City of San Bruno

By: _____
Matthew Lee, P.E.
Director of Public Works

Date: _____

THIS IS NOT A NOTICE OF AWARD OR A NOTICE TO PROCEED

-END OF DOCUMENT-

(THIS PAGE LEFT BLANK INTENTIONALLY)

DOCUMENT 00 51 00

NOTICE OF AWARD

Dated: _____

TO: _____

ADDRESS: _____

CONTRACT: SNEATH AND LAKE PUMP STATION REHAILITATION PROJECT

PROJECT NO.: 11003 & 11004

The City Council has awarded _____ the Sneath and Lake Pump Station Rehabilitation Project for the Contract Sum of $_____.

1. Enclosed are contract documents for your execution:

   - 00 52 00 Contract Agreement (will be sent via DocuSign for Signature).
   - 00 61 13.13 Construction Performance Bond.
   - 00 61 13.16 Construction Labor and Materials Payment Bond.
   - Business License Application.

2. Please return the following by 5:00 p.m. (Date) _____ (the 10th Working Day following the date of this Notice of Award).

   a. Fully DocuSigned Document 00 52 00 (Contract Agreement). (Please **DO NOT** date the first page of the contract agreement).

   b. One (1) original of Document 00 61 13.13 (Construction Performance Bond), executed by you and your surety.

   c. One (1) original of Document 00 61 13.16 (Construction Labor and Materials Payment Bond), executed by you and your surety.

   d. One (1) original set of insurance certificates with endorsements in accordance with Section 4 of Document 00 72 00 (General Conditions) of the bid documents. The City of San Bruno is to be named as additional parties insured.

   e. Obtain a San Bruno Business License. For further information please visit https://sanbruno.hdlgov.com/Apply/GettingStarted/BusinessLicense or contact City of San Bruno Business Support Center at (650) 273-4371 (email: sanbruno@hdlgov.com).

3. Failure to comply with these conditions within the time specified will entitle City to consider your bid abandoned, to annul this Notice of Award, and to declare your Bid Security forfeited.

4. Within 21 Days after you have provided the documents specified in Paragraph 2 above, the City will return to you one fully signed counterpart of Document 00 52 00 (Contract Agreement).

5. Before you may start any work at the Site, you must attend a preconstruction conference with the City staff. The preconstruction conference may be arranged through the Department of Public Works, Administration & Engineering, Attn: Camila Arcayena at (650) 754-2388. All correspondence and inquiries regarding the Project should be directed to Camila Arcayena at (650) 754-2388,

   email: carcayena@sanbruno.ca.gov.

6. Upon commencement of the work, you and each of your subcontractors shall certify and provide the City with copies of payroll records on forms provided by the Division of Labor Standards Enforcement, in accordance with California Labor Code §1776.

CITY OF SAN BRUNO

BY: _____
Name and Title

AUTHORIZED BY CITY RESOLUTION NO.: _____

ADOPTED: _____
(Date)

-END OF DOCUMENT-

DOCUMENT 00 52 00

CONTRACT AGREEMENT

_____

PROJECT TITLE

THIS AGREEMENT was executed this _____ day of _____, 20_____ by and between **[Name of Contractor]** whose place of business is located at **[Address of Contractor]** ("Contractor"), and the CITY OF SAN BRUNO ("City"), acting under and by virtue of the authority vested in the City by the laws of the State of California.

NOW, THEREFORE, in consideration of the mutual covenants hereinafter set forth, Contractor and City agree as follows:

Article 1. Work

1.1 Contractor shall complete all Work specified in the Contract Documents, in accordance with the Plans, Specifications, and all other terms and conditions of the Contract Documents.

Article 2. Architect/Engineer and Project Manager

2.1 The City Engineer and its authorized vendor designed the Project and furnished the Plans and Specifications. The City Engineer shall have the rights assigned to Architect/Engineer in the Contract Documents.

2.2 City has designated the City Engineer as its Project Manager to act as City's point of contact relating to the Contract Documents and to determine whether the work performed is in accordance with the Contract Documents.

2.3 The City may assign all or part of the Project Manager's rights, responsibilities and duties to a Project or Construction Manager.

Article 3. Contract Time and Liquidated Damages

3.1 Contract Time

Contractor shall commence work on the date established in the Notice to Proceed. City reserves the right to modify or alter the commencement date of the Work. Contractor shall achieve Substantial Completion of the entire Work within **300 Working Days** from the date when the contract time commences to run as provided in Document 00 72 00 (General Conditions). Contractor shall achieve Final Completion of the entire Work and be ready for Final Payment in accordance with Section 01 77 00 (Closeout Procedures) 20 Working Days from the date when Substantial Completion was established.

3.2 Liquidated Damages

City and Contractor recognize that time is of the essence of this Agreement and that City will suffer financial loss in the form of Contract administration expenses (such as project management and consultant expenses), if all or any part of the Work is not completed within the times specified above, plus any extensions thereof allowed in accordance with the Contract Documents. Contractor and City agree that because of the nature of the Project, it would be impractical or extremely difficult to fix the amount of actual damages incurred by City because of a delay in completion of all or any part of the Work. Accordingly, City and Contractor agree that as liquidated damages for delay Contractor shall pay City:

3.2.1 Five Hundred dollars ($500) for each Day that expires after the time specified herein for Contractor to achieve Substantial Completion of the entire Work, until achieved.

3.2.2 Five Hundred dollars ($500) for each Day that expires after the time specified herein for Contractor to achieve Final Completion of the entire Work, until achieved.

These measures of liquidated damages shall apply cumulatively and except as provided below, shall be presumed to be the damages suffered by City resulting from delay in completion of the Work.

3.3 Liquidated damages for delay shall only cover administrative, overhead, interest on bonds, and general loss of public use damages suffered by City as a result of delay. Liquidated damages shall not cover the cost of completion of the Work, damages resulting from defective work, lost revenues or costs of substitute facilities, or damages suffered by others who then seek to recover their damages from City (for example, delay claims of other contractors, subcontractors, tenants, or other third-parties), and defense costs thereof.

3.4 It is further agreed that prior to issuance of a Notice of Completion under the terms of this Contract, and as a condition precedent to the City's obligation for the issuance of the Notice of Completion and Final Payment, the Contractor shall submit to the City a "Maintenance and Warranty Bond" to be valued at ten percent (10%) of the final contract amount. Such Bond shall be in force and valid for a period of one (1) year unless extended.

Article 4. Contract Sum

4.1 City shall pay Contractor the Contract Sum of _____

Dollars ($_____) for completion of Work in accordance with Contract Documents as set forth in Contractor's Bid, attached hereto.

Article 5. Contractor's Representations

In order to induce City to enter into this Agreement, Contractor makes the following representations and warranties:

5.1 Contractor has visited the Site and has examined thoroughly and understood the nature and extent of the Contract Documents, Work, Site, locality, actual conditions, as-built conditions, and all local conditions, and federal, state and local laws and regulations that in any manner may affect cost, progress, performance or furnishing of Work or which relate to any aspect of the means, methods, techniques, sequences or procedures of construction to be employed by Contractor and safety precautions and programs incident thereto.

5.2 Contractor has examined thoroughly and understood all reports of exploration and tests of subsurface conditions, as-built drawings, drawings, products specifications or reports, available for Bidding purposes, of physical conditions, including Underground Facilities, which have been made available for Bidders or which may appear in the Drawings. Contractor accepts the determination set forth in these Documents and Document 00 72 00 of the limited extent of the information contained in such materials upon which Contractor may be entitled to rely. Contractor agrees that except for the information so identified, Contractor does not and shall not rely on any other information contained in such reports and drawings.

5.3 Contractor has conducted or obtained and has understood all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to in Section 5.2 of this Agreement) that pertain to the subsurface conditions, as-built conditions, Underground Facilities and all other physical conditions at or contiguous to the Site or otherwise that may affect the cost, progress, performance or furnishing of Work, as Contractor considers necessary for the performance or furnishing of Work at the Contract Sum, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Document 00 72 00; and no additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by Contractor for such purposes.

5.4 Contractor has correlated its knowledge and the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

Article 6. Contract Documents

6.1 Contract Documents consist of the Project Manual and include the following documents, and all changes, Addenda, and Modifications thereto:

Document 00 10 00	Notice Inviting Bids
Document 00 21 00	Instructions to Bidders
Document 00 24 13	Scopes of Bids

Document 00 41 00	Bid Proposal
Document 00 41 70	Addenda Acknowledgement
Document 00 51 00	Notice of Award
Document 00 52 00	Contract Agreement
Document 00 61 13.13	Construction Performance Bond
Document 00 61 13.16	Construction Labor and Material Payment Bond
Document 00 72 00	General Conditions
Document 00 73 00	Special Conditions
General Requirements	
Technical Specifications	
Drawings	Sheet 1 thru 85

6.2 The Contract Documents may only be amended, modified or supplemented as provided in Document 00 72 00.

Article 7. Miscellaneous

7.1 Terms and abbreviations used in this Agreement are defined in Document 00 72 00 and Section 01 42 16 (Definitions) and will have the meaning indicated therein.

7.2 It is understood and agreed that in no instance are the persons signing this Agreement for or on behalf of City or acting as an employee, agent, or representative of City, liable on this Agreement or any of the Contract Documents, or upon any warranty of authority, or otherwise, and it is further understood and agreed that liability of the City is limited and confined to such liability as authorized or imposed by the Contract Documents or applicable law.

7.3 Contractor shall not assign any portion of the Contract Documents without the City's prior approval. Any assignment of any portion of the Contract Documents without the City's prior written approval shall be deemed null and void. Contractor may subcontract portions of the Contract Documents only in compliance with the Subcontractor Listing Law, California Public Contract Code Section 4100, *et seq.*

7.4 The Contract Sum includes all allowances (if any).

7.5 In entering into a public works contract or a subcontract to supply goods, services or materials pursuant to a public works contract, Contractor or Subcontractor offers and agrees to assign to the awarding body 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. §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 public works contract or the subcontract. This assignment shall be made and become effective at the time City tenders final payment to Contractor, without further acknowledgment by the parties.

7.6 Copies of the general prevailing rates of per diem wages for each craft, classification, or type of worker needed to execute the Contract, as determined by Director of the State of California Department of Industrial Relations, are deemed included in the Contract Documents and on file at City's Office, and shall be made available to any interested party on request. Pursuant to California Labor Code Section 1861, Contractor represents that it is aware of the provisions of Section 3700 of the Labor Code 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 Contractor shall comply with such provisions before commencing the performance of the Work of the Contract Documents.

7.7 Should any part, term or provision of this Agreement or any of the Contract Documents, or any document required herein or therein to be executed or delivered, be declared invalid, void or unenforceable, all remaining parts, terms and provisions shall remain in full force and effect and shall in no way be invalidated, impaired or affected thereby. If the provisions of any law causing such invalidity, illegality or unenforceability may be waived, they are hereby waived to the end that this Agreement and the Contract Documents may be deemed valid and binding agreements, enforceable in accordance with their terms to the greatest extent permitted by applicable law. In the event any provision not otherwise included in the Contract Documents is required to be included by any applicable law, that provision is deemed included herein by this reference (or, if such provision is required to be included in any particular portion of the Contract Documents, that provision is deemed included in that portion).

7.8 This Agreement and the Contract Documents shall be deemed to have been entered into in the City of San Bruno, State of California, and governed in all respects by California law (excluding choice of law rules). The exclusive venue for all disputes or litigation hereunder shall be in San Mateo County Superior Court. Contractor accepts the terms of Document 00 72 00, Article 12, as a claims procedure by agreement under the California Government Code, Title 1, Division 3.6, Part 3, Chapter 5.

IN WITNESS WHEREOF the parties have executed this Agreement in duplicate the day and year first above written.

CONTRACTOR: [CONTRACTOR'S NAME]

By: _____

Its: _____
Title (If corporation: Chairman, President, or Vice President)

By: _____

Its: _____
Title (If corporation: Secretary, Chief Financial Officer or Assistant Treasurer)

_____
Contractor's San Bruno Business License number

CITY OF SAN BRUNO

By: _____
City Manager

Date: _____

(Council Action dated _____)

Attest: _____
City Clerk

APPROVED AS TO FORM

By: _____
City Attorney

Attachments:

-END OF DOCUMENT-

DOCUMENT 00 52 17
AGREEMENT AND RELEASE OF ANY AND ALL CLAIMS

THIS AGREEMENT AND RELEASE OF ANY AND ALL CLAIMS ("Agreement and Release"), made and entered into this ___ day of _____20__, by and between the City of San Bruno ("City"), and _____ ("Contractor"), whose place of business is at _____.

RECITALS

A. City and Contractor entered into [Contract Number] (the "Contract") for construction of the City of San Bruno Sneath and Lake Pump Station Rehabilitation Project.

Project located at:

1. Sneath Lane Pump Station
   2100 Sneath Lane
   San Bruno, CA 94066

2. Lake Drive Pump Station
   102 Lake Drive
   San Bruno, CA 94066

AGREEMENT

NOW THEREFORE, it is mutually agreed between City and Contractor as follows:

1. Contractor will not be assessed liquidated damages except as detailed below:

Original Contract Sum	$ _____
Modified Contract Sum	$ _____
Payment to Date	$ _____
Liquidated Damages	$ _____
Payment Due Contractor	$ _____

2. Subject to the provisions of this Agreement and Release, City will forthwith pay to Contractor the sum of _____Dollars and _____ Cents ($_____) under the Contract, less any amounts withheld under the Contract or represented by any Notice to Withhold Funds on file with City as of the date of such payment.

3. Contractor acknowledges and hereby agrees that there are no unresolved or outstanding claims in dispute against City arising from the Contract, except for the claims described in Paragraph 4 of this Document. It is the intention of the parties in executing this Agreement and Release that this Agreement and Release shall be effective as a full, final and general release of all claims, demands, actions, causes of action, obligations, costs, expenses, damages, losses and liabilities of Contractor against City, and all if its agents, employees, consultants, inspectors, representatives, assignees and transferees, except for the Disputed Claims set forth in Paragraph 4 of this Document. Nothing in this Agreement and Release shall limit or modify Contractor's continuing obligations described in Paragraph 6 of this Document.

4. The following claims submitted under Document 00 72 00 (General Conditions), Article 12, are disputed (hereinafter, the "Disputed Claims") and are specifically excluded from the operation of this Agreement and Release.

Claim No.	Date Submitted	Description of Claim	Amount of Claim

5. Consistent with California Public Contract Code §7100, Contractor hereby agrees that, in consideration of the payment set forth in Paragraph 2 of this Document, Contractor hereby releases and forever discharges City, and all of its agents, employees, consultants, inspectors, assignees and transferees from any and all liability, claims, demands, actions or causes of action of whatever kind or nature arising out of or in any way concerned with the Work under the Contract.

6. Guarantees and warranties for the Work, and any other continuing obligation of Contractor, shall remain in full force and effect as specified in the Contract Documents.

7. Contractor shall immediately defend, indemnify and hold harmless City, any of the City's Representatives, Project Manager, and all of their agents, employees, consultants, inspectors, assignees and transferees, from any and all claims, demands, actions, causes of action, obligations, costs, expenses, damages, losses and liabilities that may be asserted against them by any of Contractor's suppliers and/or Subcontractors of any tier and/or any suppliers to them for any and all labor, materials,

supplies and equipment used, or contemplated to be used in the performance of the Contract, except for the Disputed Claims set forth in Paragraph 4 of this Document.

8. Contractor hereby waives the provisions of California Civil Code §1542, which provide as follows:

> **A GENERAL RELEASE DOES NOT EXTEND TO CLAIMS WHICH THE CREDITOR DOES NOT KNOW OR SUSPECT TO EXIST IN HIS FAVOR AT THE TIME OF EXECUTING THE RELEASE, WHICH IF KNOWN BY HIM, MUST HAVE MATERIALLY AFFECTED HIS SETTLEMENT WITH THE DEBTOR.**

9. The provisions of this Agreement and Release are contractual in nature and not mere recitals and shall be considered independent and severable, and if any such provision or any part thereof shall be at any time held invalid in whole or in part under any federal, state, county, municipal or other law, ruling, or regulation, then such provision, or part thereof shall remain in force and effect only to the extent permitted by law, and the remaining provisions of this Agreement and Release shall also remain in full force and effect, and shall be enforceable.

10. Contractor represents and warrants that it is the true and lawful owner of all claims and other matters released pursuant to this Agreement and Release, and that it has full right, title and authority to enter into this instrument. Each party represents and warrants that it has been represented by counsel of its own choosing in connection with this Agreement and Release.

11. All rights of City shall survive completion of the Work or termination of the Contract, and execution of this Agreement and Release.

*** * * CAUTION: THIS IS A RELEASE - READ BEFORE EXECUTING * * ***

CONTRACTOR

By: _____	By: _____
Signature	Signature
Name: _____	Name: _____
Print	Print
Its: _____	Its: _____
Title	Title

CITY OF SAN BRUNO

By: _____

Signature

Name: _____

Print

Its: _____

Title

-END OF DOCUMENT-

DOCUMENT 00 55 00

NOTICE TO PROCEED

Dated: _____

TO: _____Contractor Name _____

ADDRESS: _____

CONTRACT: Sneath and Lake Pump Station Rehabilitation Project

PROJECT NOS.: 11003 & 11004

This letter will serve as your Notice to Proceed of the subject construction project effective _____.

In accordance with Article 3 of Document 00 52 00 (Contract Agreement), you will have **300 Working days** to complete the scope of work within the contract. For contractual purposes, working days charged will begin on _____.

Please direct all correspondence regarding this project to my attention and feel free to call me at (650) 616-7065 if you have any questions.

CITY OF SAN BRUNO

_____ _____
Print Name Signature

_____
Title

-END OF DOCUMENT-

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DOCUMENT 00 61 13.13

CONSTRUCTION PERFORMANCE BOND

THIS CONSTRUCTION PERFORMANCE BOND ("Bond") dated the ____day of _____, 20____ , is in the penal sum of _____ which is one hundred percent of the Contract Sum**,** and is entered into by and between the parties listed below to ensure the faithful performance of the Construction Contract listed below. This Bond consists of this page and the Bond Terms and Conditions, Paragraphs 1 through 12, attached to this page. Any singular reference to _____ _____ ("Contractor"), _____ ("Surety"), City of San Bruno ("City"), or other party shall be considered plural where applicable.

CONSTRUCTION CONTRACT: Sneath and Lake Pump Station Rehabilitation Project

CONTRACT Nos.: 11003 & 11004

DATED _____, 20___, in the Amount of $_____ (the "Penal Sum").

CONTRACTOR AS PRINCIPAL	**SURETY**
(Corp. Seal)	(Corp. Seal)
_____	_____
Company Name	Company Name
_____	_____
Signature	Signature
_____	_____
Print Name	Print Name
_____	_____
Title	Title
_____	_____
Street Address	Street Address
_____	_____
City, State, Zip Code	City, State, Zip Code

BOND TERMS AND CONDITIONS

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to City for the complete and proper performance of the Construction Contract, which is incorporated herein by reference.

2. If Contractor completely and properly performs all of its obligations under the Construction Contract, Surety and Contractor shall have no obligation under this Bond.

3. If there is no City Default, Surety's obligation under this Bond shall arise after:

    3.1 City has declared a Contractor Default under the Construction Contract pursuant to the terms of the Construction Contract; and

    3.2 City has agreed to pay the Balance of the Contract Sum:

        3.2.1 To Surety in accordance with the terms of this Bond and the Construction Contract; or

        3.2.2 To a contractor selected to perform the Construction Contract in accordance with the terms of this Bond and the Construction Contract.

4. When City has satisfied the conditions of Paragraph 3, Surety shall promptly (within 30 Days) and at Surety's expense elect to take one of the following actions:

    4.1 Arrange for Contractor, with consent of City, to perform and complete the Construction Contract (but City may withhold consent, in which case the Surety must elect an option described in Paragraphs 4.2, 4.3 or 4.4, below); or

    4.2 Undertake to perform and complete the Construction Contract itself, through its agents or through independent contractors; provided, that Surety may not select Contractor as its agent or independent contractor without City's consent; or

    4.3 Undertake to perform and complete the Construction Contract by obtaining bids from qualified contractors acceptable to City for a contract for performance and completion of the Construction Contract and, upon determination by City of the lowest responsive and responsible Bidder, arrange for a contract to be prepared for execution by City and the contractor selected with City's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract; and, if Surety's obligations defined in Paragraph 6, below, exceed the Balance of the Contract Sum, then Surety shall pay to City the amount of such excess; or

    4.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances

and, after investigation and consultation with City, determine in good faith its monetary obligation to City under Paragraph 6, below, for the performance and completion of the Construction Contract and, as soon as practicable after the amount is determined, tender payment therefor to City with full explanation of the payment's calculation. If City accepts Surety's tender under this Paragraph 4.4, City may still hold Surety liable for future damages then unknown or unliquidated resulting from the Contractor Default. If City disputes the amount of Surety's tender under this Paragraph 4.4, City may exercise all remedies available to it at law to enforce Surety's liability under Paragraph 6, below.

5. If Surety does not proceed as provided in Paragraph 4, above, then Surety shall be deemed to be in default on this Bond ten Days after receipt of an additional written notice from City to Surety demanding that Surety perform its obligations under this Bond. At all times City shall be entitled to enforce any remedy available to City at law or under the Construction Contract including, without limitation, and by way of example only, rights to perform work, protect Work, mitigate damages, advance critical Work to mitigate schedule delay, or coordinate Work with other consultants or contractors.

6. Surety's monetary obligation under this Bond is limited by the amount of this Bond identified herein as the Penal Sum. This monetary obligation shall augment the Balance of the Contract Sum. Subject to these limits, Surety's obligations under this Bond are commensurate with the obligations of Contractor under the Construction Contract. Surety's obligations shall include, but are not limited to:

   6.1 The responsibilities of Contractor under the Construction Contract for completion of the Construction Contract and correction of Defective Work;

   6.2 The responsibilities of Contractor under the Construction Contract to pay liquidated damages, and for damages for which no liquidated damages are specified in the Construction Contract, actual damages caused by non-performance of the Construction Contract including, but not limited to, all valid and proper backcharges, offsets, payments, indemnities, or other damages;

   6.3 Additional legal, design professional and delay costs resulting from Contractor Default or resulting from the actions or failure to act of the Surety under Paragraph 4, above (but excluding attorney's fees incurred to enforce this Bond).

7. No right of action shall accrue on this Bond to any person or entity other than City or its successors or assigns.

8. Surety hereby waives notice of any change, alteration or addition to the Construction Contract or to related subcontracts, purchase orders and other obligations, including changes of time. Surety consents to all terms of the Construction Contract, including provisions on changes to the Contract. No extension of time, change, alteration, Modification, deletion, or addition to the Contract Documents, or of the Work required thereunder, shall release or exonerate Surety on this Bond or in any way affect the obligations of Surety on this Bond.

9. Any proceeding, legal or equitable, under this Bond shall be instituted in any court of competent jurisdiction where a proceeding is pending between City and Contractor regarding the Construction Contract, or in the courts of the County of San Mateo, or in a court of competent jurisdiction in the location in which the Work is located. Communications from City to Surety under Paragraph 3.1 of this Bond shall be deemed to include the necessary agreements under Paragraph 3.2 of this Bond unless expressly stated otherwise.

10. All notices to Surety or Contractor shall be mailed or delivered (at the address set forth on the signature page of this Bond), and all notices to City shall be mailed or delivered as provided in Document 00 52 00 (Contract Agreement). Actual receipt of notice by Surety, City or Contractor, however accomplished, shall be sufficient compliance as of the date received at the foregoing addresses.

11. Any provision in this Bond conflicting with any statutory or regulatory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein.

12. Definitions

    12.1 Balance of the Contract Sum: The total amount payable by City to Contractor pursuant to the terms of the Construction Contract after all proper adjustments have been made under the Construction Contract, for example, deductions for progress payments made, and increases/decreases for approved Modifications to the Construction Contract.

    12.2 City Default: Material failure of City, which has neither been remedied nor waived, to pay Contractor progress payments due under the Construction Contract or to perform other material terms of the Construction Contract, if such failure is the cause of the asserted Contractor Default and is sufficient to justify Contractor termination of the Construction Contract.

    12.3 Construction Contract: The agreement between City and Contractor identified on the signature page of this Bond, including all Contract Documents and changes thereto.

    12.4 Contractor Default: Material failure of Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Construction Contract including, but not limited to, “default” or any other condition allowing a termination for cause as provided in Document 00 72 00 (General Conditions).

-END OF DOCUMENT-

DOCUMENT 00 61 13.16

CONSTRUCTION LABOR AND MATERIAL PAYMENT BOND

KNOW ALL PERSONS BY THESE PRESENTS:

1. THAT WHEREAS, the City of San Bruno ("City") has awarded to _____ as Principal Contract Numbers 11003 & 11004 dated the ___ day of _____, 20___ (the "Contract"), titled "Sneath and Lake Pump Station Rehabilitation Project", in the amount of _____, which Contract is by this reference made a part hereof, for the work generally described as follows:

   Rehabilitation of the Lake and Sneath Potable Water Pump Stations including, but not limited to new mechanical and yard piping, new HVAC, new electrical and instrumentation, existing electrical/instrumentation improvements, building refurbishment and improvements to meet current codes, civil site improvements and new generators. A new building addition at the Lake Pump Station and temporary bypass system at both locations.

2. AND WHEREAS, Principal is required to furnish a bond in connection with the Contract to secure the payment of claims of laborers, mechanics, material suppliers, and other persons as provided by law;

3. NOW, THEREFORE, we, the undersigned Principal and _____, as Surety, are held and firmly bound unto City in the sum of 100% OF THE CONTRACT PRICE ($_____) for which payment well and truly to be made we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

4. THE CONDITION OF THIS OBLIGATION IS SUCH, that if Principal, or its executors, administrators, successors, or assigns approved by City, or its subcontractors shall fail to pay any of the persons named in California Civil Code §3181, or amounts due under the State of California Unemployment Insurance Code with respect to work or labor performed under the Contract, or for any amounts required to be deducted, withheld, and paid over to the State of California Employment Development Department from the wages of employees of Principal and subcontractors pursuant to Section 13020 of the State of California Unemployment Insurance Code with respect to such work and labor, that Surety will pay for the same in an amount not exceeding the sum specified in this bond, plus reasonable attorneys' fees, otherwise the above obligation shall become and be null and void.

5. This bond shall inure to the benefit of any of the persons named in California Civil Code §3181, as to give a right of action to such persons or their assigns in any suit brought upon this bond. The intent of this bond is to comply with the California Mechanic's Lien Law.

6. Surety, for value received, hereby expressly agrees that no extension of time, change, modification, alteration, or addition to the undertakings, covenants, terms, conditions, and agreements of the Contract, or to the work to be performed thereunder, shall in any way affect the obligation of this bond; and it does hereby waive notice of any such extension of time, change, modification, alteration, or addition to the undertakings, covenants, terms, conditions, and agreements of the Contract, or to the work to be performed thereunder.

7. Surety's obligations hereunder are independent of the obligations of any other surety for the payment of claims of laborers, mechanics, material suppliers, and other persons in connection with Contract; and suit may be brought against Surety and such other sureties, jointly and severally, or against any one or more of them, or against less than all of them without impairing City's rights against the other.

8. Correspondence or claims relating to this bond shall be sent to Surety at the address set forth below.

IN WITNESS WHEREOF, we have hereunto set our hands this ____ day of , 20 .

CONTRACTOR AS PRINCIPAL	**SURETY**
(Corp. Seal)	(Corp. Seal)
Company Name	Company Name
Signature	Signature
Print Name	Print Name
Title	Title
Street Address	Street Address
City, State, Zip Code	City, State, Zip Code

-END OF DOCUMENT-

DOCUMENT 00 61 16
ESCROW AGREEMENT FOR SECURITY DEPOSIT IN LIEU OF RETENTION

California Public Contract Code §22300

THIS ESCROW AGREEMENT ("Escrow Agreement") is made and entered into this day of _____ 20____, by and between the City of San Bruno ("City"), whose address is 567 El Camino Real, San Bruno, California 94066 _____ ("Contractor"), whose place of business is located at _____; and _____, a state or federally chartered bank in the State of California, whose place of business is located at _____("Escrow Agent").

For the consideration hereinafter set forth, City, Contractor and Escrow Agent agree as follows:

1. Pursuant to California Public Contract Code §22300, Contractor has the option to deposit securities with Escrow Agent as a substitute for retention earnings required to be withheld by City pursuant to Contract Number 11003 and 11004 entered into between City and Contractor for the City of San Bruno Sneath and Lake Pump Station Rehabilitation Project in the amount of _____ dated _____ __, 20_____ (the "Contract"). Alternatively, on written request of Contractor, City shall make payments of the retention earnings directly to Escrow Agent. When Contractor deposits the securities as a substitute for Contract earnings, Escrow Agent shall notify City within ten Days of the deposit. The market value of the securities at the time of substitution shall be at least equal to the cash amount then required to be withheld as retention under terms of Contract between City and Contractor. Securities shall be held in name of _____, and shall designate Contractor as the beneficial owner.

2. City shall make progress payments to Contractor for those funds which otherwise would be withheld from progress payments pursuant to Contract provisions, provided that Escrow Agent holds securities in form and amount specified in Paragraph 1 of this Document.

3. When City makes payment(s) of retention earned directly to Escrow Agent, Escrow Agent shall hold said payment(s) for the benefit of Contractor until the time that the escrow created under this Escrow Agreement is terminated. Contractor may direct the investment of the payments into securities. All terms and conditions of this Escrow Agreement and the rights and responsibilities of the parties shall be equally applicable and binding when City pays Escrow Agent directly.

4. Contractor shall be responsible for paying all fees for the expenses incurred by Escrow Agent in administering the Escrow Account, and all expenses of City. Such expenses and payment terms shall be determined by City, Contractor, and Escrow Agent.

5. Interest earned on securities or money market accounts held in escrow and all interest earned on that interest shall be for sole account of Contractor and shall be subject to withdrawal by Contractor at any time and from time to time without notice to City.

6. Contractor shall have the right to withdraw all or any part of the principal in the Escrow Account only by written notice to Escrow Agent accompanied by written authorization from City to Escrow Agent that City consents to withdrawal of amount sought to be withdrawn by Contractor.

7. City shall have the right to draw upon the securities in event of default by Contractor. Upon seven Days written notice to Escrow Agent from City of the default, Escrow Agent shall immediately convert the securities to cash and shall distribute the cash as instructed by City.

8. Upon receipt of written notification from City certifying that the Contract is final and complete, and that Contractor has complied with all requirements and procedures applicable to the Contract, Escrow Agent shall release to Contractor all securities and interest on deposit less escrow fees and charges of the Escrow Account. The escrow shall be closed immediately upon disbursement of all moneys and securities on deposit and payments of fees and charges.

9. Escrow Agent shall rely on written notifications from City and Contractor pursuant to Paragraphs 5 through 8, inclusive, of this Document and City and Contractor shall hold Escrow Agent harmless from Escrow Agent's release and disbursement of securities and interest as set forth.

10. Names of persons who are authorized to give written notice or to receive written notice on behalf of City and on behalf of Contractor in connection with the foregoing, and exemplars of their respective signatures are as follows:

ON BEHALF OF CITY OF SAN BRUNO:	**ON BEHALF OF CONTRACTOR:**
_____	_____
Title	Title
_____	_____
Name	Name
_____	_____
Signature	Signature
_____	_____
Address	Address
_____	_____
City/State/Zip Code	City/State/Zip Code

ON BEHALF OF ESCROW AGENT:

_____
Title

_____
Name

_____
Signature

_____
Address

_____
City/State/Zip Code

-END OF DOCUMENT-

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DOCUMENT 00 61 19

MAINTENANCE AND WARRANTY BOND

KNOW ALL MEN BY THESE PRESENTS, that we, _____as Principal, and _____ , as Surety, are held and firmly bound unto the **City of San Bruno** (hereinafter called the Obligee), in the penal sum of __ Dollars ($_____) for the payment of which, well and truly to be made, we do hereby bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the said Principal has heretofore entered into a contract with the Obligee for the Sneath and Lake Pump Station Rehabilitation Project, Project Nos. 11003 & 11004. And,

WHEREAS, the work called for under said contract has now been completed and accepted by said Obligee;

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall for a period of **one (1)** year from and after the date of the completion of the contract indemnify the Obligee against any loss or damage directly arising by reason of any defect in the material or workmanship that may be discovered within the period aforesaid, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that in the event of any default on the part of the Principal, written statement of the particular facts showing such default and the date thereof shall be delivered to the Surety by registered mail, at its home office in the city of _____, promptly and in any event within ten (10) days after the Obligee or his representative shall learn of such a default; and that no claim, suit or action by reason of any default of the Principal shall be brought hereunder after the expiration of thirty days from the end of the maintenance period as herein set forth.

CONTRACTOR AS PRINCIPAL	**SURETY**
(Corp. Seal)	(Corp. Seal)
_____	_____
Company Name	Company Name
_____	_____
Signature	Signature
_____	_____
Print Name	Print Name
_____	_____
Title	Title
_____	_____
Street Address	Street Address
_____	_____
City, State, Zip Code	City, State, Zip Code

-END OF DOCUMENT-

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DOCUMENT 00 63 25
SUBSTITUTION REQUEST FORM

To: City Engineer, City of San Bruno
(650) 616-7065

Project: _____

Contractor: _____

Subcontractor/Supplier: _____

Drawing Sheet Reference/Detail No: _____

The undersigned Contractor hereby submits for consideration the following equipment instead of the specified item for the above Project:

Section	Paragraph	Specified Item
_____	_____	_____
_____	_____	_____

Proposed Substitution: _____

_____

The Contractor must include all information required under Section 01 60 00 (Product Requirements).

The undersigned has (a) attached manufacturer's literature, including complete technical data and laboratory test results, if applicable, (b) attached an explanation of why proposed substitution is a true equivalent to specified item, (c) included complete information on changes to Contract Documents that the proposed substitution will require for its proper installation, and (d) filled in the blanks below:

A. Does the substitution affect dimensions shown on Drawings?

_____

B. Are the manufacturer's guarantees and warranties on the proposed substitution items identical to those on the specified items? If there are differences, please specify each and every difference in detail.

_____

C. What effect does the substitution have on other contractors, trades, or suppliers?

_____

D. What are the differences between the proposed substitution and the specified item? If proposed substitution has a color or pattern, provide a color board showing proposed substitution in relation to the other adjacent colors and patterns.

_____

E. Will granting the requested substitution cause any schedule delay? (If yes, please explain)

_____

Submitted by:

The undersigned Contractor certifies that the function, appearance, and quality of the proposed substitution are equivalent or superior to those of the specified item.

_____
Contractor

_____
Signature

_____
Name

_____
Address

_____
City/State/Zip

Telephone: _____

Date: _____

For Use by City:

_____ Accepted _____ Accepted as Noted

_____ Not Accepted _____ Received Too Late

By: _____
City's Representative

Date: _____

Remarks: _____

_____

_____

_____

-END OF DOCUMENT-

DOCUMENT 00 72 00

GENERAL CONDITIONS

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GENERAL CONDITIONS

1. GENERAL

1.1 Documents

Contract Documents are complementary; what is called for by one is as binding as if called for by all. Contract Documents shall not be construed to create a contractual relationship of any kind between (1) Architect/Engineer or any City Representative and Contractor; (2) City and/or its representatives and (except as provided in paragraph 13.9 below) a Subcontractor, sub-Subcontractor, or supplier of any Project labor, materials, or equipment; or (3) between any persons or entities other than City and Contractor. City shall be deemed to be an intended third-party beneficiary of each agreement referenced in clause (2) above, and each such agreement shall so provide. Contractor is fully responsible for Contractor's own acts and omissions. Contractor is responsible for all acts and omissions of its Subcontractors, suppliers, and other persons and organizations performing or furnishing any of the Work, labor, materials, or equipment under a direct or indirect contract with Contractor.

1.2 Exercise Of Contract Responsibilities

In exercising its responsibilities and authorities under the Contract Documents, City does not assume any duties or responsibilities to any Subcontractor or supplier and does not assume any duty of care to Contractor, Contractor's Subcontractors or suppliers. Except as expressly set forth in the Contract Documents, in exercising their respective responsibilities and authorities under the Contract Documents, neither Engineer nor any City Representative assume any duties or responsibilities to any Subcontractor, sub-Subcontractor or supplier nor assume any duty of care to Contractor or any Subcontractor, sub-Subcontractor or suppliers.

1.3 Defined Terms

All abbreviations and definitions of terms used and not otherwise defined in this Document are set forth in Section 01 42 16 (Definitions). This Document subdivides at first level into Articles, and then into paragraphs.

2. BIDDING

2.1 Investigation Prior To Bidding

2.1A Prior to bidding, Bidders shall perform the work, investigations, research and analysis required by Article 5 of Document 00 52 00 (Contract Agreement). Under the Contract Documents, Contractor is charged with all information and knowledge that a reasonable Bidder would ascertain from having performed the required work, investigations, research, and analysis. Bid prices shall include entire cost of all "incidental work" to complete the Work, as that term is defined in paragraph 5.1C of this Document.

2.1B **Conditions Shown on Contract Documents**: Information as to underground conditions, as-built conditions, or other conditions or obstructions indicated in the Contract Documents, *e.g.*, on Drawings or in Specifications, has been obtained with reasonable care, and has been recorded in good faith. City warrants, and Contractor may rely on, the accuracy of only limited types of information as discussed below.

1. Aboveground and as-built conditions: There is no express or implied warranty and no express or implied representation that any information as to aboveground conditions or as-built conditions indicated in the Contract Documents is correctly shown, or indicated, or complete. As a condition to bidding, Contractor shall verify by independent investigation all aboveground and as-built conditions. In submitting its Bid, Contractor shall rely on the results of its own independent investigation and shall not rely on City-supplied information regarding aboveground conditions and as-built conditions.

2. Subsurface conditions: Contractor may rely only upon the general accuracy of actual reported depths, actual reported character of materials, actual reported soil types, actual reported water conditions, or actual obstructions shown or indicated in the Contract Documents. City is not responsible for (1) the completeness of any subsurface condition information for bidding or construction, (2) Contractor's conclusions or opinions drawn from any subsurface condition information, or (3) subsurface conditions that are not specifically shown. (For example, City is not responsible for soil conditions in areas contiguous to areas where a subsurface condition is shown.)

2.1C **Conditions Shown in Reports and Drawings Supplied for Informational Purposes**: City may have made available during Bidding certain geotechnical reports, "as built" information, and other drawings or other documents describing physical conditions in or relating to existing surface or subsurface conditions or structures at or contiguous to the Site. These materials are not Contract Documents and, except for any "technical data" regarding actual subsurface conditions (such as actual reported soil types, obstructions, structures, materials encountered) and "Underground Facilities" data, Contractor shall not in any manner rely on the information in these materials. Subject to the foregoing, Contractor shall make its own independent investigation of all conditions affecting the Work and must not rely on information provided by City.

2.2 Subcontractors

2.2A Consistent with Public Contract Code Sections 4101 *et seq*., Contractor shall not substitute any other person or firm in place of any Subcontractor listed in the Bid. Subcontractors shall not assign or transfer their subcontracts or permit them to be performed by any other contractor without City's written approval. At City's request, Contractor shall provide City with a complete copy of all executed subcontracts or final commercial agreements with Subcontractors and/or suppliers.

2.2B Subcontract agreements shall preserve and protect the rights of City under the Contract Documents so that subcontracting will not prejudice such rights. To the extent of the Work to be performed by a Subcontractor, Contractor shall require the Subcontractor's written agreement (1) to be bound to the terms of Contract Documents and (2) to assume vis-à-vis Contractor all the obligations and responsibilities that Contractor assumes toward City under the Contract Documents. (These agreements include for example, and not by way of limitation, all warranties, claims procedures and rules governing submittals of all types to which Contractor is subject under the Contract Documents.)

2.2C Contractor shall provide for the assignment to City of all rights any Subcontractor may have against any manufacturer, supplier, or distributor for breach of warranties and guaranties relating to the Work performed by the Subcontractor under the Contract Documents.

3. COMMENCEMENT OF THE WORK

3.1 Commencement of Work

3.1A The Contract Time will commence to run on the 30th Day after the issuance of the Notice of Award or, if a Notice to Proceed is given, on the date indicated in the Notice to Proceed. City may give a Notice to Proceed at any time within 30 Days after the Notice of Award. Contractor shall not do any Work at the Site prior to the date on which the Contract Time commences to run.

4. INSURANCE

4.1 Insurance Requirements

4.1A At or before the date specified in Document 00 21 00 (Instructions to Bidders), Contractor shall furnish to City satisfactory proof that Contractor has taken out for the entire period covered by the Contract the following classes of insurance in the form and with limits and deductibles specified below:

1. Comprehensive General Liability Insurance covering claims for personal injury, bodily injury and property damage arising out of the Work and in a form providing coverage not less than that of a Standard Commercial General Liability Insurance policy ("Occurrence Form"). Such insurance shall provide for all operations and include independent contractors, products liability, completed operations for one year after Final Completion and acceptance of the final payment for the Work, contractual liability, and coverage for explosion, collapse, and underground hazards. The limits of such insurance shall not be coverage of less than $2,000,000 each occurrence, $4,000,000 general aggregate limit, and $4,000,000 combined aggregate for products and completed operations. The policies shall be endorsed to provide Broad Form Property Damage Coverage.

2. Comprehensive Automobile Liability Insurance covering all owned, non-owned, and hired vehicles. Such insurance shall provide coverage not less than the standard Comprehensive Automobile Liability policy with limits not less than $2,000,000 each person Bodily Injury, $2,000,000 each occurrence Bodily Injury, and $2,000,000 each occurrence Property Damage.

3. All-Risk Course of Construction Insurance including damage to property owned by City, Contractor or third parties caused by fire. Insurance shall be in the amount of 100 percent of the completed value of the Work to be performed under this Contract. Deductible shall not exceed $10,000. Each loss shall be borne by Contractor.

4. Workers' Compensation Insurance for all persons whom the Contractor may employ in carrying out Work contemplated under Contract Documents, in accordance with the Act of Legislature of State of California, known as "Workers' Compensation Insurance and Safety Act," approved May 26, 1913, and all acts amendatory or supplemental thereto, in the statutory amount.

4.1.B All policies of insurance shall be placed with insurers acceptable to City. The insurance underwriter(s) for all insurance policies except Workers' Compensation shall have an A. M. Best Company rating of A-, VIII or better. Required minimum amounts of insurance may be increased should conditions of Work, in opinion of City, warrant such increase. Contractor shall increase required insurance amounts upon direction by City.

4.1.C Required Endorsements: The policies required under paragraphs 4.1.A.1 and 4.1.A.2 of this Document shall be endorsed as follows:

1. Name City, its City Council, and their employees, representatives, consultants, and agents, and Project Manager as additional insureds, but only with respect to liability arising out of the activities of the named insured.

2. Each such policy shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limit of the insurance company's liability required under paragraphs 4.1.A.1 and 4.1.A.2 of this Document.

3. Insurance shall be primary to City and no other insurance or self-insured retention carried or held by City shall be called upon to contribute to a loss covered by insurance for the named insured.

4.1.D Certificates of insurance and endorsements shall have clearly typed thereon City Contract Number and title of Contract Documents. Written notice of cancellation, non-renewal, or reduction in coverage of any policy shall be mailed to City (Attention: Contract Administration/Inspection) at the address listed in Document 00 52 00 (Contract Agreement), 60 Days in advance of the effective date of the cancellation, non-renewal, or reduction in coverage.

Written notice of cancellation for non-payment shall be mailed within 10 Days of cancellation. Contractor shall maintain insurance in full force and effect during entire period of performance of Contract Documents. Contractor shall keep insurance in force during warranty and guarantee periods, except that Contractor may discontinue All-Risk Course of Construction Insurance after Final Payment. At time of making application for extension of time, and during all periods exceeding the Contract Time resulting from any cause, Contractor shall submit evidence that insurance policies will be in effect during requested additional period of time. Upon City's request, Contractor shall submit to City, within 30 Days, copies of the actual insurance policies or renewals or replacements.

4.1.E Contractor shall pay all insurance premiums, including any charges for required waivers of subrogation or the endorsement of additional insureds. If Contractor fails to maintain insurance, City may take out comparable insurance, and deduct and retain amount of premium from any sums due Contractor under Contract Documents.

4.1.F If injury occurs to any employee of Contractor, Subcontractor or sub-subcontractor for which the employee, or the employee's dependents in the event of employee's death, is entitled to compensation from City under provisions of the Workers' Compensation Insurance and Safety Act, as amended, or for which compensation is claimed from City, City may retain out of sums due Contractor under Contract Documents, amount sufficient to cover such compensation, as fixed by the Act, as amended, until such compensation is paid, or until it is determined that no compensation is due. If City is compelled to pay compensation, City may, in its discretion, either deduct and retain from the Contract Sum the amount so paid, or require Contractor to reimburse City.

4.1.G Nothing in paragraph 4.1 of this Document shall be construed as limiting in any way the extent to which Contractor or any Subcontractor may be held responsible for payment of damages resulting from their operations.

4.1.H All Subcontractors shall maintain the same insurance required to be maintained by Contractor with respect to their portions of the Work, and Contractor shall cause the Subcontractors to furnish proof thereof to City within ten Days of City's request.

4.1.I The following provisions apply to any licensed professional engaged by Contractor to perform portions of the Work ("Professional").

Each Professional shall maintain the following insurance:

1. Professional Liability Insurance, insuring against professional errors and omissions arising from Professional's Work on the Project, in an amount not less than $2,000,000 combined single limit for each occurrence. If Professional cannot provide an occurrence policy, Professional shall provide insurance covering claims made as a result of performance of

Work on this Project and shall maintain such insurance in effect for not less than two years following Final Completion of the Project.

2. All insurance required by paragraphs 4.1.A.1, 4.1.A.2, and 4.1.A.4 of Document 00 72 00. Professional shall satisfy all other provisions of paragraph 4.1 of this Document relating to that insurance, including without limitation providing required insurance certificates (containing the required endorsements) before commencing its Work on the Project.

5. DRAWINGS AND SPECIFICATIONS

5.1 Intent

5.1A Drawings and Specifications are intended to describe a functionally complete and operable Project (and all parts thereof) to be constructed in accordance with the requirements of Contract Documents. Contractor shall perform any work, provide services and furnish any materials or equipment that may reasonably be inferred from the requirements of Contract Documents or from prevailing custom or trade usage as being required to produce this intended result. Contractor shall interpret words or phrases used to describe wok (including services), materials or equipment, that have well-known technical or construction industry or trade meaning in accordance with that meaning. Drawings' intent specifically includes the intent to depict construction that complies with all applicable laws, codes and standards.

5.1B As part of the "Work," Contractor shall provide all labor, materials, equipment, machinery, tools, facilities, services, employee training and testing, hoisting facilities, Shop Drawings, storage, testing, security, transportation, disposal, the securing of all necessary or required field dimensions, the cutting or patching of existing materials, notices, permits, documents, reports, agreements and any other items required or necessary to timely and fully complete Work described and the results intended by Contract Documents and, in particular, Drawings and Specifications. Divisions and Specification Sections and the identification on any Drawings shall not control Contractor in dividing Work among Subcontractors or suppliers or delineating the Work to be performed by any specific trade.

5.1C Contractor shall perform reasonably implied parts of Work as "incidental work" although absent from Drawings and Specifications. Incidental work includes any work not shown on Drawings or described in Specifications that is necessary or normally or customarily required as a part of the Work shown on Drawings or described in Specifications. Incidental Work includes any Work necessary or required to make each installation satisfactory, legally operable, functional, and consistent with the intent of Drawings and Specifications or the requirements of Contract Documents. Contractor shall perform incidental work without extra cost to City. Incidental work shall be treated as if fully described in Specifications and shown on Drawings, and

the expense of incidental work shall be included in price Bid and Contract Sum.

5.2 Drawing Details

5.2A A typical or representative detail on Drawings shall constitute the standard for workmanship and material throughout corresponding parts of Work. Where necessary, and where reasonably inferable from Drawings, Contractor shall adapt such representative detail for application to such corresponding parts of Work. The details of such adaptation shall be subject to prior approval by City. Repetitive features shown in outline on Drawings shall be in exact accordance with corresponding features completely shown.

5.3 Interpretation of Drawings and Specifications

5.3A Should any discrepancy appear or any misunderstanding arise as to the import of anything contained in Drawings and Specifications, or should Contractor have any questions or requests relating to Drawings or Specifications, Contractor shall refer the matter to City, in writing. City will issue with reasonable promptness written responses, clarifications or interpretations as City may determine necessary, which shall be consistent with the intent of and be reasonably inferable from Contract Documents. Such written clarifications or interpretations shall be binding upon Contractor. If Contractor believes that a written response, clarification or interpretation justifies an adjustment in the Contract Sum or Contract Time, Contractor shall give City prompt written notice. If the parties are unable to agree to the amount or extent of the adjustment, if any, then Contractor shall perform the Work in conformance with City's response, clarification, or interpretation and may make a written claim for the adjustment as provided in Article 12 of this Document.

5.4 Checking of Drawings

5.4A Before undertaking each part of Work, Contractor shall carefully study and compare Contract Documents and check and verify pertinent figures shown in the Contract Documents and all applicable field measurements. Contractor shall be responsible for any errors that might have been avoided by such comparison. Figures shown on Drawings shall be followed; Contractor shall not scale measurements. Contractor shall promptly report to City, in writing, any conflict, error, ambiguity or discrepancy that Contractor may discover. Contractor shall obtain a written interpretation or clarification from City before proceeding with any Work affected thereby. Contractor shall provide City with a follow-up correspondence every ten Days until it receives a satisfactory interpretation or clarification.

5.5 Standards to Apply Where Specifications are Not Furnished

5.5A The following general specifications shall apply wherever in the Specifications, or in any directions given by City in accordance with or

supplementing Specifications, it is provided that Contractor shall furnish materials or manufactured articles or shall do work for which no detailed specifications are shown. Materials or manufactured articles shall be of the best grade, in quality and workmanship, obtainable in the market from firms of established good reputation. If not ordinarily carried in stock, the materials or manufactured articles shall conform to industry standards for first-class materials or articles of the kind required, with due consideration of the use to which they are to be put. Work shall conform to the usual standards or codes, such as those cited in Section 01 42 16 (Definitions), for first-class Work of the kind required. Contractor shall specify in writing to City the materials to be used or Work to be performed under this paragraph 5.5A ten Business Days prior to furnishing such materials or performing such Work.

5.6 Deviation from Specifications and Drawings

5.6A Contractor shall perform Work in accordance with Drawings and Specifications. Contractor may deviate from Drawings or the dimensions given in the Drawings, and may deviate from the Specifications, only upon City's advance written approval of the proposed deviation.

5.6B City may order that locations, lines and grades for Work vary from those shown on Drawings. Changes may be made in locations, lines or grades for Work under any item of Contract Documents. No payment in addition to unit price fixed in the Contract Documents for Work under respective items will be allowed on account of variations from Drawings in unit price items. In lump sum contracts, or where there are no unit price items covering Work affected by variations of locations, lines or grades, all changes in the Contract Documents will be made as set forth in Article 14 of this Document.

5.7 Precedence of Documents

5.7A In the case of discrepancy or ambiguity in the Contract Documents, the following order of precedence shall prevail:

1. Modifications in inverse chronological order (i.e., most recent first), and in the same order as specific portions they are modifying;
2. Document 00 52 00 (Contract Agreement), and terms and conditions referenced therein;
3. Document 00 73 00 (Special Conditions), if included;
4. Document 00 72 00 (General Conditions);
5. Division 1 Specifications;
6. Division 2 Specifications;
7. Drawings;
8. Written numbers over figures, unless obviously incorrect;

9. Figured dimensions over scaled dimensions;
10. Large-scale drawings over small-scale drawings.

5.7B Any conflict between Drawings Specifications will be resolved in favor of the document of the latest date (i.e., the most recent document), and if the dates are the same or not determinable, then in favor of Specifications.

5.7C Any conflict between a bill or list of materials shown in the Contract Documents and the actual quantities required to complete Work required by Contract Documents, will be resolved in favor of the actual quantities.

5.7D In the event the Specifications include divisions above Division 2 (e.g., Division 3 and above), then such divisions shall be included within the Contract Documents unless identified otherwise.

5.8 Ownership and Use of Drawings, Specifications and Contract Documents

5.8A Drawings, Specifications and other Contract Documents were prepared for use for Work of Contract Documents only. No part of Contract Documents shall be used for any other construction or for any other purpose except with the written consent of City. Any unauthorized use of Contract Documents is prohibited and at the sole liability of the user.

6. CONSTRUCTION BY CITY OR BY SEPARATE CONTRACTORS

6.1 Construction by City or By Separate Contractor

6.1A City may perform with its own forces, construction or operations related to the Project. City may also award separate contracts in connection with other portions of the Project or other construction or operations, on the Site or areas contiguous to the Site, under conditions similar to these Contract Documents, or may have utility owners perform other work. Contractor shall adjust its schedule and fully coordinate with and shall afford all other contractors, utility owners and City (if City is performing Work with its own forces), proper and safe access to the Site, and reasonable opportunity for the installation and storage of their materials. Contractor shall ensure that the execution of its Work properly connects and coordinates with others' work, and shall cooperate with them to facilitate the progress of the Work.

7. CITY REPRESENTATIVES AND AUTHORITIES

7.1 City Representative(s)

7.1A City representative(s) will have limited authority to act on behalf of City as set forth in the Contract Documents. Except as otherwise provided in these Contract Documents or subsequently identified in writing by City, City will issue all communications to Contractor through City's representative, and Contractor shall issue all communications to City through City's representative in a written document delivered to City. Should any direct communications between Contractor and City's consultants, architects or

engineers not identified in Article 2 of Document 00 52 00 (Contract Agreement) occur during field visits or by telephone, Contractor shall immediately confirm them in a written document copied to City.

7.2 Means and Methods Of Construction

7.2A Subject to those rights specifically reserved in the Contract Documents, City will not supervise, or direct, or have control over, or be responsible for, Contractor's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or Contractor's failure to comply with laws and regulations applicable to the furnishing or performance of Work. City will not be responsible for Contractor's failure to perform or furnish the Work in accordance with Contract Documents.

8. CONTROL OF THE WORK

8.1 Observation of Work By City and/or its Engineer

8.1A Work shall be performed under City's general observation and administration. Contractor shall comply with City's directions and instructions in accordance with the terms of Contract Documents, but nothing contained in these General Conditions shall be taken to relieve Contractor of any obligations or liabilities under the Contract Documents. City's failure to review or, upon review, failure to object to any aspect of Work reviewed, shall not be deemed a waiver or approval of any non-conforming aspect of Work.

8.1B City may engage an independent consultant or engineer (collectively for purposes of this paragraph, "Engineer") to assist in administering the Work. If so engaged, Engineer will advise and consult with City, but will have authority to act on behalf of City only to extent provided in the Contract Documents or as set forth in writing by City. Engineer will not be responsible for and will not have control or charge of construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with Work. Engineer will not be responsible for or have control over the acts or omissions of Contractor, Subcontractors or their agents or employees, or any other persons performing Work.

8.1C Engineer may review Contractor's Submittals, such as Shop Drawings, Product Data, and Samples, but only for conformance with design concept of Work and with information given in the Contract Documents.

8.1D Engineer may visit the Site at intervals appropriate to stage of construction to become familiar generally with the progress and quality of Work and to determine in general if Work is proceeding in accordance with Contract Documents. Based on its observations, Engineer may recommend to City that it disapproves or rejects Work that Engineer believes to be Defective or will not produce a complete Project that conforms to Contract Documents or will prejudice the integrity of the design concept of the completed Project as

a functioning whole as indicated by Contract Documents. City will also have authority to require special inspection or testing of Work, whether or not the Work is fabricated, installed or completed.

8.1E Engineer may conduct inspections to recommend to City the dates that Contractor has achieved Substantial Completion and Final Acceptance, and will receive and forward to City for review written warranties and related documents required by Contract Documents.

8.2 Supervision of Work by Contractor

8.2A Contractor shall supervise, inspect, and direct Work competently and efficiently, devoting the attention and applying such personal skills and expertise as may be required and necessary to perform Work in accordance with Contract Documents. Contractor shall be solely responsible for and have control and charge of construction means, methods, techniques, sequences and procedures, safety precautions and programs in connection with the Work. Contractor shall be responsible to see that the completed Work complies accurately with Contract Documents.

8.2B Contractor shall keep on the Site at all times during Work progress a competent resident Superintendent, who shall not be replaced without City's express written consent. The Superintendent shall be Contractor's representative at the Site and shall have complete authority to act on behalf of Contractor. All communications to and from the Superintendent shall be as binding as if given to or by Contractor.

8.3 Access to Work

8.3A During performance of Work, City and its agents, officers, consultants, and employees may at any time enter upon Work, shops or studios where any part of the Work may be in preparation, or factories where any materials for use in Work are being or are to be manufactured, and Contractor shall provide proper and safe facilities for this purpose, and shall make arrangements with manufacturers to facilitate inspection of their processes and products to such extent as City's interests may require. Other contractors performing work for City may also enter upon Work for all purposes required by their respective contracts. Subject to the rights reserved in the Contract Documents, Contractor shall have sole care, custody, and control of the Site and its Work areas.

8.4 Existing Utilities Shown or Indicated In Contract Documents

8.4A Drawings or specifications may indicate above- and below-grade structures, drainage lines, storm drains, sewers, water, gas, electrical, chemical, hot water, and other similar items and utilities, and additional information may be on file at the regional notification center, "Underground Service Alert" ("USA"). Contractor shall locate these known existing installations before proceeding with trenching or other operations that may cause damage, shall maintain them in service where appropriate, and shall repair any damage to

them caused by the Work, at no increase in Contract Sum. Additional utilities whose locations are unknown to City are suspected to exist. Contractor shall be alert to their existence; if they are encountered, Contractor shall immediately report to City for disposition of the same. In addition to reporting if any utility is damaged, Contractor shall take appropriate action as provided in this Document. Additional compensation or extension of time on account of utilities not shown or otherwise brought to Contractor's attention, including reasonable action taken to protect or repair damage, shall be determined as provided in this Document.

8.4B At no additional cost to City, Contractor shall incorporate into the Work main or trunk line utilities identified in the Contract Documents and other utilities or underground structures known or reasonably discernible and that will remain in service, including reasonable adjustments to the design location (including minor relocations) of the existing or new installations. Contractor shall take immediate action to restore any in service installations damaged by Contractor's operations. Should City determine that Contractor has not responded in a timely manner or not diligently pursued completion of the Work, City may restore service and deduct the costs of such action by City from the amounts due under the Contract.

8.4C Consistent with Government Code Section 4215, as between City and Contractor, City will be responsible for the timely removal, relocation, or protection of existing main or trunk line utility facilities located on the Site only if such utilities are not identified in the Contract Documents or information made available for bidding. City will compensate for the cost of locating and repairing damage not due to Contractor's failure to exercise reasonable care, removing and relocating such main or trunk line utility facilities not indicated in the Contract Documents or information made available for bidding with reasonable accuracy, and equipment on the Project necessarily idled during such Work.

8.4D Prior to performing Work at the Site, Contractor shall lay out the locations of known underground utilities that are to remain in service and other significant known underground installations. At no additional cost to City, prior to commencing other Work in proximity to such known underground utilities or installations that can be readily inferred from adjacent surface improvements, Contractor shall further locate, by carefully excavating with small equipment, potholing and principally by hand, such utilities or installations that are to remain and that are subject to damage.

8.4E Nothing in this shall be deemed to require City to indicate the presence of existing service laterals or appurtenances whenever the presence of such utilities on the Site can be inferred by Contractor from the presence of an underground transmission main or other visible facilities, such as buildings, new asphalt, meters and junction boxes, on or adjacent to the Site. Contractor shall immediately secure all available information and notify City and utility, in writing, of its discovery, while performing Work under the Contract Documents, of any utility facilities not identified in the Drawings and Specifications.

8.5 Protection of Underground Facilities When Digging Trenches or During Excavation

8.5A Before commencing work of digging trenches or excavation, Contractor shall review all information available regarding subsurface conditions, including but not limited to information supplied for bidding purposes, and subject to the terms and conditions of these documents. Contractor shall also comply with Government Code Sections 4216 to 4216.9, and in particular Section 4216.2 which provides, in part:

"Except in an emergency, every person planning to conduct any excavation shall contact the appropriate regional notification center at least two working days, but no more than 14 calendar days, prior to commencing that excavation, if the excavation will be conducted in an area which is known, or reasonably should be known, to contain subsurface installations other than the underground facilities owned or operated by the excavator, and, if practical, the excavator shall delineate with white paint or other suitable markings the area to be excavated. The regional notification center shall provide an inquiry identification number to the person who contacts the center and shall notify any member, if known, who has a subsurface installation in the area of the proposed excavation.

When the excavation is proposed within 10 feet of a high priority subsurface installation, the operator of the high priority subsurface installation shall notify the excavator of the existence of the high priority subsurface installation prior to the legal excavation start date and time, as such date and time are authorized pursuant to paragraph (1) of subdivision (a) of Section 4216.2. The excavator and operator or its representative shall conduct an onsite meeting at a mutually-agreed-on time to determine actions or activities required to verify the location of the high priority subsurface installations prior to start time."

8.5B Contractor shall contact USA, and schedule the Work to allow ample time for the center to notify its members and, if necessary, for any member to field locate and mark its facilities. Contractor is charged with knowledge of all subsurface conditions reflected in USA records. Prior to commencing excavation or trenching work, Contractor shall provide City with copies of all USA records secured by Contractor. Contractor shall advise City of any conflict between information provided for bidding purposes, the Drawings and specifications, and that provided by USA records. Contractor's excavation shall be subject to and comply with the Contract Documents.

8.5C The cost of all of the following will be included in the Contract Sum and Contractor shall have full responsibility for (a) reviewing and checking all available information and data including, but not limited to, information made available for bidding and information on file at USA; (b) locating all Underground Facilities shown or indicated in the Contract Documents, available information, or indicated by visual observation including, but not limited to, and by way of example only, engaging qualified locating services and all necessary backhoeing and potholing; (c) coordination of the Work

with the owners of such Underground Facilities during construction; and (d) the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

8.5D If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated in the materials supplied by City for bidding or in information on file at USA or is otherwise reasonably available to Contractor, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby (and in no event later than seven Days), and prior to performing any Work in connection therewith (except in an emergency as required by Article 13 of this Document), identify the owner of such Underground Facility and give written notice to that owner and to City. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

8.5E Contractor shall be allowed an increase in the Contract Sum or an extension of the Contract Time, or both, to the extent that they are attributable to the existence of any Underground Facility that is owned and was built by City only where the Underground Facility:

1. Was not shown or indicated in the Contract Documents or in the information supplied for bidding purposes or in information on file at USA; and
2. Contractor did not know of it; and
3. Contractor could not reasonably have been expected to be aware of it or to have anticipated it from the information available. (For example, if surface conditions such as pavement repairs, valve covers, or other markings, indicate the presence of an Underground Facility, then an increase in the Contract Price or an extension of the Contract Time will not be due, even if the Underground Facility was not indicated in the Contract Documents, in the information supplied to Contractor for bidding purposes, in information on file at USA, or otherwise reasonably available to Contractor.)

8.5F Contractor shall bear the risk that Underground Facilities not owned or built by City may differ in nature or locations shown in information made available by City for bidding purposes, in information on file at USA, or otherwise reasonably available to Contractor. Underground Facilities are inherent in construction involving digging of trenches or other excavations, and Contractor is to apply its skill and industry to verify the information available.

9. WARRANTY, GUARANTY, AND INSPECTION OF WORK

9.1 Warranty and Guaranty

9.1A **General Representations and Warranties**: Contractor represents and warrants that it is and will be at all times fully qualified and capable of performing every Phase of the Work and to complete Work in accordance with the terms of Contract Documents. Contractor warrants that all

construction services shall be performed in accordance with generally accepted professional standards of good and sound construction practices and all requirements of Contract Documents. Contractor warrants that Work, including but not limited to each item of materials and equipment incorporated therein, shall be new, of suitable grade of its respective kind for its intended use, and free from defects in design, engineering, materials, construction and workmanship. Contractor warrants that Work shall conform in all respects with all applicable requirements of federal, state and local laws, applicable construction codes and standards, licenses, and permits, Drawings and Specifications and all descriptions set forth therein, and all other requirements of Contract Documents. Contractor shall not be responsible, however, for the negligence of others in the specification of specific equipment, materials, design parameters and means or methods of construction where that is specifically shown and expressly required by Contract Documents.

9.1B **Extended Guaranties**: Any guaranty exceeding one year provided by the supplier or manufacturer of any equipment or materials used in the Project shall be extended for such term. Contractor expressly agrees to act as co-guarantor of such equipment and materials and shall supply City with all warranty and guaranty documents relative to equipment and materials incorporated in the Project and guaranteed by their suppliers or manufacturers.

9.1C **Environmental and Toxics Warranty**: The covenants, warranties and representations contained in this paragraph 9.1C are effective continuously during Contractor's Work on the Project and following cessation of labor for any reason including, but not limited to, Project completion. Contractor covenants, warrants and represents to City that:

1. To Contractor's knowledge after due inquiry, no lead or asbestos-containing materials were installed or discovered in the Project at any time during Contractor's construction thereof. If any lead or asbestos-containing materials were discovered, Contractor made immediate written disclosure to City.

2. To Contractor's knowledge after due inquiry, no electrical transformers, light fixtures with ballasts or other equipment containing PCBs are or were located on the Project at any time during Contractor's construction thereof.

3. To Contractor's knowledge after due inquiry, no storage tanks for gasoline or any other toxic substance are or were located on the Project at any time during Contractor's construction thereof. If any such materials were discovered, Contractor made immediate written disclosure to City.

4. Contractor's operations concerning the Project are and were not in violation of any applicable environmental federal, state, or local statute, law or regulation dealing with hazardous materials substances or toxic

substances and no notice from any governmental body has been served upon Contractor claiming any violation of any such law, ordinance, code or regulation, or requiring or calling attention to the need for any work, repairs, construction, alteration, or installation on or in connection with the Project in order to comply with any such laws, ordinances, codes, or regulations, with which Contractor has not complied. If there are any such notices with which Contractor has complied, Contractor shall provide City with copies thereof.

9.2 Inspection of Work

9.2A All materials, equipment, and workmanship used in Work shall be subject to inspection and testing at all times during construction and/or manufacture in accordance with the terms of the Contract Documents. Work and materials, and manufacture and preparation of materials, from beginning of construction until final completion and acceptance of Work, shall be subject to inspection and rejection by City, its agents, representatives or independent contractors retained by City to perform inspection services, or governmental agencies with jurisdictional interests. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's Site safety procedures and program so that they may comply therewith as applicable. Upon request or where specified, City shall be afforded access for inspection at the source of supply, manufacture or assembly of any item of material or equipment, with reasonable accommodations supplied for making such inspections.

9.2B Contractor shall give City timely notice of readiness of Work for all required inspections, tests or approvals, and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

9.2C If applicable laws or regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests or approvals, and furnish City with the required certificates of inspection, or approval. City will pay the cost of initial testing and Contractor shall pay all costs in connection with any follow-up or additional testing. Contractor shall also be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests or approvals required for the acceptance of materials or equipment to be incorporated in the Work, or of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

9.2D If Contractor covers any Work, or the work of others, prior to any required inspection, test or approval without written approval of City, Contractor shall uncover the Work at City's request. Contractor shall bear the expense of uncovering Work and replacing Work.

9.2E In any case where Contractor covers Work contrary to City's request, Contractor shall uncover Work for City's observation or inspection at City's request. Contractor shall bear the cost of uncovering Work.

9.2F Whenever required by City, Contractor shall furnish tools, labor and materials necessary to make examination of Work that may be completed or in progress, even to extent of uncovering or taking down portions of finished Work. Should Work be found unsatisfactory, cost of making examination and of reconstruction shall be borne by Contractor. If Work is found to be satisfactory, City, in manner herein prescribed for paying for alterations, modifications, and extra Work, except as otherwise herein specified, will pay for examination.

9.2G As necessary, City shall select testing agencies for the Project. A list of required structural tests and inspections prepared by the Engineer shall be provided to the designated testing agency prior to the start of construction.

9.2H The testing agency shall forward the test results to the Engineer, Contractor and City within 14 Days of the date of the test.

9.2I Inspection of the Work by or on behalf of City, or City's failure to do so, shall not under any circumstances be deemed a waiver or approval of any non-conforming aspect of the Work. Contractor shall have an absolute duty, in the absence of a written Change Order signed by City, to perform Work in conformance with the Contract Documents.

9.2J Any inspection, evaluation, or test performed by or on behalf of City relating to the Work is solely for the benefit of City, and shall not be relied upon by Contractor. Contractor shall not be relieved of the obligation to perform Work in accordance with the Contract Documents, nor relieved of any guaranty, warranty, or other obligation, as a result of any inspections, evaluations, or tests performed by City, whether or not such inspections, evaluations, or tests are permitted or required under the Contract Documents. Contractor shall be solely responsible for testing and inspecting Work already performed to determine whether such Work is in proper condition to receive later Work.

9.3 Correction of Defective Work

9.3A If Contractor fails to supply sufficient skilled workers, suitable materials or equipment, or to furnish or perform the Work in such a way that the completed Work will conform to Contract Documents, City may order Contractor to replace any Defective Work, or stop any portion of Work to permit City (at Contractor's expense) to replace such Defective Work. These City rights are entirely discretionary on the part of the City, and shall not give rise to any duty on the part of City to exercise the rights for the benefit of Contractor or any other party.

9.3B City may direct Contractor to correct any Defective Work or remove it from the Site and replace it with Work that is not defective and satisfactorily

correct or remove and replace any damage to other Work or the work of others resulting from the correction or removal. Contractor shall be responsible for any and all claims, costs, losses and damages caused by or resulting from such correction or removal. A Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work and the Contract Sum. If the parties are unable to agree to the amount of an appropriate decrease in the Contract Sum, City may decide the proper amount or, in its discretion may elect to leave the Contract Sum unchanged and deduct from moneys due Contractor, all such claims, costs, losses and damages caused by or resulting from the correction or removal. If Contractor disagrees with City's calculations, it may make a claim as provided in Article 12 of this Document. City's rights under this paragraph 9.3B shall be in addition to any other rights it may have under the Contract Documents or by law.

9.3C **Correction Period**: If within one year after the date of Final Acceptance, or such longer period of time as may be prescribed by laws or regulations, or by the terms of Contract Documents, whether a structure, equipment, machinery, facilities or otherwise, and whether completed or incomplete, is found to be Defective, Contractor shall promptly, without cost to City and in accordance with City's written instructions, correct such Defective Work. Contractor shall remove any Defective Work rejected by City and replace it with Work that is not defective, and satisfactorily correct or remove and replace any damage to other Work or the work of others resulting therefrom. If Contractor fails to promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, City may have the Defective Work corrected or the rejected Work removed and replaced. Contractor shall pay for all claims, costs, losses and damages caused by or resulting from such removal and replacement. Where Contractor fails to correct Defective Work, or defects are discovered outside the correction period, City shall have all rights and remedies granted by law.

9.3D In special circumstances where a part of the Work is occupied or a particular item of equipment is placed in continuous service before Final Acceptance of all the Work, the correction period for that part of Work or that item may start to run from an earlier date if so provided by Change Order or Certificate of Substantial Completion.

9.3E Where Defective Work or rejected Work (and damage to other Work resulting therefrom) has been removed and replaced under this provision after the commencement of the correction period, the correction period hereunder with respect to such Work shall be extended for an additional period of one year after such removal and replacement has been satisfactorily completed.

9.3F If defects requiring correction by Contractor are found in any equipment, machinery, or facilities furnished by Contractor, City shall have the right to operate such defective equipment or facilities and make reasonable use

thereof until the equipment, machinery, or facilities can be shut down for correction of defects without causing injury to City.

9.4 Acceptance and Correction of Defective Work by City

9.4A City may accept Defective Work. Contractor shall pay all claims, costs, losses and damages attributable to City's evaluation of and determination to accept such Defective Work. If City accepts any Defective Work prior to final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work and the Contract Sum. If the parties are unable to agree to the amount of an appropriate decrease in the Contract Sum, City may deduct from moneys due Contractor, all claims, costs, losses, damages, expenses and liabilities attributable to the Defective Work. If Contractor disagrees with City's calculations, Contractor may make a claim as provided in Article 12 of this Document. If City accepts any Defective Work after final payment, Contractor shall pay to City, an appropriate amount as determined by City.

9.4B City may correct and remedy deficiency if, after five Days' written notice to Contractor, Contractor fails to correct Defective Work or to remove and replace rejected Work in accordance with paragraph 9.3B of this Document; or provide a plan for correction of Defective Work acceptable to City; or perform Work in accordance with Contract Documents. In connection with such corrective and remedial action, City may exclude Contractor from all or part of the Site; take possession of all or part of Work and suspend Contractor's Work related thereto; take possession of all or part of Contractor's tools, appliances, construction equipment and machinery at the Site; and incorporate in Work any materials and equipment stored at the Site or for which City has paid Contractor but which are stored elsewhere. Contractor shall allow City, its representatives, agents, employees, and other contractors and City's consultants access to the Site to enable City to exercise the rights and remedies under this paragraph 9.4B. Contractor shall be responsible for all claims, costs, losses, damages, expenses and liabilities incurred or sustained by City in exercising such rights and remedies. A Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to Work and the Contract Sum. If the parties are unable to agree to the amount of an appropriate decrease in the Contract Sum, City may deduct from moneys due Contractor, all claims, costs, losses and damages caused by or resulting from the correction or removal. If Contractor disagrees with City's calculations, Contractor may make a claim as provided in Article 12 of this Document.

9.5 Rights Upon Inspection, Correction or Acceptance

9.5A Contractor shall not be allowed an extension of Contract Time because of any delay in the performance of Work attributable to the exercise by City of its rights and remedies under this Article 9. Where City exercises its rights under this Article 9, it retains all other rights it has by law or under the Contract Documents including, but not limited to, the right to terminate

Contractor's right to proceed with the Work under the Contract Documents for cause and/or make a claim or back charge where a Change Order cannot be agreed upon.

9.5B Inspection by City shall not relieve Contractor of its obligation to have furnished material and workmanship in accordance with Contract Documents. Payment for Work completed through periodic progress payments or otherwise shall not operate to waive City's right to require full compliance with Contract Documents and shall in no way be deemed as acceptance of the Work paid therefor. Contractor's obligation to complete the Work in accordance with Contract Documents shall be absolute, unless City agrees otherwise in writing.

9.5C Neither acceptance of the whole or any part of Work by City nor any verbal statements on behalf of City or its authorized agents or representatives shall operate as a waiver or modification of any provision of the Contract Documents, or of any power reserved to City herein nor any right to damages provided in the Contract Documents. Any waiver of any breach of the Contract Documents shall not be held to be a waiver of any other subsequent breach.

9.6 Samples and Tests of Materials and Work

9.6A Contractor shall furnish, in such quantities and sizes as may be required for proper examination and tests, Samples or test specimens of all materials to be used or offered for use in connection with Work. Contractor shall prepare Samples or test specimens at its expense and furnish them to City. Contractor shall submit all Samples in ample time to enable City to make any necessary tests, examinations, or analyses before the time it is desired to incorporate the material into the Work.

9.7 Proof of Compliance of Contract Provisions

9.7A In order that City may determine whether Contractor has complied or is complying with requirements of Contract Documents not readily enforceable through inspection and tests of Work and materials, Contractor shall at any time, when requested, submit to City properly authenticated documents or other satisfactory proofs of compliance with all applicable requirements.

10. CONTRACTOR'S ORGANIZATION AND EQUIPMENT

10.1 Contractor's Legal Address

10.1A Address and facsimile number given in Contractor's Bid are hereby designated as Contractor's legal address and facsimile number. Contractor may change its legal address and facsimile number by notice in writing, delivered to City, which in conspicuous language advises City of a change in legal address or facsimile number, and which City accepts in writing. Delivery to Contractor's legal address or depositing in any post office or post office box regularly maintained by the United States Postal Service, in a

wrapper with postage affixed, directed to Contractor at legal address, or of any drawings, notice, letter or other communication, shall be deemed legal and sufficient service thereof upon Contractor. Facsimile to Contractor's designated facsimile number of any letter, memorandum, or other communication on standard or legal sized paper, with proof of facsimile transmission, shall be deemed legal and sufficient service thereof upon Contractor.

10.2 Contractor's Superintendents or Forepersons

10.2A Contractor shall at all times be represented on Site by one or more superintendents or forepersons authorized and competent to receive and carry out any instructions that City may give, and shall be liable for faithful observance of instructions delivered to Contractor or to authorized representative or representatives on Site.

10.3 Proficiency in English

10.3A Supervisors, security guards, safety personnel and employees who have unescorted access to the Site shall possess proficiency in the English language in order to understand, receive and carry out oral and written communications or instructions relating to their job functions, including safety and security requirements.

10.4 Contractor's and Subcontractors' Employees

10.4A Contractor shall employ, and shall permit its Subcontractors to employ, only competent and skillful personnel to do Work. If City notifies Contractor that any of its employees, or any of its Subcontractors' employees on Work is incompetent, unfaithful, disorderly or profane, or fails to observe customary standards of conduct or refuses to carry out any provision of the Contract Documents, or uses threatening or abusive language to any person on Work representing City, or violates sanitary rules, or is otherwise unsatisfactory, and if City requests that such person be discharged from Work, then Contractor or its Subcontractor shall immediately discharge such person from Work and the discharged person shall not be re-employed on the Work except with consent of City.

10.5 Contractor to Supply Sufficient Workers And Materials

10.5A Unless otherwise required by City under the terms of Contract Documents, Contractor shall at all times keep on the Site materials and employ qualified workers sufficient to prosecute Work at a rate and in a sequence and manner necessary to complete Work within the Contract Time. This obligation shall remain in full force and effect notwithstanding disputes or claims of any type.

10.5B At any time during progress of Work should Contractor directly or indirectly (through Subcontractors) refuse, neglect, or be unable to supply sufficient materials or employ qualified workers to prosecute the Work as required,

then City may require Contractor to accelerate the Work and/or furnish additional qualified workers or materials as City may consider necessary, at no cost to City. If Contractor does not comply with the notice within three Business Days of date of service thereof, City shall have the right (but not a duty) to provide materials and qualified workers to finish the Work or any affected portion of Work, as City may elect. City may, at its discretion, exclude Contractor from the Site, or portions of the Site or separate Work elements during the time period that City exercises this right. City will deduct from moneys due or which may thereafter become due under the Contract Documents, the sums necessary to meet expenses thereby incurred and paid to persons supplying materials and doing Work. City will deduct from funds or appropriations set aside for purposes of Contract Documents the amount of such payments and charge them to Contractor as if paid to Contractor. Contractor shall remain liable for resulting delay, including liquidated damages and indemnification of City from claims of others.

10.5C Exercise by City of the rights conferred upon City in paragraph 10.5B of this Document is entirely discretionary on the part of City. City shall have no duty or obligation to exercise the rights referred to in paragraph 10.5B of this Document and its failure to exercise such rights shall not be deemed an approval of existing Work progress or a waiver or limitation of City's right to exercise such rights in other concurrent or future similar circumstances. The rights conferred upon City under paragraph 10.5B of this Document are cumulative to City's other rights under any provision of the Contract Documents.

10.6 Contractor's Use of the Site

10.6A Contractor shall not make any arrangements with any person to permit occupancy or use of any land, structure or building within the limits of the Work, for any purpose whatsoever, either with or without compensation, in conflict with any agreement between City and any owner, former owner or tenant of such land, structure or buildings. Contractor may not occupy City-owned property outside the limit of the Work as indicated on the Drawings unless it obtains prior written approval from City.

10.7 Temporary Facilities

10.7A Unless expressly provided otherwise in the Contract Documents, Contractor shall provide all temporary electricity, water, telephone, sanitary facilities, barriers and enclosures, tree and plant protection, and any other necessary services required for construction, testing or completion of the Work and to assure non-interference with City operations, ingress or egress of the public to near the Site and public safety.

11. PROSECUTION AND PROGRESS OF THE WORK

11.1 Schedules and Examinations of Contract Documents

11.1A Contractor shall submit schedules, reports, and Submittals in the appropriate quantity and within the required time, arrange conferences and meetings and proceed with the Work in accordance with Contract Documents, including Sections 01 31 19 (Project Meetings), 01 32 16 (Progress Schedules and Reports), and 01 33 00 (Submittal Procedures).

11.1B Contractor shall submit to City for review and discussion at the Preconstruction Conference described in Section 01 31 19 (Project Meetings):

1. Progress Schedules and Reports as required by Sections 01 32 16 (Progress Schedules and Reports) and 01 33 00 (Submittal Procedures).
2. A preliminary schedule of Submittals that shall list each required Submittal and the times for submitting, reviewing and processing such Submittal. If no such schedule is agreed upon, then all Submittals shall be completed and submitted within 14 Days after the Notice of Award.
3. A preliminary Schedule of Values for all the Work, which shall conform to Section 01 20 00 (Measurement and Payment).

11.1C Unless otherwise provided in the Contract Documents, at least 15 Days before submission of the first Application for Payment, a conference attended by Contractor, City, and others as appropriate, will be held to review for acceptability the schedules submitted in accordance with paragraph 11.1B of this Document and first reviewed at the Preconstruction Conference. Contractor shall have an additional seven Days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be due or owing to Contractor until the schedules are submitted to and acceptable to City and/or Project Manager as meeting the requirements of the Contract Documents. City's acceptance of Contractor's schedules will not create any duty of care or impose on City any responsibility for the sequencing, scheduling or progress of Work nor will it interfere with or relieve Contractor from Contractor's full responsibility.

11.2 Cost Data

11.2A Contractor shall maintain full and correct information as to the number of workers employed in connection with each subdivision of Work, the classification and rate of pay of each worker in form of certified payrolls, the cost to Contractor of each class of materials, tools and appliances used by Contractor in Work, and the amount of each class of materials used in each subdivision of Work.

11.2B City shall have the right to audit and copy Contractor's books and records of any type, nature or description relating to the Project (including but not limited to financial records reflecting in any way costs claimed on the Project), and to inspect the Site, including Contractor's trailer, or other job Site office, and this requirement shall be contained in the subcontracts of Subcontractors working on Site. By way of example, City shall have the right to inspect and obtain copies of all Contract Documents, planning and design documents, Bid proposal and negotiation documents, cost records and job cost variance reports, design modification proposals, value engineering or other cost reduction proposals, revisions made to the original design, job progress reports, photographs, and as-built drawings maintained by Contractor. City and any other applicable governmental entity shall have the right to inspect all information and documents maintained under this paragraph 11.2B at any time during the Project and for a period of five years following Final Completion. This right of inspection shall not relieve Contractor of its duties and obligations under the Contract Documents. This right of inspection shall be specifically enforceable in a court of law, either independently or in conjunction with enforcement of any other rights in the Contract Documents.

11.2C Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Contract Modifications, Change Orders, Work Directives, Force Account orders, and written interpretations and clarifications in good order and annotated to show all changes made during construction. These Project Record Documents, together with all approved Samples and a counterpart of all approved Shop Drawings, shall be maintained and available to City for reference. Upon completion of the Work, Contractor shall deliver to City, the Project Record Documents, Samples and Shop Drawings and as-built drawings.

12. CLAIMS BY CONTRACTOR

12.1 Obligation to File Claims for Disputed Work

12.1.A Should it appear to Contractor that the Work to be performed or any of the matters relative to the Contract Documents are not satisfactorily detailed or explained therein, or should any clarification, determination, action or inaction by City or Engineer, or any other event, in the opinion of Contractor, exceed the requirements of or not comply with Contract Documents in any way, or should any questions arise as to the meaning or intent of the Contract Documents, or should any dispute arise regarding the true value of any Work performed, Work omitted, extra Work that Contractor may be required to perform, time extensions, payment to Contractor during performance of this Contract, performance of the Contract, and/or compliance with Contract procedures, or should Contractor otherwise seek extra time or compensation FOR ANY REASON WHATSOEVER, then Contractor shall first follow procedures set forth in the Contract (including, without limitation, other Articles of this Document and Section 01 26 00.)

12.1.B If a dispute remains, then Contractor shall give written notice to City that expressly invokes this Article 12. City shall decide the issue in writing within 15 Days; and City's written decision shall be final and conclusive.

12.1.C If Contractor disagrees with City's decision, or if Contractor contends that City failed to provide a decision timely, then Contractor's SOLE AND EXCLUSIVE REMEDY is to promptly file a written claim setting forth Contractor's position as required herein.

12.2 Form and Contents of Claim

12.2.A Contractor's written claim must identify itself as a "claim" under this Article 12 and must include the following: (1) a narrative of pertinent events; (2) citation to contract provisions; (3) theory of entitlement; (4) complete pricing of all cost impacts; (5) a critical path analysis (or a Time Impact Evaluation if so specified in Section 01 32 00) of all time delays that shows actual time impact on the critical path; (6) documentation supporting items 1 through 5; and (6) a verification under penalty of perjury of the claim's accuracy. The Claim shall be submitted to City within thirty (30) calendar Days of receiving City's written decision, or the date Contractor contends such decision was due, and shall be priced like a change order according to Section 01 26 00 herein, and must be updated monthly as to cost and entitlement if a continuing claim. Routine contract materials, for example, correspondence, RFI, Change Order requests, or payment requests shall not constitute a claim. Contractor shall bear all costs incurred in the preparation and submission of a claim.

12.3 Administration During/After Claim Submission

12.3.A City may in its discretion conduct an administrative hearing on Contractor's claim, in which case Contractor shall appear, participate, answer questions and inquiries, and present any further evidence or analysis requested by City to evaluate and decide Contractor's claim. Notwithstanding and pending the resolution of any claim or dispute, Contractor shall diligently prosecute the disputed Work to final completion in accordance with City's determination.

12.3.B Upon receipt of Contractor's formal claim including all arguments, justifications, cost or estimates, schedule analysis, and documentation supporting its position as required herein, City or its designee will review the issue and render a final determination.

12.3.C Claims shall be calculated in the same manner as Change Orders per Section 01 26 00 (Contract Modification Procedures). Except where provided by law, or elsewhere in these contract documents (if applicable), city shall not be liable for special or consequential damages, and contractor shall not include them in its claims. Contractor shall be limited in its recovery on claims to the change order calculations set forth in Section 01 26 00.

12.3.D After their submission, claims less than $375,000 shall also be subject to the Local Agency Disputes Act.

12.4 Compliance

12.4.A The provisions of this Article 12 constitute a non-judicial claim settlement procedure, and also step one of a two step claim presentment procedure by agreement under Section 930.2 of the Government Code, and shall survive termination, breach or completion of the Contract Documents. Contractor shall bear all costs incurred in the preparation and submission of a claim. Pursuant to Government Code Section 930.2, the one-year period in Government Code section 911.2 to file a Government Code Section 910 claim (step two) shall be reduced to 150 Days. Any Section 910 claims shall be presented in accordance with the Government Code and shall affirmatively indicate Contractor's prior compliance with the claims procedure herein and previous dispositions under paragraph 12.B.3 above.

12.4.B Failure to submit and administer claims as required in Article 12 shall waive Contractor's right to claim on any specific issues not included in a timely submitted claim. Claim(s) or issue(s) not raised in a timely protest and timely claim submitted under this Article 12 may not be asserted in any subsequent litigation, Government Code Section 910 claim, or legal action. City shall not be deemed to waive any provision under this Article 12, if at City's sole discretion, a claim is administered in a manner not in accord with this Article 12.

13. LEGAL AND MISCELLANEOUS

13.1 Laws And Regulations

13.1A Contractor shall keep fully informed of and shall comply with all laws, ordinances, municipal code, regulations and orders of any properly constituted authority affecting the Contract Documents, Work and persons connected with Work, and shall protect and indemnify City and its officers, employees, consultants and agents against any claim or liability, including attorney's fees, arising from or based on violation of law, ordinance, municipal code, regulation, or order, whether by Contractor or by Subcontractors, employees or agents. Authorized persons may at any time enter upon any part of Work to ascertain compliance of all applicable laws, ordinances, municipal code, regulations and orders.

13.1B Whenever Drawings and Specifications require larger sizes or higher standards than are required by any applicable law, ordinance, regulation or order, Drawings and Specifications shall govern. Whenever Drawings and Specifications require something that will violate such laws, ordinances, regulations or orders, then such laws, ordinances, regulations or orders shall govern.

13.2 Permits and Taxes

13.2A Contractor shall procure all permits and licenses applicable to the Work (including environmental matters to the extent applicable); pay all charges and fees, including fees for street opening permits; comply with, implement and acknowledge effectiveness of all permits; initiate and cooperate in securing all required notifications or approvals therefore; and give all notices necessary and incident to due and lawful prosecution of Work, unless otherwise provided herein. City will pay applicable building permits, sanitation and water fees for the completed construction, except as otherwise provided in the Contract Documents. Contractor shall pay all sales and/or use taxes levied on materials, supplies, or equipment purchased and used on or incorporated into Work, and all other taxes properly assessed against equipment or other property used in connection with Work, without any increase in the Contract Sum. Contractor shall make necessary arrangements with proper authorities having jurisdiction over roads, streets, pipelines, navigable waterways, railroads, and other works in advance of operations, even where City may have already obtained permits for the Work.

13.3 Responsibility of Contractor and Indemnification

13.3A City and each of its officers, employees, consultants and agents including, but not limited to, the Board, City Engineer and each City Representative, shall not be liable or accountable in any manner for loss or damage that may happen to any part of the Work; loss or damage to materials or other things used or employed in performing the Work; injury, sickness, disease, or death of any person; or damage to property resulting from any cause whatsoever except their sole negligence, willful misconduct or active negligence, attributable to performance or character of the Work, and Contractor releases all of the foregoing persons and entities from any and all such claims.

13.3B To the furthest extent permitted by law (including without limitation California Civil Code Section 2782), Contractor shall assume defense of, and indemnify and hold harmless, City and each of its officers, employees, consultants and agents, including but not limited to the Board, Engineer and each City representative, from claims, suits, actions, losses and liability of every kind, nature and description, including but not limited to claims and fines of regulatory agencies and attorney’s fees and consultant’s fees, directly or indirectly arising out of, connected with or resulting from performance of the Work, failure to perform the Work, or condition of the Work which is caused in whole or part by any act or omission of Contractor, Subcontractors, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether it is caused in part by the negligence of City or by any person or entity required to be indemnified hereunder.

13.3C With respect to third-party claims against Contractor, Contractor waives any and all rights to any type of express or implied indemnity against City and

each of its officers, employees, consultants and agents including, but not limited to City, the Board, Engineer and each City representative.

13.3D Approval or purchase of any insurance contracts or policies shall in no way relieve from liability nor limit the liability of Contractor, its Subcontractors of any tier, or the officers or agents of any of them.

13.3E To the furthest extent permitted by law (including, without limitation, Civil Code Section 2782), the indemnities, releases of liability and limitations of liability, claims procedures, and limitations of remedy expressed throughout Contract Documents shall apply even in the event of breach of contract, negligence (active or passive), fault or strict liability of the party(ies) indemnified, released, or limited in liability, and shall survive the termination, rescission, breach, abandonment, or completion of the Work or the terms of the Contract Documents. If Contractor fails to perform any of these defense or indemnity obligations, City may in its discretion back charge Contractor for City's costs and damages resulting therefrom and withhold such sums from progress payments or other contract moneys which may become due.

13.F The indemnities in the Contract Documents shall not apply to any indemnified party to the extent of its sole negligence or willful misconduct; nor shall they apply to City or other indemnified party to the extent of its active negligence.

13.4 Concealed or Unknown Conditions

13.4A If either of the following conditions is encountered at Site when digging trenches or other excavations that extend deeper than four feet below the surface, Contractor shall give a written Notice of Differing Site Conditions to City promptly before conditions are disturbed, except in an emergency as required by paragraph 16.4A of this Document, and in no event later than seven Days after first observance of:

1. Subsurface or Latent physical conditions which differ materially from those indicated in the Contract Documents; or

2. Unknown physical conditions of an unusual nature or which differ materially from those ordinarily encountered and generally recognized as inherent in Work of the character provided for in the Contract Documents.

13.4B In response to Contractor's Notice of Differing Site Conditions under this paragraph 13.4B, City will investigate the identified conditions, and if they differ materially and cause increase or decrease in Contractor's cost of, or time required for, performance of any part of the Work, City will negotiate an appropriate change order following the procedures set forth in the Contract Documents. If City determines that physical conditions at the Site are not Latent or are not materially different from those indicated in Contract Documents or that no change in terms of the Contract Documents is

justified, City will so notify Contractor in writing, stating reasons (with Contractor retaining its rights under Article 12 of this Document.)

13.4C Contractor shall not be entitled to any adjustment in the Contract Sum or Contract Time regarding claimed Latent or materially different Site conditions (whether above or below grade) if Contractor knew or should have known of the existence of such conditions at the time Contractor submitted its Bid, failed to give proper notice, or relied upon information, conclusions, opinions or deductions of the kind that the Contract Documents preclude reliance upon.

13.5 Notice of Hazardous Waste or Materials Conditions

13.5A Contractor shall give a written Notice of Hazardous Materials Condition to City promptly, before any of the following conditions are disturbed (except in an emergency as required by paragraph 16.4 of this Document), and in no event later than 24 hours after first observance of any:

1. Material that Contractor believes may be hazardous waste or hazardous material, as defined in Section 25117 of the Health and Safety Code (including, without limitation, asbestos, lead, PCBs, petroleum and related hydrocarbons, and radioactive material) that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with provisions of existing law (“hazardous material”); or

2. Other material that may present an imminent substantial danger to persons or property exposed thereto in connection with Work at the Site (“other materials”).

13.5B Except as otherwise provided in the Contract Documents or as provided by applicable law, Contractor shall not be required to give any notice for the disturbance or observation of any such hazardous materials or other materials where such matter is disturbed or observed as part of the scope of Work under the Contract Documents (such as hazardous waste or hazardous material investigation, remediation or disposal activities which are identified as the subject of Work under the Contract Documents), where Contractor complies with all requirements in the Contract Documents and applicable law respecting such materials.

13.5C Contractor’s Notice of Hazardous Materials Condition shall indicate whether the hazardous materials or other materials were shown or indicated in the Contract Documents to be within the scope of Work, and whether the hazardous materials or other materials were brought to the Site by Contractor, its Subcontractors, suppliers, or anyone else for whom Contractor is responsible.

13.5D Contractor shall not be entitled to any adjustment in the Contract Sum or Contract Time regarding claimed hazardous waste or materials if:

1. Contractor knew of the existence of such hazardous materials or other materials at the time Contractor submitted its Bid; or
2. Contractor should have known of the existence of such hazardous material or other materials as a result of its having the responsibility to obtain additional or supplementary examinations, investigation, explorations, tests, studies, and data concerning the conditions at or contiguous to the Site prior to submitting its Bid; or
3. Contractor failed to give the written notice within the time required by paragraph 13.5A of this Document.

13.5E If City determines that conditions involve hazardous materials or other materials and that a change in Contract Document terms is justified, City will issue either a Request for Proposal or Construction Change Directive under the procedures described in the Contract Documents. If City determines that conditions do not involve hazardous materials or other materials or that no change in Contract Document terms is justified, City will notify Contractor in writing, stating the reasons for its determination.

13.5F In addition to the parties' other rights under paragraph 13.5E of this Document, if Contractor does not agree to resume Work based on a reasonable belief that it is unsafe, or does not agree to resume Work under special conditions, City may order the disputed portion of Work deleted from the Work, or performed by others, or City may invoke its right to terminate Contractor's right to proceed under the Contract Documents in whole or in part, for convenience or for cause as the facts may warrant.

13.5G If Contractor does not agree with any City determination of any adjustment in the Contract Sum or Contract Time under this paragraph 13.5, Contractor may make a claim as provided in Article 12 of this Document.

13.6 Suspension of Work

13.6A City may, without cause, order Contractor in writing to suspend, delay or interrupt Work in whole or in part for such period of time as City may determine. An adjustment shall be made for increases in cost of performance of Work of the Contract Documents caused by any such suspension, delay or interruption, calculated using the measures set forth in Section 01 26 00 (Contract Modification Procedures). No adjustment shall be made to extent that performance is, was or would have been so suspended, delayed or interrupted by another cause for which Contractor is responsible.

13.7 Termination of Contract for Cause

13.7A City may declare Contractor in default of the Contract Documents and City may terminate Contractor's right to proceed under the Contract Documents for cause, in whole or in part, should Contractor commit a material breach of the Contract Documents and not cure such breach within ten (10) calendar Days of the date of notice from City to Contractor demanding such cure; or,

if such breach is curable but not curable within such ten (10) Day period, within such period of time as is reasonably necessary to accomplish such cure. (In order for Contractor to avail itself of a time period in excess of 10 calendar Days, Contractor must provide City within the ten (10) Day period with a written plan acceptable to City that demonstrates actual resources, personnel and a schedule to promptly to cure said breach, and then diligently commence and continue such cure according to the written plan.)

13.7B In the event of termination by City as provided above for cause, Contractor shall deliver to City possession of the Work in its then condition, including but not limited to, all designs, engineering, Project records, cost data of all types, Drawings and Specifications and contracts with vendors and subcontractors, all other documentation associated with the Project, and all construction supplies and aids dedicated solely to performing the Work which, in the normal course of construction, would be consumed or only have salvage value at the end of the construction period. Contractor shall remain fully liable for the failure of any Work completed and materials and equipment provided through the date of such termination to comply with the provisions of the Contract Documents. The provisions of this Section shall not be interpreted to diminish any right which City may have to claim and recover damages for any breach of the Contract Documents or otherwise, but rather, Contractor shall compensate City for all loss, cost, damage, expense, and/or liability suffered by City as a result of such termination and/or failure to comply with the Contract Documents.

13.7C In the event a termination for cause is later determined to have been made wrongfully or without cause, then the termination shall be treated as a termination for convenience, and Contractor shall have the recovery rights specified in paragraph 13.8. Any Contractor claim arising out of a termination for cause, however, shall be made in accordance with Article 12 of this Document. No other loss, cost, damage, expense or liability may be claimed, requested or recovered by Contractor.

13.8 Termination of Contract for Convenience

13.8A City may terminate performance of the Work under the Contract Documents in accordance with this clause in whole, or from time to time in part, whenever City shall determine that termination is in City's best interest. Termination shall be effected by City delivering to Contractor notice of termination specifying the extent to which performance of the Work under the Contract Documents is terminated, and the effective date of the termination.

13.8B Contractor shall comply strictly with City's direction regarding the effective date of the termination, the extent of the termination, and shall stop Work on the date and to the extent specified.

13.8C Contractor shall be entitled to a total payment on account of the Contract Work so terminated measured by (i.) the actual cost to Contractor of Work actually performed, up to the date of the termination, with profit and

overhead limited to twelve percent (12%) of actual cost of Work performed, up to but not exceeding the actual contract value of the Work completed as measured by the Schedule of Values and Progress Schedule, (ii.) offset by payments made and other contract credits. In connection with any such calculation, however, City shall retain all rights under the Contract Documents, including but not limited to claims, indemnities, or setoffs.

13.8D Under no circumstances may Contractor recover legal costs of any nature, nor may Contract recover costs incurred after the date of the termination.

13.9 Contingent Assignment of Subcontracts

13.9A Contractor hereby assigns to City each Subcontract for a portion of the Work, provided that:

1. The assignment is effective only after City's termination of Contractor's right to proceed under the Contract Documents (or portion thereof relating to that Subcontract) pursuant to paragraphs 13.7 or 13.8 of this Document.
2. The assignment is effective only for the Subcontracts which City expressly accepts by notifying the Subcontractor in writing;
3. The assignment is subject to the prior rights, if any, of the Surety, obligated by Document 00 61 13.13 (Construction Performance Bond) provided under the Contract Documents, where the Surety exercises its rights to complete the Contract;
4. After the effectiveness of an assignment, Contractor shall, at its sole cost and expense (except as otherwise provided in this Document), sign all instruments and take all actions reasonably requested by City to evidence and confirm the effectiveness of the assignment in City; and
5. Nothing in this paragraph 13.9 shall modify or limit any of Contractor's obligations to City arising from acts or omissions occurring before the effectiveness of any Subcontract assignment, including but not limited to all defense, indemnity and hold-harmless obligations arising from or related to the assigned Subcontract.

13.10 Remedies and Contract Integration

13.10A Subject to Contract Documents provisions regarding Contractor claims, claim review, and claim resolution, and subject to the limitations therein, the exclusive jurisdiction and venue for resolving all claims, counter-claims, disputes and other matters in question between City and Contractor arising out of or relating to Contract Documents, any breach thereof or the Project shall be the applicable court of competent jurisdiction located in the State of California for the City of San Bruno. All City remedies provided in the Contract Documents shall be taken and construed as cumulative and not exclusive; that is, in addition to each and every other remedy herein

provided; and in all instances City shall have any and all other equitable and legal rights and remedies which it would have according to law.

13.10B The Contract Documents, any Contract Modifications, and Change Orders shall represent the entire and integrated agreement between City and Contractor regarding the subject matters hereof and thereof and shall constitute the exclusive statement of the terms of the parties' agreement. The Contract Documents, and any Contract Modifications and Change Orders, shall supersede any and all prior negotiations, representations or agreements, written or oral, express or implied, that relate in any way to the subject matter of the Contract Documents or written modifications. City and Contractor represent and agree that, except as otherwise expressly provided in the Contract Documents, they are entering into the Contract Documents and any subsequent written modification in sole reliance upon the information set forth or referenced in the Contract Documents or Contract Modifications and the parties are not and will not rely on any other information.

13.10C In any proceeding to enforce the Contract Documents, Contractor and City agree that the finder of fact shall receive detailed instructions on the meaning and operation of the Contract Documents, including their conditions, limitations of liability and remedies clauses, claims procedures and any other provisions impacting major defenses and theories of liability of the parties. Detailed findings of fact shall be requested, to verify Contract enforcement.

13.10D Either party's waiver of any breach or failure to enforce any of the terms, covenants, conditions or other provisions of the Contract Documents at any time shall not in any way affect, limit, modify or waive that party's right thereafter to enforce or compel strict compliance with every term, covenant, condition or other provision hereof, any course of dealing or custom of the trade or oral representations notwithstanding.

13.11 Patents

13.11A Fees or claims for any patented invention, article or arrangement that may be used upon or in any manner connected with performance of the Work or any part thereof shall be included in the Bid price for doing the Work. Contractor shall defend, indemnify and hold harmless City and each of its officers, employees, consultants and agents, including, but not limited to, the Board, Engineer and each City representative, from all damages, claims for damages, costs or expenses in law or equity, including attorney's fees, arising from or relating to any claim that any article supplied or to be supplied under the Contract Documents infringes on the patent rights, copyright, royalties, trade name, trademark, service mark, trade secret or other intellectual property right of any person or persons or that the person or entity supplying the article does not have a lawful right to sell the same. Such costs or expenses for which Contractor agrees to indemnify and hold harmless the above indemnities include but are not limited to any and all

license fees, whether such fees are agreed by any indemnitee or ordered by a court or administrative body of any competent jurisdiction.

13.12 Substitution for Patented and Specified Articles

13.12A Except as noted specifically in Document 00 21 00 (Instructions to Bidders), whenever in Specifications, material or process is designated by patent or proprietary name or by name of manufacturer, such designation shall be deemed to be used for purpose of facilitating description of material and process desired, and shall be deemed to be followed by the words “or approved equal” and Contractor may offer any substitute material or process that Contractor considers equal in every respect to that so designated and if material or process offered by Contractor is, in opinion of City, equal in every respect to that so designated, its use will be approved. However, Contractor may utilize this right only by timely submitting Document 00 43 25 (Substitution Request Form) as provided in Document 00 21 00. A substitution will be approved only if it is a true “equal” item in every aspect of its design and quality, including but not limited to its dimensions, weights, service requirements, durability, functioning, impact on contiguous construction elements, overall schedule and design.

13.13 Interest of Public Officers

13.13A No representative, officer, or employee of City no member of the governing body of the locality in which the Project is situated, no member of the locality in which City was activated, and no other public official of such locality or localities who exercises any functions or responsibilities with respect to the Project, during the tenure of the official or for one year thereafter, shall, as principal, agent, attorney or otherwise, be directly or indirectly interested, in the Contract Documents or the proceeds thereof.

13.14 Limit of Liability

13.14a City, and each of its officers, board members, employees, consultants and agents including, but not limited to, city engineer and each other city representative, shall have no liability to contractor for special, consequential, or incidental damages, except to the limited extent that these contract documents or applicable public contracting statutes may specify their recovery.

14. MODIFICATIONS OF CONTRACT DOCUMENTS

14.1 Alterations, Modifications and Force Account Work

14.1A No modification or deviation from the Drawings and Specifications will be permitted except by written addenda, written Change Order or written Supplemental Instruction. As appropriate, Change Orders are subject to approval by City.

14.1B City, before the date of completion of Work, may order changes in Work herein required, and may order extra materials and extra Work in connection

with performance of Contract, and Contractor shall promptly comply with such orders. Any such orders shall be diligently carried out by Contractor in accordance with the Contract Documents. If changes ordered in design, workmanship or materials are of such a nature as to increase or decrease the time or cost of any part of Work, price fixed in Contract shall be increased or decreased by amount as Contractor and City may agree upon as reasonable and proper allowance for increase or decrease in cost of Work, and absent such agreement, then as City may direct (with Contractor retaining its rights under Article 12 herein).

14.1C City may, without notice to the sureties, make alterations, deviations, additions to, or deletions from Contract Documents; increase or decrease the quantity of any item or portion of the Work; expand, contract or otherwise change the Contract Time; delete any item or portion of the Work; and require extra Work. Contractor shall perform such Work under applicable provisions of the Contract Documents, unless specifically provided otherwise at the time the change is ordered. In the case of any ordered extra Work, City reserves the right to furnish all or portions of associated labor, material, and equipment, which Contractor shall accept and use without payment for costs, markup, profit, or otherwise for such City-furnished labor, materials, and equipment.

14.1D Changes affecting the Contract Time or Contract Sum of the Work shall be set forth in a written Change Order that shall specify:

1. The Work performed in connection with the change to be made;
2. The amount of the adjustment of the Contract Sum, if any, and the basis for compensation for the Work ordered; and
3. The extent of the adjustment in the Contract Time, if any.

14.1E A Change Order will become effective when signed by City, notwithstanding that Contractor has not signed it.

14.1F Procedures for Modifications of Contract Documents and for calculating the cost of extra Work are given in Section 01 26 00 (Contract Modification Procedures). Regarding delay and impact costs of any nature, Contractor may not seek delay compensation for on-Site or off-Site costs based on formulas, e.g., “Eichlay” or other formula. Rather, Contractor shall prove actual costs resulting from such delays.

14.1G A performance bond rider covering the changed Work must be executed and delivered to City before proceeding with the changed Work.

15. TIME ALLOWANCES

15.1 Entitlement to Change of Contract Time

15.1A The Contract Time may only be changed by Change Order or by Contract Modification, and all time limits stated in the Contract Documents are of the essence of Contract Documents.

15.1B The Contract Time may be adjusted in an amount equal to the time lost due to:

1. Changes in the Work ordered by City;
2. Acts or neglect by City, Engineer, any City representative, utility owners or other contractors performing other work, provided that Contractor has fully and completely performed its responsibilities under the Contract Documents; or
3. Fires, floods, epidemics, abnormal weather conditions beyond the parameters otherwise set forth in this paragraph 15.1, earthquakes, civil or labor disturbances, strikes or acts of God, provided damages resulting therefrom are not the result of Contractor's failure to protect the Work as required by Contract Documents.

15.1C The Contract Time shall not be extended for any cause identified in paragraph 15.1B above, however, unless:

1. Contractor actually has been prevented from completing any part of the Work within the Contract Time due to delay that is beyond Contractor's control and due to reasons for which Contractor is not responsible (delays attributable to and within the control of a Subcontractor, or its subcontractors, or supplier shall be deemed to be delays within the control of Contractor);
2. A claim for delay is made as provided herein; and
3. Contractor submits a critical path analysis (or a Time Impact Evaluation if so specified in Section 01 32 00 that demonstrates actual delay to critical Work activities that actually delay the progress of the Work in the amount of time requested.

15.2 Weather Related Delays

15.2A Delays due to abnormal or adverse weather conditions will not be allowed for weather conditions that fall within the parameters listed or referenced in this paragraph. Adverse weather delays may be allowed only if the number of workdays of adverse weather exceeds these parameters on a monthly basis and Contractor proves that adverse weather actually caused delays. Contractor shall give written notice of intent to claim an adverse weather day within one Day of the adverse weather day occurring. Rain parameters are as follows, pro-rated in the individual month Contractor starts and finishes Work:

January, [8]; February, [7]; March, [6]; April, [3]; May, [1]; June, [0]; July, [0]; August, [0]; September, [0]; October, [2]; November, [4]; and December, [7].

In order to qualify as an adverse weather delay with respect to the foregoing parameters, daily rainfall must exceed .1 of an inch or more at the San Francisco California WSO (San Francisco Airport), California station, as measured by the National Oceanic & Atmospheric Administration, and

Contractor shall prove that the rain actually caused delay as set forth in paragraph 15.3 of this Document. Notwithstanding the foregoing allowances, Contractor shall at all times employ all available mitigation measures to enable Work to continue. Delays due to abnormal or adverse weather conditions will not be allowed for weather conditions that fall within the parameters listed in this paragraph 15.2A.

15.2B Contractor shall include the foregoing precipitation parameters as a monthly activity in its progress schedule. As Work on the critical path is affected by precipitation, Contractor shall notify City and request that the days be moved to the affected activities. Any adverse weather days remaining shall be considered Project float.

15.2C Adverse weather delay for precipitation shall be recognized for the actual period of time Contractor proves it was delayed by precipitation exceeding the specified parameters. For example, and not by way of limitation, if precipitation exceeding the specified parameters does not in fact delay Contractor's progress on the critical path, then no time extension shall be recognized; and conversely, if Contractor proves to City's satisfaction that precipitation exceeding the specified parameters causes delay to Contractor for a period longer than the number of precipitation Days incurred (e.g., if it rains or snows during grading work), then Contractor shall be entitled to a time extension equal to the actual period of such delay.

15.2D Contractor shall take reasonable steps to mitigate potential weather delays, such as dewatering the Site, and covering Work and material that could be affected adversely by weather. Failure to do so shall be cause for City to not grant a time extension due to adverse weather, where Contractor could have avoided or mitigated the potential delay by exercising reasonable care.

15.3 Notice of Delay

15.3A Within seven Days of the beginning of any delay, Contractor shall notify City in writing, by submitting a notice of potential claim, of all anticipated delays resulting from the delay event in question. Any request for extension of time shall be accompanied by Contractor's written statement that the adjustment claimed is the entire adjustment to which the claimant is entitled as a result of the occurrence of the delay event, and shall include a written schedule document that demonstrates delay to the critical path using a critical path analysis (or a Time Impact Evaluation if so specified in Section 01 32 00). City will determine all claims and adjustments in the Contract Time. No claim for an adjustment in the Contract Time will be valid and such claim will be waived if not submitted in accordance with the requirements of this paragraph.

15.4 Time Extensions and/or Damages Entitlements for Delays

15.4A Contractor may receive a time extension and be compensated for delays caused directly and solely by City.

15.4.B Contractor may receive a time extension without compensation for delays resulting in whole or in part from causes beyond the reasonable control of Contractor and City including, without limitation, adverse weather conditions exceeding Contract Documents parameters, earthquakes, Acts of God and epidemics, and acts of public utilities. In such cases, a time extension without compensation shall constitute Contractor's sole and exclusive remedy for such delays.

15.4.C Contractor shall not be entitled to any time extension or compensation including, but not limited to, extended field or home office overhead, field supervision, costs of capital, interest, escalation charges, acceleration costs or other impacts for any delays caused in whole or in part by Contractor's failure to perform its obligations under the Contract Documents, or during periods of delay concurrently caused by Contractor and either City or others.

15.4.D Contractor shall not be entitled to damages for delay to the Work caused by the following reasons:

1. City's right to sequence the Work in a manner which would avoid disruption to City's tenants and their contractors or other prime contractors and their respective subcontractors, exercised as a result of Contractor's failure to perform its cooperation and coordination responsibilities required by Contract Documents; City's enforcement of any government act or regulation; or the provisions of the Contract Documents;
2. For changed Site conditions that are beyond the parties' contemplation, except that City may approve direct costs associated with unknown conditions (but not costs or damages which result from such delays); and
3. Extensive requests for clarifications to Contract Documents or Contract Modifications thereto, provided such clarifications or Contract Modifications are processed by City or its consultants in a reasonable time commensurate with Contract Documents requirements.

15.5 Liquidated Damages

15.5A Time is of the essence. Execution of Contract Documents by Contractor shall constitute acknowledgement by Contractor that Contractor understands, has ascertained and agrees that City will actually sustain damages in the amount fixed in the Contract Documents for each and every Day during which completion of Work required is delayed beyond expiration of time fixed for completion or extensions of time allowed pursuant to provisions hereof. Contractor and City agree that specified measures of liquidated damages shall be presumed to be the damages actually sustained by City as defined in Document 00 52 00 (Contract Agreement), and that because of the nature of the Project, it would be impracticable or extremely difficult to fix the actual damages.

15.5B City may deduct from any money due or to become due to Contractor subsequent to time for completion of entire Work and extensions of time allowed pursuant to provisions hereof, a sum representing then-accrued liquidated damages. Should Contractor fall behind the approved Progress Schedule, City may deduct liquidated damages based on its estimated period of late completion. City need not wait until Final Completion to withhold liquidated damages from Contractor's progress payments. Should money due or to become due to Contractor be insufficient to cover aggregate liquidated damages due, then Contractor forthwith shall pay the remainder of the assessed liquidated damages to City.

16. WORKING CONDITIONS AND PREVAILING WAGES

16.1 Use of Site/Sanitary Rules

16.1A All portions of the Work shall be maintained at all times in neat, clean and sanitary condition. Contractor shall furnish toilets for use of Contractor's and Subcontractors' employees on the Site where needed, and their use shall be strictly enforced. All toilets shall be properly secluded from public observation, and shall be located, constructed and maintained subject to City's approval.

16.1B Contractor shall confine construction equipment, the storage of materials and equipment and the operations of workers to the Site and land areas identified in and permitted by Contract Documents and other land and areas permitted by applicable laws and regulations, rights of way, permits and easements or as designated by City, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, any improvement located thereon, or to the owner or occupant thereof resulting from the performance of Work.

16.1C During the progress of the Work, Contractor shall keep the Site and the Project free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work, Contractor shall clean the site, remove all waste materials, rubbish and debris from and about the Site as well as all tools, appliances, construction equipment and machinery, surplus materials and SWPPP components. Contractor shall leave the premises clean and ready for occupancy by City at Substantial Completion of Work. Contractor shall restore to original condition all property not designated for alteration by Contract Documents.

16.1D Contractor shall not load nor permit any part of any structure or pavement to be loaded in any manner that will endanger the structure or pavement, nor shall Contractor subject any part of Work or adjacent property to stresses or pressures that will endanger it. Contractor shall conduct all necessary existing conditions investigation regarding structural, mechanical, electrical or any other system existing, shall perform Work consistent with such existing conditions, and shall have full responsibility for insufficiencies or

damage resulting from insufficiencies of existing systems, equipment or structures to accommodate performing the Work.

16.2 Protection of Work, Persons, Property and Operations

16.2A Contractor shall be responsible for initiating, maintaining and supervising all safety and site security precautions and programs in connection with Work, and shall develop and implement a site security and safety plan throughout construction. Contractor shall comply with all safety requirements specified in any safety program established by City, or required by state, federal or local laws and ordinances. Contractor shall be responsible for all theft or damage to Work, property or structures, all injuries to persons, and all damage and interruptions to City's operations, arising from the performance of Work of the Contract Documents. Except as otherwise expressly approved by City in writing, Contractor shall at all times perform all Work in a manner which does not interrupt, damage or otherwise adversely impact any facilities, operations, or real or personal property of City, its officers, employees, agents, invitees, licensees, lessees or contractors.

16.2B Contractor shall comply with all applicable laws and regulations of any public body having jurisdiction for safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property.

16.2C Contractor shall remedy all damage, injury, loss or interruption to any property or operations referred to in paragraph 16.2A of this Document, caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, supplier, or any other person or organization directly or indirectly employed by any of them to perform or furnish any Work or anyone for whose acts any of them may be liable. Contractor's duties and responsibility for safety and for protection of Work shall continue until such time as all the Work is completed and Final Acceptance of the Work. City and its agents do not assume any responsibility for collecting any indemnity from any person or persons causing damage to Contractor's Work.

16.2D Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

16.2E City may, at its option, retain such moneys due under the Contract Documents as City deems necessary until any and all suits or claims against Contractor for injury to persons, property or operations shall be settled and City receives satisfactory evidence to that effect.

16.3 Responsibility for Safety and Health

16.3A Contractor shall ensure that its and each tier of Subcontractors' employees, agents and invitees comply with applicable health and safety laws while at the Site. These laws include the Occupational Safety and Health Act of 1970 and rules and regulations issued pursuant thereto, and City's safety regulations as amended from time to time. Contractor shall comply with all City directions regarding protective clothing and gear.

16.3B Contractor shall be fully responsible for the safety of its and its Subcontractors' employees, agents and invitees on the Site. Contractor shall notify City, in writing, of the existence of hazardous conditions, property or equipment at the Site that are not under Contractor's control. Contractor shall be responsible for taking all the necessary precautions against injury to persons or damage to the property of Contractor, Subcontractors or persons from recognized hazards until the responsible party corrects the hazard.

16.3C Contractor shall confine all persons acting on its or its Subcontractors' behalf to that portion of the Site where Work under the Contract Documents is to be performed, City-designated routes for ingress and egress thereto, and any other City-designated area. Except those routes for ingress and egress over which Contractor has no right of control, within such areas, Contractor shall provide safe means of access to all places at which persons may at any time have occasion to be present.

16.4 Emergencies

16.4A In emergencies affecting the safety or protection of persons or Work or property at the Site or adjacent thereto, Contractor, without special instruction or authorization from City, is obligated to act to prevent threat and damage, injury or loss, until directed otherwise by City. Contractor shall give City prompt written notice if Contractor believes that any significant changes in Work or variations from Contract Documents have been caused thereby. If City determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Change Order or Construction Change Directive will be issued to document the consequences of such action.

16.5 Use of Roadways and Walkways

16.5A Contractor shall not unnecessarily interfere with use of any roadway, walkway or other facility for vehicular or pedestrian traffic. Before beginning any interference and only with City's prior concurrence, Contractor may provide detour or temporary bridge for traffic to pass around or over the interference, which Contractor shall maintain in satisfactory condition as long as interference continues. Unless otherwise provided in the Contract Documents, Contractor shall bear the cost of these temporary facilities.

16.6 Nondiscrimination

16.6A No person or entity shall discriminate in the employment of persons upon public works because of race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, marital status, sexual preference, or gender of such persons, except as provided in Section 12940 of the Government Code. Every contractor for public works violating the provisions of Section 1735 of the Labor Code is subject to all the penalties imposed for a violation of Chapter 1, Part 7, Division 2 of the Labor Code.

16.7 Prevailing Wages

16.7A Contractor shall pay to persons performing labor in and about Work provided for in the Contract Documents an amount equal to or more than the general prevailing rate of per diem wages for (1) work of a similar character in the locality in which the Work is performed and (2) legal holiday and overtime work in said locality. The per diem wages shall be an amount equal to or more than the stipulated rates contained in a schedule that has been ascertained and determined by the Director of the State Department of Industrial Relations and City to be the general prevailing rate of per diem wages for each craft or type of workman or mechanic needed to execute this Contract. Contractor shall also cause a copy of this determination of the prevailing rate of per diem wages to be posted at each Site.

16.7B Contractor shall forfeit, as a penalty to City, Fifty Dollars ($50.00) for each laborer, workman, or mechanic employed in performing labor in and about the Work provided for in the Contract Documents for each Day, or portion thereof, that such laborer, workman or mechanic is paid less than the said stipulated rates for any work done under the Contract Documents by him or her or by any Subcontractor under him or her, in violation of Articles 1 and 2 of Chapter 1 of Part 7 of Division II of the California Labor Code. The sums and amounts which shall be forfeited pursuant to this paragraph 16.7B and the terms of the Labor Code shall be withheld and retained from payments due to Contractor under the Contract Documents, pursuant to this Document and the Labor Code, but no sum shall be so withheld, retained or forfeited except from the final payment without a full investigation by either the State Department of Industrial Relations or by City. The Labor Commissioner pursuant to Labor Code Section 1775 shall determine the final amount of forfeiture.

16.7C Contractor shall insert in every subcontract or other arrangement which Contractor may make for performance of Work or labor on Work provided for in the Contract, provision that Subcontractor shall pay persons performing labor or rendering service under subcontract or other arrangement not less than the general prevailing rate of per diem wages for Work of a similar character in the locality in which the Work is performed, and not less than the general prevailing rate of per diem wages for holiday and overtime work fixed in the Labor Code.

16.7D Contractor stipulates that it shall comply with all applicable wage and hour laws, including without limitation Labor Code Section 1813. Failure to so comply, including without limitation Labor Code Section 1776, shall constitute a default under this Contract.

16.7E Contractor and its Subcontractors shall be responsible for compliance with Labor Code Section 1776.

1. Contractor and Subcontractors 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 by him or her in connection with the Work of the Contract documents. Each payroll record shall contain or be verified by a written declaration as required by Labor Code Section 1776.
2. The payroll records enumerated above must be certified and shall be available for inspection at all reasonable hours at the principal office of Contractor as required by Labor Code Section 1776.
   (a) Contractor shall inform the City of the location of records enumerated above, including the street address, city and City, and shall, within five working Days, provide a notice of a change of location and address.
   (b) Contractor or Subcontractor has 10 Days in which to comply subsequent to receipt of a written notice requesting the records enumerated above. In the event that Contractor or Subcontractor fails to comply with the ten-Day period, he or she shall, as a penalty to the City on whose behalf the contract is made or awarded, forfeit $25.00 for each calendar Day, or portion thereof, for each worker, until strict compliance is effectuated. Upon the request of the Division of Apprenticeship Standards or the Division of Labor Standards Enforcement, these penalties shall be withheld from progress payments then due. Contractor is not subject to a penalty assessment pursuant to this paragraph due to the failure of a Subcontractor to comply with this paragraph.
3. Contractor shall also deliver certified payrolls to City with each Application for Payment as described in Section 00 12 00 (Measurement and Payment).

16.7F No contractor or subcontractor may be listed on a bid proposal for a public works project (submitted on or after March 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5 [with limited exceptions from this requirement for bid purposes only under Labor Code section 1771.1(a)].

No contractor or subcontractor may be awarded a contract for public work on a public works project (awarded on or after April 1, 2015) unless

registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.

This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

16.8 Environmental Controls

16.8A Contractor shall comply with all rules, regulations, ordinances, and statutes that apply to any Work performed under the Contract Documents including, without limitation, any toxic, water, stormwater management and soil pollution controls and air pollution controls specified in Government Code Section 11017. Contractor shall be responsible for insuring that Contractor's Employees, Subcontractors, and the public are protected from exposure to airborne hazards or contaminated water, soil, or other toxic materials used during or generated by activities on the Site or associated with the Project.

16.9 Shoring Safety Plan

16.9A Any conflict between this paragraph 16.9 and Division 2 of the Specifications shall be resolved in favor of the most stringent requirement.

16.9B At least five Days in advance of any excavation five feet or more in depth, Contractor shall submit to City a detailed plan showing the shoring, bracing and sloping design (including calculations) and other provisions to be made for worker protection from the hazard of caving ground during the excavation, as required by Labor Code Section 6705. A civil or structural engineer registered in the State in which the Work is performed and retained by the Contractor shall prepare and sign any plan that varies from the shoring system standards established by the State Construction Safety Orders.

16.9C During the course of Work, Contractor shall be responsible for determining where sloping, shoring, and/or bracing is necessary and the adequacy of the design, installation, and maintenance of all shoring and bracing for all excavation, including any excavation less than five feet in depth. Contractor will be solely responsible for any damage or injuries that may result from excavating or trenching. City's acceptance of any Drawings showing the shoring or bracing design or Work schedule shall not relieve Contractor of its responsibilities under this paragraph 16.9.

16.9D Appoint a qualified supervisory employee who shall be responsible to determine the sloping or shoring system to be used depending on local soil type, water table, stratification, depth, etc.

-END OF DOCUMENT-

DOCUMENT 00 73 00

SPECIAL CONDITIONS

List and describe any Contract Conditions not covered under Document 00 72 00 General Conditions that are unique to this specific project.

1. Construction equipment and materials may be stored within the public right-of-way but must be moved every five (5) days as construction progresses. Material storage at the construction site shall be limited to what is needed for five (5) days construction. No construction material shall be stored over the weekend unless approved by the City Engineer. Operating reflector barricades shall be required for all equipment and material left on the street overnight. At the end of each workday all loose material, parts and debris must be cleaned up and discarded and any stored materials shall be neatly stacked and organized.

   Failure to comply with these requirements shall result in liquidated damages in the amount of **$250** per **Calendar Day**.

2. The construction site and any off-site staging areas must be secured by temporary chain linked fencing, with a minimum height of 72 inches, unless the building code requires additional protection. The chain link fence is to be made of galvanized steel and must include a top and bottom rail. The fencing must be adequately anchored to prevent movement and the effects of wind. No visible gaps in the fencing are allowed, including between panels or under them. Gates must be sliding or in-swinging and close tightly with no gaps in or around them.

   When the construction site or off-site staging area is adjacent to any public right-of-way, the fence adjacent to the right-of-way shall have a visual/dust barrier or screening. The screen is to be constructed of green knitted polyethylene or canvas securely fixed to the inside face of the fencing and shall be maintained in a taut condition throughout the project. No twisted wire is to protrude on the exterior side of the fence. No tears or rips greater than 2” in any dimension will be allowed. Any screening that is torn or ripped or fencing or barricades that have been defaced will be replaced at the contractor’s expense within 48 hours.

   In addition to the required screening, any wood barricades or temporary chain link fencing facing a public roadway shall be setback two (2) feet from any property line or sidewalk, if site conditions allow. All areas visible from the public right-of-way shall be maintained free of weeds and litter.

   Any construction site or staging area fencing facing a public roadway shall include a sign, securely installed on the fence that is made of durable and waterproof materials that provides the following information: the name and emergency contact telephone number of the general contractor. The sign lettering shall be large enough to be read from 10 feet away and the sign shall not extend above the top of the fence. The sign language and graphics need to be approved by City staff prior to installation.

   Failure to comply with these requirements shall result in liquidated damages in the amount of **$250** per **Calendar Day.**

3. Contractor shall protect-in-place the monument and ensure that the monument is not disturbed. If the monument is disturbed or damaged, the Contractor shall be responsible to reset the monument, including filing new corner records with County as required per Monument Preservation. Full compensation for handling replacement units is considered as included in the contract unit price paid and no separate payment will be made.

4. All monuments must be preserved in accordance with State Business and Professions Code section 8771. If a monument is within the project limits, the Contractor shall perform pre and post construction survey and file corner record with the County and submit a duplicate corner record to the City Engineer prior to start of work.

5. The placement or display of any non-Project-related signs, banners, flags, symbols, or similar materials on the Project site and/or on equipment, vehicles, or materials used for City projects—whether on City-owned property or public infrastructure—is strictly prohibited. Failure to comply with this requirement shall result in a Stop Work notice and may trigger enforcement actions, including removal of the unauthorized material(s) by the City at the contractor's expense and potential assessment of damages. The City shall retain sole discretion in determining whether any material is in violation of this prohibition.

6. No work shall be permitted December 24 through January 1. Said days shall not be considered working days.

7. No Parking Signs to be posted and the Police Department notified at least **72 hours** in advance of no parking dates. Posted no parking dates must coincide with the actual scheduled work days for each individual street. Remove signs by the end of the work day if determined that work will not be occurring on the posted dates.

8. Contractor notification prior and during construction.

    a. Notification to the public shall happen at the beginning of the project to all residents and businesses after the contractor receives the notice to proceed with a schedule list of anticipated streets to be worked on.

    b. For construction for a particular area of the project, notice shall be given no less than 72 hours prior to proceeding with road construction operations.

    c. Contractor shall also notify the public if planned work for an area is postponed, no-parking signs will have to modified within the first 24 hours.

9. In the vicinity of any schools, the contractor shall not begin any operation before 9:00 A.M. when school is in session.

10. A Temporary Use Permit (TUP) shall be obtained by Contractor planning to operate a temporary use on private property for off-site storage, staging areas or parking facilities related to construction projects. The application shall be made at least sixty days in advance of the intended commencement date of the temporary use.

-END OF DOCUMENT-

SECTION 01 11 00

SUMMARY OF WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Contractor shall perform all work necessary to complete the Contract in a satisfactory manner. Furnishing transportation, labor, materials, equipment, and incidentals necessary to perform the work including but not limited to the following:

2. New mechanical piping
3. New HVAC
4. New Electrical and Instrumentation
5. Existing electrical and instrumentation improvements
6. Building refurbishment and improvements to meet current applicable codes
7. A building addition at Lake Pump Station
8. A concrete pad for PG&E transformer at Lake Pump Station
9. Ancillary civil site improvements
10. New generators
11. Provide public notification, construction area signs and public notices per Section 01 31 14 (Coordination, Public Notice, and Project Requirements).
12. Secure necessary permit per Section 01 41 00 (Regulatory Requirements).
13. Temporary traffic control per Section 01 51 00 (Temporary Facilities and Control).
14. Remove concrete sidewalk, curb and gutter, driveway approaches per Section 02 00 01 (Basic Site Material and Methods)
15. Remove and replace asphalt concrete pavement along the newly installed curb and gutter per Section 02 00 01 (Basic Site Materials and Methods)
16. Clearing and grubbing per Section 31 11 00 (Clearing and Grubbing)

B. The work shall include the provisions of all materials, equipment and apparatus not specifically mentioned in the specifications or noted on the plans, but which are ancillary to the successful and acceptable completion of the work.

1.2 SEQUENCE OF WORK AND COORDINATION

A. Completion of the Lake Pump Station is a priority over the Sneath Pump Station.

B. Sneath Pump Station: Contractor to coordinate with the contractor for the 2100 Sneath Lane development project to avoid conflicts.

1.3 WORK DAYS AND HOURS

A. Working Days and hours: Monday-Friday inclusive, **8:00 a.m.-5:00 p.m.** local time.

B. Work at the Site on weekends or holidays is not permitted, unless Contractor requests otherwise from City in writing at least 72 hours in advance and City approves in its sole discretion.

C. Contractor will not be permitted to schedule utility shutdowns on Fridays.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

-END OF SECTION-

SECTION 01 20 00

MEASUREMENT AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Document describes the manner in which the amount of payments to the Contractor will be established.

B. Definitions of the Bid Items identified in the Document 00 41 00 (Bid Proposal), and in conjunction with this Section, is listed in Document 00 24 13 (Scopes of Bids).

1.2 REFERENCES

A. California Public Contract Code

B. California Code of Civil Procedures

C. California Government Code

1.3 SCOPE OF WORK

A. The Contract Sum for performance of the Work under Contract Documents, or under any bid item, allowance, or alternate, shall include full compensation for all labor, materials, taxes, transport, handling, storage, supervision, administration, and all other items necessary for the satisfactory completion of the Work, whether or not expressly specified or indicated.

1.4 DETERMINATION OF QUANTITIES

A. Quantity of Work to be paid for under any item for which a unit price is fixed in Contract Documents shall be, as determined by City, number of units of Work satisfactorily completed in accordance with Contract Documents or as directed by City. Unless otherwise provided, determination of number of units of Work so completed will be based, so far as practicable, on actual measurement or count within prescribed or ordered limits, and no payment will be made for Work done outside of limits. Unit Prices shall apply to Work covered by unit prices so long as actual quantities performed on the Project are **[not less than 75 percent or greater than 125 percent]** of the estimated quantities contained in Document 00 41 00 (Bid Proposal) or otherwise referenced in Document 00 24 13 (Scopes of Bids). If actual quantities exceed these parameters, then the unit price shall be adjusted by an amount to reflect the Contractor's incremental cost differential resulting from increased or decreased economies of scale.

1.5 BASIS OF PAYMENT

A. Unit Price Quantities: When estimated quantity for specific portions of Work is listed in Bid Proposal, quantity of Work to be paid for shall be actual number of units

satisfactorily completed, as determined by City and certified by Contractor, in accordance with the Contract Documents.

B. Lump Sum: When estimated quantity for specific portion of Work is not indicated and Work is designated as lump sum, payment will be on a lump sum basis for Work satisfactorily completed in accordance with Contract Documents.

C. Allowances: Allowance items (if any) will be paid for as provided in Document 00 24 13 (Scopes of Bids) and Document 00 41 00 (Bid Proposal). Funds authorized for Allowance Work will not be released for Contract payments unless City has authorized Allowance Work in writing. Unused allowance amounts at Contract completion shall reduce the Contract price accordingly.

D. Alternates: Alternate items (if any) will be paid for as provided in Document 00 24 13 (Scopes of Bids) and Document 00 41 00 (Bid Proposal). City will determine whether to include all or some the Alternates Work as part of the Contract prior to contract award.

E. City does not expressly, or by implication, agree, warrant, or represent in any manner, that actual amount of Work will correspond with amount shown or estimated and reserves right to increase or decrease amount of any class or portion of Work, to delete entire Bid item or items, or to add work not originally included in Bid or Contract Documents, when in its judgment such change is in best interest of City. No change in Work shall be considered a waiver of any other condition of Contract Documents. No claim shall be made for anticipated profit, for loss of profit, for damages, or for extra payment whatever, except as otherwise expressly provided for in the Contract Documents, because of any differences between amount of Work actually done and estimated amount as set forth herein, or for elimination of Bid items.

F. No payment shall be made for materials or equipment not yet incorporated into the Work, except as expressly specified otherwise in Section 01 11 00 (Summary of Work).

1.6 PROGRESS PAYMENTS

A. If requested by Contractor, progress payments will be made monthly.

B. Schedule of Values:

1. Within ten (10) Days from issuance of Notice of Award and prior to the Contractor’s first Application for Payment, Contractor shall submit a detailed breakdown of its Bid by scheduled Work items and/or activities, including coordination responsibilities and Project Record Documents responsibilities. Where more than one Subcontractor comprises the work of a Work item or activity, the Schedule of Values shall show a separate line item for each subcontract. Contractor shall furnish such breakdown of the total Contract Sum by assigning dollar values (cost estimates) to each applicable Progress Schedule network activity, which cumulative sum equals the total Contract Sum. This breakdown shall be referred to as the Schedule of Values.

2. Contractor's overhead, profit, insurance, cost of bonds (except to the extent expressly identified in a Bid item) and/or other financing, as well as "general conditions costs," (e.g., Site cleanup and maintenance, temporary roads and access, off-Site access roads, temporary power and lighting, security, and the like), shall be prorated through all activities so that the sum of all the Schedule of Values line items equals Contractor's total Contract Sum, less any allowances designated by City. Scheduling, record documents and quality assurance control shall be separate line items.

3. City will review the breakdown in conjunction with the Progress Schedule to ensure that the dollar amounts of this Schedule of Values are, in fact, fair market cost allocations for the Work items listed. Upon favorable review by City, City will accept this Schedule of Values for use. City shall be the sole judge of fair market cost allocations.

4. City will reject any attempt to increase the cost of early activities, i.e., "front loading," resulting in a complete reallocation of moneys until such "front loading" is corrected. Repeated attempts at "front loading" may result in suspension or termination of the Work for default, or refusal to process progress payments until such time as the Schedule of Values is acceptable to City.

C. Monthly Report Sheets and Applications for Payment: Contractor shall establish and maintain records of cost of the Work in accordance with generally accepted accounting practices, reconcile the amount of Work completed monthly with City, and sign City's monthly report sheet certifying to the Work done. Monthly report sheets shall be considered the true record of the Cost of the Work and Contractor shall submit in a form acceptable to City an itemized cost breakdown of Contractor's record of Cost of the Work together with supporting data and any certification required by City. In addition:

1. On or before the sooner of (a) the 20th Day of each month and (b) receipt of City's approval of the updated Schedule as required by Section 01 32 16 (Progress Schedules and Reports), Contractor shall submit to City five copies of an Application for Payment for the cost of the Work put in place during the period from the 15th Day of the previous month to the 15th Day of the current month, along with one copy of the City-approved updated Schedule. Such Applications for Payment shall be for the total value of activities completed or partially completed, based upon Schedule of Values prices (or Bid Item prices if unit price) of all labor and materials incorporated in the Work up until midnight of the last Day of that one month period, less the aggregate of previous payments. Accumulated retainage shall be shown as separate item in payment summary. City and Contractor will reconcile any differences in the field, based on the reconciled monthly report sheets. If Contractor is late submitting its Application for Payment, that Application may be processed at any time during the succeeding one-month period, resulting in processing of Contractor's Application for Payment being delayed for more than a Day-for-Day basis.

2. Except as otherwise provided in a labor compliance program applicable to the Work (if any) or as otherwise required by City, concurrently with each Application for Payment, Contractor shall submit to the City the Contractor's and its Subcontractors' certified payroll records required to be maintained pursuant to

Labor Code Section 1776 for all labor performed during pay periods ending during the period covered by the Application for Payment.

3. No progress payment will be processed prior to City receiving all requested, acceptable schedule update information and certified payrolls. Failure to submit a schedule update complying with Section 01 32 16 (Progress Schedules and Reports) and certified payrolls complying with Labor Code Section 1776, justifies denying the entire Application for Payment in City's sole and absolute discretion.

4. Each Application for Payment shall list each Change Order and Construction Change Directive ("CCD") executed prior to date of submission, including the Change Order/CCD Number, and a description of the Work activities, consistent with the descriptions of original Work activities. Contractor shall submit a monthly Change Order/CCD status log to City.

5. If City requires substantiating data, Contractor shall submit information requested by City, with cover letter identifying Project, Application for Payment number and date, and detailed list of enclosures. Contractor shall submit one copy of substantiating data and cover letter for each copy of Application for Payment submitted.

6. If Contractor fails or refuses to participate in monthly Work reconciliations or other construction progress evaluation with City, Contractor shall not receive current payment until Contractor has participated fully in providing construction progress information and schedule update information to City.

D. Progress Payments

1. City will review Contractor's Application for Payment following receipt. If adjustments need to be made to percent of completion of each activity, City will make appropriate notations and return to Contractor. Contractor shall revise and resubmit. All parties shall update percentage of completion values in the same manner, i.e., express value of an accumulated percentage of completion to date.

2. If City determines that portions of the Application for Payment are not proper or not due under the Contract Documents, then City may approve the other portions of the Application for Payment, and in the case of disputed items or Defective Work not remedied, may withhold up to 150 percent of the disputed amount from the progress payment.

3. Pursuant to California Public Contract Code §20104.50, if City fails to make any progress payment within thirty (30) Days after receipt of an undisputed and properly submitted Application for Payment from Contractor, City shall pay interest to the Contractor equivalent to the legal rates set forth in subdivision (a) of Section 685.010 of the California Code of Civil Procedure. The 30-Day period shall be reduced by the number of Days by which City exceeds the seven-Day return requirement set forth herein.

4. As soon as practicable after approval of each Application for Payment for progress payments, City will pay to Contractor in manner provided by law, an

amount equal to ninety-five percent (95%) of the amounts otherwise due as provided in the Contract Documents, or a lesser amount if so provided in the Contract Documents, provided that payments may at any time be withheld if, in judgment of City, Work is not proceeding in accordance with Contract, or Contractor is not complying with requirements of Contract, or to comply with stop notices or to offset liquidated damages accruing or expected.

5. Before any progress payment or final payment is due or made, Contractor shall submit satisfactory evidence that Contractor is not delinquent in payments to employees, Subcontractors, suppliers, or creditors for labor and materials incorporated into Work. This specifically includes, without limitation, conditional lien release forms for the current progress payment and unconditional release forms for past progress payments. This also includes copies of certified payroll from contractor and subcontractors for the current payment period.

1.7 FINAL PAYMENT

A. As soon as practicable after all required Work is completed in accordance with Contract Documents, including punch list, testing, record documents and Contractor maintenance after Final Acceptance, City will pay to Contractor, in manner provided by law, unpaid balance of Contract Sum of Work (including, without limitation, retentions), or whole Contract Sum of Work if no progress payment has been made, determined in accordance with terms of Contract Documents, less sums as may be lawfully retained under any provisions of Contract Documents or by law.

B. Prior progress payments and change orders shall be subject to audit and correction in the final payment. City's determination of amount due as final payment shall be final and conclusive evidence of amount of Work performed by Contractor under Contract Documents and shall be full measure of compensation to be received by Contractor.

C. Contractor and each assignee under an assignment in effect at time of final payment shall execute and deliver at time of final payment, and as a condition precedent to final payment, Document 00 52 17 (Agreement and Release of Any and All Claims).

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

-END OF SECTION-

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SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 GENERAL

A. Only Contractor or City may initiate changes in scope of Work or deviation from Contract Documents.

1. Contractor may initiate changes by submitting a Request for Information (RFI), Notice of Concealed or Unknown Conditions, or Notice of Hazardous Waste Conditions.

   a. RFIs shall be submitted to seek clarification of or request changes in the Contract Documents.

   b. Notices of Concealed or Unknown Conditions shall be submitted in accordance with Document 00 72 00 (General Conditions).

   c. Notices of Hazardous Waste Conditions shall be submitted in accordance with Document 00 72 00 (General Conditions).

2. City may initiate changes by issuing a Supplemental Instruction, which may revise, add to or subtract from the Work.

3. City may initiate changes in the Work or Contract Time by issuing a Request for Quotation (RFQ) to Contractor. Such RFQ will detail all proposed changes in the Work and request a quotation of changes in Contract Sum and Contract Time from Contractor.

4. City may also, by Construction Change Directive (CCD), order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly. A CCD shall be used in the absence of total agreement on the terms of a Change Order and may, upon notice, consist of a Change Order executed by City only.

1.2 PROCEDURES

A. Cost Quotation and Procedures: Whenever Contractor is required in this Section to prepare a cost quotation, and whenever Contractor is entitled to submit a cost quotation and elects to do so, Contractor shall prepare and submit to City for consideration a cost quotation using the form attached to this Section. All cost quotations must contain a complete breakdown of actual, current costs of credits, deducts, and extras; and itemizing materials, labor, taxes, overhead and profit. All Subcontractor Work shall be so indicated. Individual entries on the Cost Quotation Form shall be determined as provided

in this Section. After receipt of a cost quotation with a detailed breakdown, City will act promptly thereon.

1. If City accepts a Cost Quotation, City will prepare Change Order for City and Contractor signatures.

2. If the Cost Quotation is not acceptable to City because it does not agree with cost and/or time included in the Cost Quotation, City will submit in a response what it believes to be a reasonable cost and/or adjustment, if any. Except as otherwise provided in this Section, Contractor shall have 7 Days in which to respond to City with a revised Cost Quotation.

3. When necessity to proceed with a change does not allow the City sufficient time to conduct a proper check of a Cost Quotation (or revised Cost Quotation), City may order Contractor to proceed on basis to be determined at earliest practical date. In this event, value of change, with corresponding equitable adjustment to Contract, shall not be more than increase or less than decrease proposed.

B. Request for Information (RFI): Whenever Contractor requires information regarding the Project or Contract Documents, or receives RFI from a Subcontractor, Contractor may prepare and deliver an RFI to City. Contractor shall use RFI format provided by City. Contractor must submit time critical RFIs at least 30 Days before scheduled start date of the affected Work activity. Contractor shall reference each RFI to an activity of Progress Schedule and shall note time criticality of the RFI, indicating time within which a response is required. Contractor's failure to reference RFI to an activity on the Progress Schedule and note time criticality on the RFI shall constitute Contractor's waiver of any claim for time delay or interruption to the Work resulting from any delay in responding to the RFI.

1. City will respond within 7 Days from receipt of RFI with a written response to Contractor. Contractor shall distribute response to all appropriate Subcontractors.

2. If Contractor is satisfied with the response and does not request a change in Contract Sum or Contract Time, then the response shall be executed without a change.

3. If Contractor believes the response is incomplete, Contractor shall issue another RFI (with the same RFI number with the letter "A" indicating if it is a follow-up RFI) to City clarifying original RFI. Additionally, City may return RFI requesting additional information should original RFI be inadequate in describing condition.

4. If Contractor believes that the response results in change in Contract Sum or Contract Time, Contractor shall notify City in writing within 7 Days after receiving the response. If City disagrees with Contractor, then Contractor may give notice of intent to submit a Claim as described in Article 12 of Document 00 72 00 (General Conditions), and submit its

Claim within 30 Days. If City agrees with Contractor, then Contractor must submit a Cost Quotation within 7 Days of receiving the response to the RFI. Contractor's failure to deliver either the foregoing notice and Claim or Cost Quotation by the respective deadlines stated in the foregoing sentences shall result in waiver of the right to file a Cost Quotation or Claim.

C. Supplemental Instruction: City may issue Supplemental Instruction to Contractor.

1. If Contractor is satisfied with Supplemental Instruction and does not request a change in Contract Sum or Contract Time, then Supplemental Instruction shall be executed without a Change Order.

2. If Contractor believes that Supplemental Instruction results in a change in Contract Sum or Contract Time, then Contractor must submit a Cost Quotation to City within 21 Days of receiving the Supplemental Instruction.

D. City requested RFQ: Contractor shall furnish a Cost Quotation within 5 Business Days of City's RFQ. Upon approval of RFQ, City will issue a Change Order directing Contractor to proceed with extra Work. If the parties do not agree on the price for an RFQ, City may either issue a CCD or decide the issue per Article 12 of Document 00 72 00 (General Conditions). Contractor shall perform the changed Work notwithstanding any claims or disagreements of any nature.

E. Construction Change Directives: If at any time City believes in good faith that a timely Change Order will not be agreed upon using the foregoing procedures, City may issue a CCD with its recommended cost and/or time adjustment. Upon receipt of CCD, Contractor shall promptly proceed with the change of Work involved and concurrently respond to City's CCD within 10 Days.

1. Contractor's response must be any one of following:

a. Return CCD signed, thereby accepting City's response, time, and cost.

b. Submit a (revised if applicable) Cost Quotation with supporting documentation (if applicable, reference original Cost Quotation number followed by letter A, B, etc. for each revision), if City so requests.

c. Give notice of intent to submit a Claim as described in Article 12 of Document 00 72 00 (General Conditions), and submit its Claim within 30 Days.

2. If the CCD provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

    a. Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation.

    b. Unit prices stated in the Contract Documents or subsequently agreed upon.

    d. Cost to be determined in a manner agreed.

3. CCD signed by Contractor indicates the agreement of Contractor therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

4. If Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the method and the adjustment shall be determined by City on the basis of reasonable expenditures and savings of those performing the Work attributable to the change including, in case of an increase in the Contract Sum, a reasonable allowance for overhead and profit. If the parties still do not agree on the price for a CCD, Contractor may file a Claim per Article 12 of Document 00 72 00 (General Conditions). Contractor shall keep and present, in such form as City may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this paragraph shall be limited to those provided in this Section.

5. Pending final determination of cost to City, amounts not in dispute may be included in Applications for Payment. The amount of credit to be allowed by Contractor to City for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by City. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

F. Differing Site Conditions: Contractor shall submit Notices of Differing Site Conditions to resolve problems regarding differing underground Site conditions encountered in the execution of the Work pursuant to Paragraph 13.4 of Document 00 72 00 (General Conditions), which shall govern. If City determines that a change in Contract Sum or Contract Time is justified, City will issue RFQ or CCD.

G. Hazardous Waste Conditions: Contractor shall submit Notices of Hazardous Waste Conditions to resolve problems regarding hazardous materials encountered in the execution of the Work pursuant to Paragraph 13.5 of Document 00 72 00 (General Conditions), which shall govern. If City

determines that a change in Contract Sum or Contract Time is justified, City will issue RFQ or CCD.

1.3 COST DETERMINATION

A. Total cost of extra Work or of Work omitted shall be the sum of labor costs, material costs, equipment rental costs, and specialist costs as defined herein plus overhead and profit as allowed herein. This limit applies in all cases of claims for extra Work, whether calculating cost quotation, change orders or CCDs, or calculating claims of all types, and applies even in the event of fault, negligence, strict liability, or tort claims of all kinds, including strict liability or negligence. Contractor may recover no other costs arising out of or connected with the performance of extra Work, of any nature. No special, incidental or consequential damages may be claimed or recovered against City, its representatives or agents, whether arising from breach of Contract, negligence, or strict liability, unless specifically authorized in the Contract Documents.

B. Overhead and Profit: (Overhead shall be as defined in this Section)

1. Overhead and profit on labor for extra Work shall be 15 percent.

2. Overhead and profit on materials for extra Work shall be 15 percent.

3. Overhead and profit on equipment rental for extra Work shall be 10 percent.

4. When extra Work is performed by a first tier Subcontractor, Contractor shall receive a 5 percent markup on Subcontractors' total costs of extra Work. First tier Subcontractor's markup on its Work shall not exceed 15 percent.

5. When extra Work is performed by a lower tier Subcontractor, Contractor shall receive a total of 5 percent markup on the lower tier Subcontractors' total costs of extra Work. Contractor and first tier Subcontractors and lower tier Subcontractors shall divide the 10 percent markup as mutually agreed.

6. Notwithstanding the foregoing, in no case shall the total markup on any extra Work exceed 20 percent of the direct cost, notwithstanding the actual number of Contract tiers.

7. On quotations covering both increases and decreases in Contract Sum, overhead, profit, and commission shall be allowed on the net increase only as determined in this Section. When the net difference is a deletion, no percentage for overhead profit and commission shall be allowed, but rather a deduction shall apply.

8. The markup shall include profit, small tools, cleanup, engineering, supervision, warranties, cost of preparing the cost quotation, jobsite overhead, and home office overhead. No markup will be allowed on taxes, insurance, and bonds.

C. Taxes:

1. All State sales tax, use tax, and San Mateo County and applicable City sales taxes shall be included.

2. Federal and Excise tax shall not be included.

D. Owner-Operated Equipment: When owner-operated equipment is used to perform extra Work, Contractor will be paid for operator as follows:

1. Payment for equipment will be made in accordance with this Section.

2. Payment for cost of labor will be made at no more than rates of such labor established by collective bargaining agreements for type of worker and location of Work, whether or not owner-operator is actually covered by such an agreement.

E. Accord and Satisfaction: Every Change Order and accepted CCD shall constitute a full accord and satisfaction, and release, of all Contractor (and if applicable, Subcontractor) claims for additional time, money or other relief arising from or relating to the subject matter of the change including, without limitation, impacts of all types, cumulative impacts, inefficiency, overtime, delay, and any other type of claim. Contractor may elect to reserve its rights to disputed claims arising from or relating to the changed Work at the time it signs a Change Order or approves a CCD, but must do so expressly in a writing delivered concurrently with the executed Change Order or approved CCD, and must also submit a Claim for the reserved disputed items pursuant to Article 12 of Document 00 72 00 (General Conditions) no later than 30 Days of Contractor's first written notice of its intent to reserve rights.

1.4 COST BREAKDOWN

A. Labor: Contractor will be paid cost of labor for workers (including forepersons when authorized by City) used in actual and direct performance of extra Work. Labor rate, whether employer is Contractor, Subcontractor or other forces, will be sum of following:

1. Actual Wages: Actual wages paid shall include any employer payments to or on behalf of workers for health and welfare, pension, vacation, and similar purposes.

2. Labor Surcharge: Payments imposed by local, county, state, and federal laws and ordinances, and other payments made to, or on behalf of, workers, other than actual wages as defined in Paragraph 1.4A.1 of this Section, such as taxes and insurance. Labor surcharge shall be and shall not exceed that set forth in California Department of Transportation official labor surcharges schedule which is in effect on date upon which extra Work is accomplished and which schedule is incorporated herein by reference as though fully set forth herein.

B. Material: Only materials furnished by Contractor and necessarily used in performance of extra Work will be paid for. Cost of such materials will be cost, including sales tax, to purchaser (Contractor, Subcontractor or other forces) from supplier thereof, except as the following are applicable:

1. If cash or trade discount by actual supplier is offered or available to purchaser, it shall be credited to City notwithstanding fact that such discount may not have been taken.

2. For materials salvaged upon completion of extra Work, salvage value of materials shall be deducted from cost, less discounts, of materials.

3. If cost of a material is, in opinion of City, excessive, then cost of material shall be deemed to be lowest current wholesale price at which material is available in quantities concerned delivered to Site, less any discounts as provided in this Section.

C. Equipment Rental: For Contractor- or Subcontractor-owned equipment, payment will be made at rental rates listed for equipment in California Department of Transportation official equipment rental rate schedule which is in effect on date upon which extra Work is accomplished and which schedule is incorporated herein by reference as though fully set forth herein. If there is no applicable rate for an item of equipment, then payment shall be made for Contractor- or Subcontractor-owned equipment at rental rate listed in the most recent edition of the Association of Equipment Distributors (AED) book. For rented equipment, payment will be made based on actual rental invoices. Equipment used on extra Work shall be of proper size and type. If, however, equipment of unwarranted size or type and cost is used, cost of use of equipment shall be calculated at rental rate for equipment of proper size and type, as determined by City. Rental rates paid shall be deemed to cover cost of fuel, oil, lubrication, supplies, small tools, necessary attachments, repairs and maintenance of any kind, depreciation, storage, insurance, and all incidentals. Unless otherwise specified, manufacturer's ratings, and manufacturer-approved modifications, shall be used to classify equipment for determination of applicable rental rates. Individual pieces of equipment or tools not listed in said publication and having a replacement value of $100 or less, whether or not consumed by use, shall be considered to be small tools and no payment will be made therefor as payment is included in payment for labor. Rental time will not be allowed while equipment is inoperative due to breakdowns.

1. For equipment on Site, rental time to be paid for equipment shall be time equipment is in operation on extra Work being performed or on standby as approved by City. The following shall be used in computing rental time of equipment:

a. When hourly rates are listed, less than 30 minutes of operation shall be considered to be ½ hour of operation.

b. When daily rates are listed, less than four hours of operation shall be considered to be ½ Day of operation.

2. For equipment that must be brought to Site to be used exclusively on extra Work, cost of transporting equipment to Site and its return to its original location shall be determined as follows:

    a. City will pay for costs of loading and unloading equipment.

    b. Cost of transporting equipment in low bed trailers shall not exceed hourly rates charged by established haulers.

    c. Cost of transporting equipment shall not exceed applicable minimum established rates of California Public Utilities Commission.

    e. City will not make any payment for transporting and loading and unloading equipment if equipment is used on Work in any other way than upon extra Work.

3. Rental period may begin at time equipment is unloaded at Site of extra Work and terminate at end of the performance of the extra Work or Day on which City directs Contractor to discontinue use of equipment, whichever first occurs. Excluding Saturdays, Sundays, and City's legal holidays, unless equipment is used to perform extra Work on such Days, rental time to be paid per Day shall be four hours for zero hours of operation, six hours for four hours of operation and eight hours for eight hours of operation, time being prorated between these parameters. Hours to be paid for equipment that is operated less than eight hours due to breakdowns, shall not exceed eight less number of hours equipment is inoperative due to breakdowns.

C. Work Performed by Special Forces or Other Special Services: When City and Contractor, by agreement, determine that special service or item of extra Work cannot be performed by forces of Contractor or those of any Subcontractors, service or extra Work item may be performed by specialist. Invoices for service or item of extra Work on basis of current market price thereof may be accepted without complete itemization of labor, material, and equipment rental costs when it is impracticable and not in accordance with established practice of special service industry to provide complete itemization. In those instances wherein Contractor is required to perform extra Work necessitating a fabrication or machining process in a fabrication or machine shop facility away from Site, charges for that portion of extra Work performed in such facility may, by agreement, be accepted as a specialist billing. City must be notified in advance of all off-Site Work. In lieu of overhead and profit provided in Paragraph 1.3B of this Section, 15 percent will be added to specialist invoice price, after deduction of any cash or trade discount offered or available, whether or not such discount may have been taken.

1.5 FORCE-ACCOUNT WORK

A. If it is impracticable because of nature of Work, or for any other reason, to fix an increase or decrease in price definitely in advance, the Contractor may be directed to proceed at a not-to-exceed (NTE) maximum price which shall not

under any circumstances be exceeded. Subject to such limitation, such extra Work shall be paid for at actual necessary cost for Force-Account Work or at the negotiated cost, as determined by City. The cost for Force-Account Work shall be determined pursuant to this Section.

B. Force-Account Work shall be used when it is not possible or practical to price out the changed Work prior to the start of that Work. In these cases, Force-Account Work will be utilized during the pricing and negotiation phase of the change. Once negotiations have been concluded and a bilateral agreement has been reached, the tracking of the Work under Force-Account is no longer necessary. Force-Account Work shall also be used when negotiations between City and Contractor have broken apart and a bilateral agreement on the value of the changed Work cannot be reached. City may approve other uses of Force-Account Work.

D. Whenever any Force-Account Work is in progress, definite price for which has not been agreed on in advance, Contractor shall report to City each Business Day in writing in detail amount and cost of labor and material used, and any other expense incurred in Force-Account Work on preceding Day, by using the Cost Quotation form attached hereto. No claim for compensation for Force-Account Work will be allowed unless report shall have been made.

E. Whenever Force-Account Work is in progress, definite price for which has not been agreed on in advance, Contractor shall report to City when 75 percent of the NTE amount has been expended.

F. Force-Account Work shall be paid as extra Work under this Section. Methods of determining payment for Work and materials provided in this Paragraph 1.5 shall not apply to performance of Work or furnishings of material that, in judgment of City, may properly be classified under items for which prices are otherwise established in Contract Documents.

1.6 CITY-FURNISHED MATERIALS

A. City reserves right to furnish materials as it deems advisable, and Contractor shall have no claims for costs and overhead and profit on such materials.

1.7 OVERHEAD DEFINED

A. The following constitutes charges that are deemed included in overhead for all Contract Modifications, including Force-Account Work or CCD Work, whether incurred by Contractor, Subcontractors, or suppliers, and Contractor shall not invoice or receive payment for these costs separately:

1. Drawings: field drawings, Shop Drawings, etc., including submissions of drawings

2. Routine field inspection of Work proposed

3. General Superintendence

4. General administration and preparation of cost quotations, schedule analysis, Change Orders, and other supporting documentation as necessary

5. Computer services

6. Reproduction services

7. Salaries of project engineer, superintendent, timekeeper, storekeeper, and secretaries

8. Janitorial services

9. Temporary on-Site facilities:

    a. Offices

    b. Telephones

    c. Plumbing

    d. Electrical: Power, lighting

    f. Platforms

    g. Fencing, etc.

    h. Water

10. Home Office Overhead

11. Insurance and Bond premiums

12. Procurement and use of vehicles and fuel used coincidentally in Work otherwise included in the Contract Documents

13. Surveying

14. Estimating

15. Protection of Work

16. Handling and disposal fees

17. Final cleanup

18. Other incidental Work

1.8 RECORDS AND CERTIFICATION

A. Force-Account (cost reimbursement) charges shall be recorded daily and summarized in Cost Quotation form attached hereto. Contractor or authorized

representative shall complete and sign form each Day. Contractor shall also provide with the form: the names and classifications of workers and hours worked by each; an itemization of all materials used; a list by size, type, and identification number of equipment and hours operated; and an indication of all Work performed by specialists.

B. No payment for Force-Account Work shall be made until Contractor submits original invoices substantiating materials and specialists charges.

C. City shall have the right to audit all records in possession of Contractor relating to activities covered by Contractor's claims for Modification of Contract, including Force-Account Work and CCD Work.

D. Further, City will have right to audit, inspect, or copy all records maintained in connection with this Contract, including financial records, bidding records, in possession of Contractor relating to any transaction or activity occurring or arising out of, or by virtue of, the Contract. If Contractor is a joint venture, right of City shall apply collaterally to same extent to records of joint venture sponsor, and of each individual joint venture member. This right shall be specifically enforceable, and any failure of Contractor to voluntarily comply shall be deemed an irrevocable waiver and release of all claims then pending that were or could have been subject to the Article 12 of Document 00 72 00 (General Conditions).

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

COST QUOTATION FORM FOLLOWS ON NEXT PAGE

-END OF SECTION-

COST QUOTATION (CQ)

City of San Bruno

Project Title:_____

Contract Number _____

CQ Number: _____

Date: _____

In Response To _____

RFQ #, etc.

To: City of San Bruno

Attention: _____

567 El Camino Real

San Bruno, CA 94066

Phone: (650) 616-7065

Subject Ref. No: _____

(for Project Manager use only)

Fax: (650) 794-1443

From:_____

_____

_____

This Cost Quotation is in response to the above-referenced _____ **[insert RFQ, etc. as applicable]**.

Brief description of change(s):

_____

_____

ITEM DESCRIPTION	PRIME CONTRACTOR	SUB 1	SUB 2	SUB 3	SUB 4	TOTAL
MATERIAL						
Direct Labor Cost						
EQUIPMENT						
Other (Specify) Extended Overhead						
TOTAL COST						
Subcontractor's Overhead & Profit 15 percent						
Contractor's Overhead & Profit 15 percent						
Overhead & Profit to Contractor for Subcontractor's Work 5 percent						
(Percent of Total Cost above not including any Overhead & Profit)						
GRAND TOTAL						
REQUESTED CHANGE IN CONTRACT TIME (DAYS)						
By Contractor: **dsda**		Signature:			Date:	

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SECTION 01 31 14

COORDINATION, PUBLIC NOTIFICATION, AND PROJECT REQUIREMENTS

PART 1 - GENERAL

1.1 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.

1.2 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. Remove and replace defective and non-conforming work.

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.

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. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection.

4. Report any hazardous or unsatisfactory conditions to the Engineer.

1.3 ALTERATION PROJECT PROCEDURES

A. Plan, schedule and perform alteration work as required to minimize impacting the Owner's continued operations.

B. The existing sewer lines must remain in operation during construction.

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.

1.4 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 (ISA North 811) may occur, call 800-642-2444 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. Individual house services for gas and sewer are not shown. 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.

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. The Contractor shall notify all owners of utilities when its work is in progress and shall make arrangements as are necessary to make any emergency repairs. Should any damage to a utility occur during the progress of the work, the Contractor shall notify the owner of the utility at once and render every assistance possible to repair the damage and restore service. No extra compensation will be made for the repair of any services or utility damaged by the Contractor nor for any damage incurred through neglect or failure to provide adequate protection to existing utilities. This provision exists even in the event that a utility or service is damaged after backfilling or is not discovered until after completion of the backfilling.

F. All utilities encountered during the Work shall remain in continual service under the Contract, unless otherwise noted on the drawings, or unless the Engineer and owner of the said utility are in agreement to shutdown the said utility.

1.5 FIELD ENGINEERING AND LAYOUT

A. The Owner will establish reference benchmarks. Base lines shall be set by Contractor to locate new sewer line in relationship to existing as shown on Plans for this Contract. The Contractor shall develop and make additional surveys as needed for construction, such as control lines, stakes for pipe locations and other working points, lines, and elevations. Survey work shall be performed under the supervision of a licensed land surveyor or registered civil engineer. The Contractor shall protect reference points provided by the Owner and shall reset any that are damaged or destroyed by his operation at no cost to the Owner.

B. The Contractor shall lay out the Work from the reference points provided and shall be responsible for accurate location, alignment, elevation and level of the completed Work.

C. Employ a Professional Land Surveyor or Professional Civil Engineer to establish and verify the elevation of all elements affecting the hydraulic gradient of the system including the inverts of all manholes and piping. Use recognized engineering surveying methods and documentation techniques.

1.6 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. Testing During Construction

5. Contractors Coordination

6. Facilities and Temporary Controls

7. Maintenance of Record Drawings

8. Final Review of Manholes and Television Inspection of Sewer Line

9. Punch Lists and Project Closeout Procedures

10. Final Deliverables including Record Drawings, Television Logs, and Special Guarantees.

1.7 PROGRESS MEETINGS

A. The Engineer will conduct weekly progress meetings with Contractor and the 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 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.

1.8 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. For exterior storage of fabricated products, place items on sloped supports, aboveground.

3. Cover products subject to deterioration from moisture, dust, or sunlight with opaque watertight but breathable sheet covering. Provide ventilation to avoid condensation.

4. Provide offsite storage and protection including insurance coverage when site does not permit onsite storage or protection.

5. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

6. Provide facilities, equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

7. 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.

1.9 SEISMIC REQUIREMENTS

A. The Contractor is responsible for producing designs that resist the total seismic forces in accordance with the design criteria.

B. For items listed below, 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 for the attachments for permanent equipment supported by the structure demonstrating that the design is capable of resisting the total seismic forces in accordance with the seismic design criteria.

1. The Contractor is responsible for coordinating between the Engineer of Record and the Specialty Engineer.

2. The Specialty Engineer shall be responsible for the following:

a. Equipment anchorage including pumps and electrical panels.

b. Pipe and conduit supports not detailed on the drawings.

C. Total seismic forces shall be determined in accordance with the seismic design requirements for non-structural components and equipment included in the California adopted and amended versions of IBC (Chapter 16) and the coefficients and factors for determining the total design seismic forces as follows:

1. Occupancy Category = III

2. Seismic Design Category = D

3. Site Class = D

4. Spectral Response Acceleration at Short Period, S_{DS} = 1.434

5. Component Importance Factor, I_P = 1.0

6. Components Coefficient, a_P, in accordance with ASCE 7-05, Table 13.6-1

7. Components Coefficient, R_P, in accordance with ASCE 7-05, Table 13.6-1

D. Non-structural components and equipment shall include the following items:

1. Mechanical, electrical, and plumbing equipment and appurtenances.

2. Conduit, piping, cable trays, raceways, ducts and similar systems.

E. Quality Assurance Submittals:

1. Where required in the equipment specifications in Divisions 2 through 17, submit certification that the equipment itself is designed to resist all internal seismic forces based on the seismic design criteria for the project.

2. Where required in Paragraph B. above and in the the equipment specifications in Divisions 2 through 17, submit 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 for the attachments and anchorage to the structure.

3. Where required in the equipment specifications in Divisions 2 through 17, submit certification that the attachments and anchorage are designed to resist all seismic forces based on the design criteria for this project.

1.10 SAFETY

A. In accordance with generally accepted construction practice and applicable law 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.

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.

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.

1.11 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 its Registered Engineer.

B. Work Within Confined Spaces: Work within confined spaces is subject to applicable laws, regulations and safety orders including applicable 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.

1.12 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.

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.

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.

1.13 TESTING LABORATORY SERVICES AND CERTIFIED LABORATORY REPORTS

A. Provide testing service in accordance with specific requirements contained in each technical specification section. Submit Certified Laboratory Reports required by technical specification sections.

1.14 PERMITS

A. The Contractor shall abide by conditions of all permits and shall obtain proof of satisfaction of conditions from issuers of permits, prior to acceptance of the Work by the City.

B. The Contractor shall obtain the following permits:

1. Permits for legal disposal of demolition debris and excess materials.

2. California/OSHA Permit for excavations deeper than five (5) feet.

3. RWQCB Permit for discharging water from dewatering operations.

4. City of San Bruno Business License and Encroachment Permit.

1.15 CONVENIENCE AND ACCESS

A. Contractor shall conduct his Work so as to minimize inconvenience to local traffic, residences, etc. The Contractor shall regard the rights of the public by not undertaking more work than he can properly conduct and complete by the end of the day.

B. The Contractor shall provide access to all fire hydrants at all times.

C. Unless the Contractor makes other arrangements with property owners, it shall provide and maintain safe and adequate vehicular access to driveways for residences at all times except when necessary trench excavations preclude such access for reasonable periods of time. The excavated trench shall be backfilled or plated as soon as possible to provide access.

D. The Contractor shall cooperate with the various forces involved in the collection and removal of trash and garbage from residences adjacent to the work, to the extent that the existing schedule for these services can be maintained.

1.16 PRE-CONSTRUCTION/POST-CONSTRUCTION PHOTOGRAPHS

A. The Contractor shall provide pre-construction photographs prior to commencement of work on the site.

B. The photographs shall be digital, color, and shall indicate the date, description of subject, and the location where the photograph was taken.

C. Before construction may begin, a CD shall be burned with all pre-construction photographs and shall be delivered to the City.

D. Pre-construction photographs shall be taken at locations selected by the Contractor, and also as directed by the Engineer. At a minimum photographs will be take at 50-feet intervals with one photo taken up line and the other photo taken down line.

E. The Contractor shall document post-construction conditions by re-photographing the same subjects, from the same locations, as taken for the pre-construction photographs. Contractor shall burn a CD with all post-construction photographs.

1.17 PUBLIC NOTIFICATION

Public notification shall consist of providing project information signs and establishing and implementing a procedure to provide at least two separate written construction notices (handouts and/or mailings) to affected properties, and door-to-door notification as described below. A written Public Notification Plan shall be provided to the Engineer for review prior to implementation and shall include documentation that required noticing has been accomplished.

A. Written Notifications: A copy of all written notices shall be provided to the Engineer for review at least one week prior to handout and/or mailing

1. Notifications shall include the type(s) of work, the period the work will last, parking and any ingress/egress impacts, construction times and dates. Notifications shall also include 24-hour contact information for the Contractor and a contact if residents or businesses have question regarding work or if they have special needs that need to be accommodated.

2. Written notifications shall consist of, at a minimum, a general notice describing the overall project including an outline of the proposed work tasks

and a second task-specific notice of the construction that will impact individual residents within the construction area. Should additional tasks impact a property, the Contractor shall provide additional task-specific notice(s) as necessary.

3. The Contractor shall provide the general written notice to all businesses and residents residing on the project streets and all emergency, garbage/recycle collection and transit services at least four (4) working days, but not more than seven (7) working days prior to start of construction on each project street. Work shall be scheduled to avoid interruption of garbage/recycling collection services.

4. The task-specific notices shall be provided to affected residents a minimum of 48 hours prior to the start of the construction task. On the day before work is to begin, the Contractor shall securely attach a door hanger reminding affected residents of the type of work (ie digouts, overlay, slurry seal, etc.), period the specific construction will last, construction time and date of construction, information regarding access to their property and information regarding street closures, parking and/or detours. Any notices remaining on doors the evening of construction completion shall be picked up and disposed of by the Contractor.

5. Failure to comply with the notification requirement will result in a stop work order. The Contractor shall maintain an updated and chronological record at the job site of all written notifications along with a list of recipients. Such records shall be made available upon request by the Engineer.

6. No work shall take place prior to the required notification, re-notification, or coordination work with affected facilities.

B. Project Information Sign: Contractor shall place a 4'x 4' min. sign facing traffic on each project roadway at the beginning and end of the project area at least seven (7) days prior to the start of construction. The signs shall be in accordance with City Standard Detail **M-01 "Project Sign Template"**, and shall include the project name, start date, and Contractor Contact Phone Number. Project title shall be 4" min. height and be legible by motorists. All excavations required to install construction area signs shall be performed by hand methods without the use of power equipment, except that power equipment may be used if it is determined there are no utility facilities in the area of the proposed post holes. Construction area signs shall be used at cross streets as needed to notify the public of the construction activities before entering the construction zone. Locations of all signs shall be approved by the Engineer prior to their placement. All signs shall be placed within City's right-of-way. No signs shall be placed in Caltrans right-of-way or private properties.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

-END OF SECTION-

SECTION 01 31 19

PROJECT MEETINGS

PART 1 - GENERAL

1.1 PRECONSTRUCTION CONFERENCE

A. City will call for and administer Preconstruction Conference at time and place to be announced (usually the week prior to start of Work at the Site).

B. Contractor, all major Subcontractors, and major suppliers shall attend Preconstruction Conference.

C. Agenda will include, but not be limited to, the following items.

1. Schedules
2. Personnel and vehicle permit procedures
3. Use of premises
4. Location of any Contractor on-Site facilities
5. Security
6. Housekeeping
7. Submittal and RFI procedures
8. Inspection and testing procedures, on-Site and off-Site
9. Control and reference point survey procedures
10. Injury and Illness Prevention Program
11. Contractor’s Initial Schedule
12. Contractor’s Schedule of Values
13. Contractor’s Schedule of Submittals

D. City will distribute copies of minutes to attendees. Attendees shall have seven (7) Days to submit comments or additions to minutes. Minutes will constitute final documentation of results of Preconstruction Conference.

1.2 WEEKLY PROGRESS MEETINGS

A. City will schedule and administer weekly progress meetings throughout duration of Work. Progress meetings will be held weekly unless otherwise directed by City.

1. Meetings shall be held at the City of San Bruno Public Works Department, Administration & Engineering, 567 El Camino Real, San Bruno, CA. 94066.

2. A City Representative will prepare agenda and distribute it 4 Days in advance of meeting to Contractor.

3. Participants with agenda items shall present them.

4. The City Engineer's authorized representative shall preside at the meetings.

5. The City shall record and distribute the meeting minutes. Minutes shall be distributed by the City to the Contractor within 3 business days after the meeting. Contractor shall distribute the minutes to those affected by decisions made at meeting. Attendees shall have five business days to submit comments or additions to the minutes. Minutes shall constitute final documentation of results of meeting.

B. Progress meetings shall be attended by Contractor's job superintendent, major Subcontractors and suppliers, City, and others as appropriate to agenda topics for each meeting.

C. Agenda will contain the following items, as appropriate:

1. Review, revise as necessary, and approve previous meeting minutes

2. Review of Work progress since last meeting

3. Status of Construction Work Schedule, delivery schedules, adjustments

4. Submittal, RFI, and Change Order status

5. Review of the Contractor's safety program activities and results, including report on all serious injury and/or damage accidents

6. Other items affecting progress of Work

1.3 PROGRESS SCHEDULE AND BILLING MEETINGS

A. A meeting will be held on approximately the 20th of each month to review the schedule update submittal and progress payment application.

1. At this meeting, at a minimum, the following items will be reviewed:

a. Percent complete of each activity;

b. Time impact evaluations for Change Orders and Time Extension Request;

c. Actual and anticipated activity sequence changes;

d. Actual and anticipated duration changes; and

e. Actual and anticipated Contractor delays.

2. These meetings are considered a critical component of overall monthly schedule update submittal and Contractor shall have appropriate personnel attend. At a minimum, Contractor's General Superintendent and Scheduler shall attend these meetings.

3. Contractor shall plan on the meeting taking no less than one hour.

1.4 SAFETY MEETINGS

A. Conduct monthly Contractor Safety Committee meetings.

B. Conduct weekly toolbox safety talks.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

-END OF SECTION-

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SECTION 01 32 16

PROGRESS SCHEDULES AND REPORTS

PART 1 - GENERAL

1.1 GENERAL

A. Progress Schedule shall be based on and incorporate Milestone and completion dates specified in Contract Documents.

B. Overall time of completion and time of completion for each Milestone shown on Progress Schedule shall adhere to times in Document 00 52 00 (Contract Agreement), unless an earlier (advanced) time of completion is requested by Contractor and agreed to by City. A Change Order shall formalize any such agreement.

1. City is not required to accept an earlier (advanced) schedule, i.e., one that shows early completion date(s) for the Contract Time.

2. Contractor is not entitled to extra compensation in the event agreement is reached on an earlier (advanced) schedule and Contractor completes its Work, for whatever reason, beyond completion date shown in earlier (advanced) schedule but within the Contract Time.

C. Failure of Progress Schedule to include any element of the Work or any inaccuracy in Progress Schedule will not relieve Contractor from responsibility for accomplishing the Work in accordance with the Contract. City's acceptance of Schedule shall be for its use in monitoring and evaluating job progress, payment requests, and time extension requests, and shall not, in any manner, impose a duty of care upon City, or act to relieve Contractor of its responsibility for means and methods of construction.

1.2 PROGRESS SCHEDULE

A. Contractor shall provide City with a Preliminary Schedule at the Preconstruction Conference which include the Contractor's schedule for up to thirty (30) Days after the Notice to Proceed.

B. The Preliminary Schedule shall indicate detailed plan for the Work to be completed in first thirty (30) Days of the Contract; details of planned mobilization; sequence of early operations; and procurement of materials and equipment. The Preliminary Schedule shall show Work beyond thirty (30) Days in summary form.

C. Contractor shall submit an updated Initial Schedule for City review and approval no later than ten (10) Days after the Notice to Proceed effective date. The Initial Schedule and all subsequent updates shall comply with all standards herein.

1.3 SCHEDULE FORMAT AND LEVEL OF DETAIL

A. Each Schedule (Preliminary, Initial, and Updates) shall indicate all separate fabrication, procurement and field construction activities required for completion of the Work, including but not limited to the following:

1. All Contractor, Subcontractor, and assigned Contractor Work shall be shown in a logical Work sequence that demonstrates a coordinated plan of Work for all contractors. The intent is to provide a common basis of acceptance, understanding, and communication, as well as interface with other contractors.

2. Activities related to the delivery of Contractor-furnished and City-furnished equipment to be Contractor-installed per Contract shall be shown.

3. All activities shall be identified through codes or other identification to indicate the building (i.e. buildings, Site Work) and Contractor/Subcontractor responsibility to which they pertain.

4. Each Schedule shall break up the work schedule into activities of durations of approximately fourteen (14) Days or less each, except for non-field construction activities or as otherwise deemed acceptable by City.

5. Each Schedule shall show the critical path in red. For each activity, the Schedule shall show early start, late start, early finish, late finish, durations measured in Days, Project Float, resources, predecessor and successor activities, planned workday/week for the activity, manpower loading, and scheduled/actual progress payments.

B. Seasonal weather conditions (which do not constitute a delay as defined herein) shall be considered in the planning and scheduling of all potential Work influenced by high or low ambient temperatures or presence of high moisture for the completion of the Work within the allotted Contract Time.

C. Failure by Contractor to include any element of Work required for performance of the Work on the detailed construction schedule shall not excuse Contractor from completing all Work required within the Contract Time.

D. A two-week “look ahead,” detailed daily bar chart schedule shall be updated weekly and provided to the City.

E. Utilize computer-scheduling software, such as “Microsoft Project” or approved equivalent, for all scheduling including schedule updates.

1.4 MONTHLY SCHEDULE UPDATE SUBMITTALS

A. Following acceptance of Contractor’s Initial Schedule, Contractor shall monitor progress of Work and adjust its Schedule each month to reflect actual progress in blue and any anticipated changes to planned activities.

1. Each Schedule update submitted shall be complete, including all information requested for the Preliminary Schedule and Initial Schedule submittal.

2. Each update shall continue to show all Work activities including those already completed.

3. Completed activities (shown in blue) shall accurately reflect “as built” information by indicating when activities were actually started and completed, and Contractor warrants the accuracy of as-built information as shown.

B. Updating, changing or revising of any report, curve, schedule or narrative submitted to City by Contractor under this Contract, nor City’s review or acceptance of any such report, curve, schedule or narrative shall not have the effect of amending or modifying, in any way, the Contract Substantial Completion date or Milestone dates or of modifying or limiting, in any way, Contractor’s obligations under this Contract.

1.5 RECOVERY SCHEDULE

A. If a Schedule update shows a Substantial Completion Date five (5) Days beyond any Contract Substantial Completion date, or individual Milestone completion dates, Contractor shall submit to City within seven (7) Days the proposed revisions to recover the lost time. As part of this submittal, Contractor shall provide a written narrative for each revision made to recapture the lost time. If the revisions include sequence changes, Contractor shall provide a schedule diagram comparing the original sequence to the revised sequence of Work. If City reasonably requests, Contractor shall show the intended critical path; secure appropriate Subcontractor and supplier consent to the recovery Schedule, and submit a narrative explaining trade flow and construction flow changes, duration changes, added/deleted activities, critical path changes and identify all near critical paths and man-hour loading assumptions for major Subcontractors.

1.6 TIME IMPACT EVALUATION (“TIE”) FOR CHANGE ORDERS, TIME EXTENSIONS AND DELAYS

A. When Contractor requests a time extension for any reason, Contractor shall submit a TIE that includes both a written narrative and a schedule diagram depicting how the changed Work or other impact affects other schedule activities. The schedule diagram shall show how Contractor proposes to incorporate the changed Work or other impact in the schedule, and how it impacts the current Schedule update critical path or otherwise. Contractor is also responsible for requesting time extensions based on the TIE’s impact on the critical path. The diagram shall be tied to the main sequence of scheduled activities to enable City to evaluate the impact of changed Work to the scheduled critical path.

B. Contractor shall comply with the requirements of paragraph 1.6A of this Section for all types of delays such as, but not limited to, Contractor/Subcontractor delays, adverse weather delays, strikes, procurement delays, fabrication delays, etc.

C. Contractor is responsible for all costs associated with the preparation of TIEs, and the process of incorporating TIEs into the current schedule update. Contractor shall provide City with four copies of each TIE.

1.7 DAILY REPORTS

A. Contractor shall provide daily construction reports the following morning showing personnel, trades, equipment and supervision on site; weather; work started, completed and any impediments, problems or delays, for the work day.

1.8 COST DATA

A. Contractor shall provide City with copies for each Day Contractor works on the Project, to be delivered to City either the same Day or the following morning before starting Work at the Site. Contractor shall take monthly progress photographs of all areas of the Work. Contractor shall maintain copies of all correspondence with Subcontractors and records of meetings with Subcontractors.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

-END OF SECTION-

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 SUBMITTAL PROCEDURES

A. Accompany each submittal with a Submittal form, 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. Submit electronic copies for each submittal and follow the procedures described below or in other paragraphs in this Section.

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. Subcontractors'/Suppliers'/Manufacturers' Affidavits. Submit electronic copies for items specified in the Technical Specifications.

4. Environmental Protection Plan. Submit electronic copies for information.

1.02 SCHEDULE OF SUBMITTALS

A. Submit electronic copies for information.

B. At the pre-construction meeting, 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 (see paragraph 1.05 of this Section) 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. Submit electronic copies.

B. Before beginning on site work, submit a plan showing Contractor's intended use of the Work site, including on site storage of materials, on site handling of materials, and field offices.

1.04 CONSTRUCTION SCHEDULE

A. Submit electronic copies for information.

B. The form of Construction Schedule may be selected by the Contractor, but shall require the following:

1. Beginning and ending date for each major construction task.

2. Sequential order of tasks.

3. Input from the Contractor’s subcontractors and suppliers.

4. An allowance for normal unfavorable weather.

5. Enough time to accomplish all clarifications or changes such that it shall not exceed time limits specified in the Contract Documents.

6. 5 working days for review and response of submittal while not impacting Contractor’s schedule.

7. Tabulation and analysis of the work schedule shall be performed by computer.

C. If the Construction Schedule does not reflect the 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 two (2) days following any monthly meeting to review Contractor's Application for Payment when Contractor's work is five (5) days or more behind schedule.

E. Accelerated Work if Required to Meet Schedule: Give Engineer three (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 three (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 for the Technical Specifications of the contract documents. Submittals required for information only are referred to as Product Information submittals in the Technical Specifications and are covered in paragraph 1.07 of this Section.

B. Number and type of submittals:

1. Shop Drawings: Submit clear, sharp high contrast electronic copies, which will be marked, stamped and returned to the Contractor.

The Contractor shall distribute the stamped copies to its superintendent, subcontractors and suppliers.

2. Product Data: Submit clear electronic copies. Electronic copies will be marked, stamped and returned. The Contractor distribute the stamped copies to its superintendent, subcontractors and suppliers.

C. 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.

D. 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.

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 "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.

F. Requirements for Contractor Designed Items:

Verify that products delivered meet requirements of Contract Documents.

G. 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.

H. 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. The Contractor warrants:

1. Work or items submitted are complete, accurate and meet the requirements of the Contract Documents, or else any deviations are identified and described in a separate letter accompanying the submittal form.

2. Work or items submitted have been coordinated with and meet the requirements of other submittals, field conditions and the Work as a while and quantities and dimensions are correct.

3. Proposed Equivalent items are at least equal in quality, utility and appearance to the first specified item, or else any deviations are identified in a separate letter accompanying the submittal form.

4. Adjustments to other work required to accommodate Proposed Equivalent items including second named items have been delineated on the submittal and will be made at the Contractor’s expense.

5. This submittal includes all items needed for a particular specification section or assembly for which submittals are required.

I. Submittals that contain deviations from the requirements of the Contract Documents shall be accompanied by a separate letter explaining the deviations. 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.

J. 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. The Engineer's Favorable Review is contingent on the Contractor's warranties. Favorable Review is also 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 in a major way. Resubmit items that comply with the requirements of the Contract Documents.

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.

K. 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.

L. Favorable Review Required Prior to Proceeding.

1. Do not proceed with manufacture, fabrication, delivery or installation of items prior to obtaining the Engineers Favorable Review of Product Review submittals.

M. Intent and Limitation on Engineer's Review

1. 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. Submittal for Proposed Equivalent products or materials shall comply with the submittal requirements for Shop Drawings, Product Data, and Samples submitted for Product Review in this Section. Bidders wanting to use “or approved equal items” may submit Document 00 43 25 (Substitution Request Form) no later than seven (7) days after the issuance of the Notice of Award.

B. Time of Submittal:

1. Submittal of Proposed Equivalents shall be received within five (5) days of the Notice to Proceed. The Engineer may agree to a later submittal date if requested in writing within five (5) days of the Notice to Proceed. The request shall identify the item, providing 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.

C. 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.

D. 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.

E. 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. Submit electronic copies.

B. Product Information submittals are required for the Owner's permanent records and will be used for future maintenance, repair, modification or replacement work. Product Information submittals will be examined only to verify that the required submittals have been made; they will NOT be reviewed for compliance with the Contract Documents.

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.

1.08 MANUFACTURER'S CERTIFICATES

A. Submit electronic copies.

B. 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.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

- END OF SECTION -

SECTION 01 41 00

REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: regulatory requirements applicable to Contract Documents.

B. Specific reference in the Specifications to codes and regulations or requirements of regulatory agencies shall mean the latest printed edition of each adopted by the regulatory agency in effect at the time of the opening of Bids, except as may be otherwise specifically stated in the Contract Documents.

C. Should any conditions develop not covered by the Contract Documents wherein the finished Work will not comply with current codes, a Change Order detailing and specifying the required Work shall be submitted to and approved by City before proceeding with the Work.

1.2 REFERENCES TO REGULATORY REQUIREMENTS

A. Contractor shall comply with all codes, laws, ordinances, rules and regulations applicable to the Work, which shall have full force and effect as though printed in full in these Specifications. Code, laws, ordinances, rules and regulations are not furnished to Contractor, because Contractor is assumed to be familiar with these requirements.

1. Work shall be accomplished in conformance with all applicable laws, ordinances, rules and regulations of federal, state, and local governmental agencies and jurisdictions having authority over the Project.

2. Work shall be accomplished in conformance with all rules and regulations of public utilities and utility districts.

3. Where such laws, ordinances rules, and regulations require more care or greater time to accomplish Work, or require better quality, higher standards or greater size of products, Work shall be accomplished in conformance to such requirements with no change to the Contract Time and Contract Sum, except where changes in laws, ordinances, rules, and regulations occur subsequent to the time of opening of the Bids.

B. Change Orders and Claims. The California Public Contract Code (including but not limited to Section 7105 (d)(2)) and the California Government Code (Section 930.2 et. seq.) apply to all contract procedures for changes, time extensions, change orders (time and money), and claims. Any change, alteration, Modifications, waiver, or omission to implement these procedures, shall have no legal effect unless approved in advance in a fully executed Change Order approved in writing by City's legal counsel.

1.3 PRECEDENCE

A. Where Drawings or Specifications require or describe products or execution of better quality, higher standard or greater size than required by applicable codes, ordinances and standards, Drawings and Specifications shall take precedence so long as such increase is legal.

B. Where no requirements are identified on Drawings or in Specifications, comply with all requirements of applicable codes, ordinances and standards of governing authorities having jurisdiction.

C. Conflicts between referenced regulatory requirements: Comply with the one establishing the more stringent requirement.

D. Conflicts between referenced regulatory requirements and Contract Documents: Comply with the one establishing the more stringent requirement.

1.4 REQUIRED PROVISIONS ON CONTRACT CLAIM RESOLUTION

A. The California Public Contract Code specifies required provisions on resolving contract claims less than $375,000, which are set forth below, and constitute a part of this Contract.

1. For the purposes of this Section, “Claim” means a separate demand by Contractor of $375,000 or less for (1) a time extension, (2) payment or money or damages arising from Work done by or on behalf of Contractor arising under the Contract Documents and payment of which is not otherwise expressly provided for or the Claimant is not otherwise entitled to, or (3) an amount the payment of which is disputed by City. In order to qualify as a Claim, the written demand must state that it is a Claim submitted under paragraph 12 of Document 00 72 00 (General Conditions) and be submitted in compliance with all requirements of Document 00 72 00, paragraph 12.

2. A voucher, invoice, payment application, or other routine or authorized form of request for payment is not a Claim for purposes of this Section. If such request is disputed as to liability or amount, then the disputed portion of the submission may be converted to a Claim under this Section by submitting a separate claim in compliance with Contract Documents claim submission requirements.

3. Caution: This Section does not apply to tort claims and nothing in this Section is intended nor shall be construed to change the time periods for filing tort claims or actions specified by Chapter 1 and Chapter 2 of Part 3 of Division 3.6 of Title 1 of the California Government Code, Sections 900, et seq.

B. Procedure:

1. The Claim must be in writing, submitted in compliance with all requirements of Document 00 72 00, paragraph 12, including, but not limited to, the time

prescribed by and including the documents necessary to substantiate the Claim, pursuant to Document 00 72 00. Claims must be filed on or before the day of final payment. Nothing in this Section is intended to extend the time limit or supersede notice requirements for the filing of claims as set forth in Document 00 72 00, paragraph 12 or elsewhere in the Contract Documents.

2. For Claims of fifty thousand dollars ($50,000) or less

    a. City shall respond in writing within forty-five (45) days of receipt of the Claim, or

    b. City may request in writing within thirty (30) days of receipt of the Claim, any additional documentation supporting the Claim or relating to any defenses or claims City may have against Claimant.

        1) If additional information is thereafter required, it shall be requested and provided in accordance with this Section, upon mutual agreement of City and Claimant.

        2) City's written response to the Claim, as further documented, shall be submitted to Claimant within fifteen (15) days after receipt of further documentation or within a period of time no greater than taken by Claimant in producing the additional information, whichever is greater.

3. For Claims over Fifty Thousand Dollars ($50,000) and less than or equal to $375,000:

    a. City shall respond in writing within 60 days of receipt of the Claim, or

    b. City may request in writing within 30 days of receipt of the Claim, any additional documentation supporting the Claim or relating to any defenses or claims City may have against Claimant.

        1) If additional information is thereafter required, it shall be requested and provided in accordance with this Section, upon mutual agreement of City and Claimant;

        2) City's written response to the Claim, as further documented, shall be submitted to Claimant within thirty (30) days after receipt of further documentation or within a period of time no greater than taken by Claimant in producing the additional information, whichever is greater.

4. Meet and Confer:

    a. If Claimant disputes City's written response, or City fails to respond within the time prescribed above, Claimant shall notify City, in writing, either within fifteen (15) days of receipt of City's response or within fifteen (15) days of City's failure to timely respond, and demand an

informal conference to meet and confer for settlement of the issues in dispute. Upon demand City will schedule a meet and confer conference within thirty (30) days for settlement of the dispute.

b. Following the meet and confer conference, if the Claim or any portion remains in dispute, Claimant may file a claim as provided in Chapter 1 (commencing with Section 900) and Chapter 2 (commencing with Section 910) of Part 3 of Division 3.6 of Title 1 of the California Government Code. For purposes of those provisions, the running of the period of time within which a claim must be filed shall be tolled from the time Claimant submits its written claim under Paragraph 1.4.B hereunder, until the time that Claim is denied as a result of the meet and confer process, including any period of time utilized by the meet and confer process.

1.5 COMPLIANCE WITH AMERICANS WITH DISABILITIES ACT

A. Contractor acknowledges that, pursuant to the Americans with Disabilities Act (ADA), programs, services, and other activities provided by a public entity to the public, whether directly or through a contractor, must be accessible to the disabled public. Contractor shall provide the services specified in the Contract Documents in a manner that complies with the ADA and any and all other applicable federal, state, and local disability rights legislation. Contractor agrees not to discriminate against disabled persons in the provision of services, benefits, or activities provided under this Agreement and further agrees that any violation of this prohibition on the part of Contractor, its employees, agents, or assigns shall constitute a material breach of the Contract Documents.

1.6 SUBSTITUTION OF SECURITIES IN LIEU OF RETENTION

A. In accordance with the provisions of California Public Contract Code Section 22300, substitution of securities for any moneys withheld under Contract Documents to ensure performance is permitted under following conditions:

1. At request and expense of Contractor, securities listed in Section 16430 of the California Government Code, bank or savings and loan certificates of deposit, interest bearing demand deposit accounts, standby letters of credit, or any other security mutually agreed to by Contractor and City which are equivalent to the amount withheld under retention provisions of Contract shall be deposited with Controller or with a state or federally chartered bank in California, as the escrow agent, who shall then pay such moneys to Contractor. Upon satisfactory completion of Contract, securities shall be returned to Contractor.

2. Alternatively, Contractor may request and City shall make payment of retentions earned directly to the escrow agent at the expense of Contractor. At the expense of Contractor, Contractor may direct the investment of the payments into securities and receive the interest earned on the investments upon the same terms provided for in Document 00 61 16 (Escrow Agreement for Security Deposit in lieu of Retention) for securities deposited

by Contractor. Upon satisfactory completion of the Work as specified in the Contract Documents, Contractor shall receive from escrow agent all securities, interest, and payments received by the escrow agent from City, pursuant to the terms of this Section. Pay to each Subcontractor, not later than twenty (20) Days after receipt of the payment, the respective amount of interest earned, net of costs attributed to retention withheld from each Subcontractor, on the amount of retention withheld to insure the performance of Contractor.

3. Contractor shall be beneficial owner of securities substituted for moneys withheld and shall receive any interest thereon.

4. Enter into escrow agreement with Controller according to Document 00 61 16 (Escrow Agreement for Security Deposits in Lieu of Retention), as authorized under California Public Contract Code Section 22300, specifying amount of securities to be deposited, terms and conditions of conversion to cash in case of default of Contractor, and termination of escrow upon completion of Contract Documents.

5. California Public Contract Code Section 22300 is hereby incorporated in full by this reference.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

-END OF SECTION-

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SECTION 01 42 16

DEFINITIONS

PART 1 - GENERAL

1.1 DEFINITIONS

A. Wherever any of the words or phrases defined below, or a pronoun used in place thereof, is used in any part of the Contract Documents, it shall have the meaning here set forth. In the Contract Documents, the neuter gender includes the feminine and masculine, and the singular number includes the plural.

B. While City has made an effort to identify all defined terms with initial caps, the following definitions shall apply regardless of case unless the context otherwise requires:

1. **Addenda**: Written or graphic instruments issued prior to the opening of Bids, which clarify, correct, or change the bidding requirements or the Contract Documents. Addenda shall not include the minutes of the Pre-Bid Conference and/or Site Visit.

2. **Contract Agreement (Document 00 52 00)**: Agreement is the basic Contract Document that binds the parties to construction Work. Agreement defines relationships and obligations between City and Contractor and by reference incorporates Conditions of Contract, Drawings, and Specifications and contains Addenda and all Modifications subsequent to execution of Contract Documents.

3. **Alternate**: Work added to or deducted from the base Bid, if accepted by City.

4. **Application for Payment**: Written application for monthly or periodic progress or final payment made by Contractor complying with the Contract Documents.

5. **Approved Equal**: Approved in writing by City as being of equivalent quality, utility and appearance.

6. **Architect/Engineer**: If used elsewhere in the Contract Documents, “Architect/Engineer” shall mean a person holding a valid California State Architect’s or Engineer’s license representing the City in the administration of the Contract Documents. Architect/Engineer may be an employee of or an independent consultant to City. When Architect/Engineer is referred to within the Contract Documents and no Architect/Engineer shall be construed to include employees of Architect/Engineer and/or employees that Architect/Engineer supervises. When the designated Architect/Engineer is an employee of City, his or her authorized representatives on the Project will be included under the term Architect/Engineer. If Architect/Engineer is an employee of City, Architect/Engineer is the beneficiary of all Contractor obligations to City, including without limitation, all releases and indemnities.

7. **Asbestos**: Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by OSHA or Cal/OSHA.

8. **Bid**: The offer or proposal of the Bidder submitted on the prescribed form(s) setting forth the prices for the Work to be performed.

9. **Bidder**: One who submits a Bid.

10. **Bidding Documents**: All documents comprising the Project Manual (including all documents and specification sections listed in Document 00 01 10 (Table of Contents), including documents supplied for bidding purposes only, and Contract Documents.

11. **Board**: The City Council of the City.

12. **Change Order**: A written instrument prepared by City and signed by City and Contractor, stating their agreement upon all of the following:

    a. A change in the Work;

    b. The amount of the adjustment in the Contract Sum, if any; and

    c. The amount of the adjustment in the Contract Time, if any.

13. **Code Inspector**: A local or state agency responsible for the enforcement of applicable codes and regulations.

14. **Construction Change Directive** ("CCD"): A written order prepared and signed by City, directing a change in the Work and stating a proposed basis for adjustment, if any, in the Contract Sum or Contract Time, or both.

15. **Contract Conditions or Conditions of the Contract**: Document 00 72 00 (General Conditions) and any other Supplementary Conditions.

16. **Contract Documents and Contract**: Contract Documents and Contract shall consist of the documents identified as the Contract Documents in Document 00 52 00 (Contract Agreement), plus all changes, Addenda, and Modifications thereto.

17. **Contract Modification**: Either:

    a. A written amendment to Contract signed by Contractor and City; or

    b. A Change Order; or

    c. A Construction Change Directive; or

    d. A written directive for a minor change in the Work issued by City.

18. **Contract Sum**: The sum stated in the Agreement and, including authorized adjustments, the total amount payable by City to Contractor for performance of the Work and the Contract Documents. The Contract Sum is also sometimes referred to as the Contract Price or the Contract Amount.

19. **Contract Time**: The number or numbers of Days or the dates stated in the Agreement to achieve Substantial Completion of the Work or designated Milestones; and/or to complete the Work so that it is ready for final payment and is accepted.

20. **Contractor**: The person or entity identified as such in the Agreement and referred to throughout the Contract Documents as if singular in number and neutral in gender. The term "Contractor" means the Contractor or its authorized representative.

21. **Contractor's Employees**: Persons engaged in execution of Work under Contract as direct employees of Contractor, as Subcontractors, or as employees of Subcontractors.

22. **City**: The City of San Bruno.

23. **City-Furnished, Contractor-Installed**: Items furnished by City at its cost for installation by Contractor at its cost under Contract Documents.

24. **City's Representative(s)**: See Document 00 52 00 (Contract Agreement).

25. **County**: The County of San Mateo, California.

26. **Day**: One calendar day of 24 hours measured from midnight to the next midnight, unless the word "day" is specifically modified to the contrary.

27. **Defective**: An adjective which, when modifying the word "Work," refers to Work that is unsatisfactory or unsuited for the use intended, faulty, or deficient, that does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents (including but not limited to approval of Samples and "or approved equal" items), or has been damaged prior to final payment (unless responsibility for the protection thereof has been assumed by City). City is the sole judge of whether Work is Defective.

28. **Drawings**: The graphic and pictorial portions of Contract Documents, wherever located and whenever issued, showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

29. **Equal**: Equal in opinion of City. Burden of proof of equality is responsibility of Contractor.

30. **Final Acceptance or Final Completion**: City's acceptance of the Work as satisfactorily completed in accordance with Contract Documents. Requirements for Final Acceptance/Final Completion include, but are not limited to:

    a. All systems having been tested and accepted as having met requirements of Contract Documents.

    b. All required instructions and training sessions having been given by Contractor.

    c. All Project Record Documents having been submitted by Contractor, reviewed by City, and accepted by City.

    d. All punch list Work, as directed by City, having been completed by Contractor.

    e. Generally all Work, except Contractor maintenance after Final Acceptance/Final Completion, having been completed to satisfaction of City.

31. **Force Account**: Work directed to be performed without prior agreement as to lump sum or unit price cost thereof, and which is to be billed at cost for labor, materials, equipment, taxes, and other costs, plus a specified percentage for overhead and profit.

32. **Home Office Overhead**: Home office overhead shall not be included as part of the cost of the Work, but shall be part of Contractor's profit and shall include, but is not limited to, the following:

    a. Accounting functions of Contractor's main office.

    b. General expenses of Contractor's main office.

    c. Interest on capital.

    d. Salaries of any home office estimators and administration.

33. **Milestone**: A principal event specified in Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all Work.

34. **Modification**: Same as Contract Modification.

35. **Not in Contract**: Work that is outside the scope of Work to be performed by Contractor under Contract Documents.

36. **Notice of Completion**: Shall have the meaning provided in California Civil Code §3093, and any successor statute.

37. **Off Site**: Outside geographical location of the Project.

38. **Overhead**: Shall include by not be limited to the following:

    a. All on-site payroll costs, and fringe benefits of same, for supervising, estimating, expediting, drafting and clerical services where directly affecting the cost of the Work.

    b. Small tools less than Five Hundred Dollars ($500.00) capital cost per item.

    c. Equipment maintenance and repairs.

    d. Temporary construction, utilities, and safety requirements, forming, and necessary scaffolding.

    e. Transportation of materials other than direct identifiable cost of specific deliveries, or as included in the price of material.

    f. Parking fees for workmen.

    g. Permit fees.

    h. Cost of reproduction

    i. General Insurance and Bonds.

39. **Partial Utilization**: Use by City of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all of the Work.

40. **PCBs**: Polychlorinated biphenyls.

41. **Phase**: A specified portion of the Work (if any) specifically identified as a Phase in Document 00 52 00 (Contract Agreement).

42. **Product Data**: That information (brochures, catalog sheets, manufacturer's cut sheets, etc.) supplied by vendors having technical and commercial characteristics of the supplied equipment or materials and accompanying commercial terms such as warranties, instructions, and manuals.

43. **Progress Report**: A periodic report submitted by Contractor to City with progress payment invoices accompanying progress schedule. See Document 00 72 00 (General Conditions).

44. **Project**: Total construction of which Work performed under Contract Documents may be whole or part.

45. **Project Manager**: If used elsewhere in the Contract Documents, "Project Manager" shall mean a person representing the City in the administration of the Contract Documents. Project Manager may be an employee of or an independent consultant to City. When Project Manager is referred to

within the Contract Documents and no Project Manager has been designated, the matter shall be referred to City. The term Project Manager shall be construed to include employees of Project Manager and/or employees that Project Manager supervises. When the designated Project Manager is an employee of City, his or her authorized representatives on the Project will be included under the term Project Manager. If Project Manager is an employee of City, the Project Manager is the beneficiary of all Contractor obligations to City, including without limitation, all releases and indemnities.

46. **Project Manual**: Project Manual consists of Bidding Requirements, Agreement, Bonds, Certificates, Contract Conditions, Drawings, and Specifications.

47. **Project Record Documents**: All Project deliverables required under Sections 01 78 39, including without limitation, As-built drawings; Installation, Operation, and Maintenance Manuals; and Machine Inventory Sheets.

48. **Reference Specifications (RS):** The current edition of the Standard Specifications for Public Works Construction also known as the "Greenbook".

49. **Request for Information ("RFI")**: A document prepared by Contractor requesting information regarding the Project or Contract Documents. The RFI system is also a means for City to submit Contract Document clarifications or supplements to Contractor.

50. **Request for Proposals ("RFP")**: A document issued by City to Contractor whereby City may initiate changes in the Work or Contract Time as provided in Contract Documents.

51. **Request for Substitution ("RFS")**: A document prepared by Contractor requesting substitution of materials as permitted and to the extent permitted in Contract Documents.

52. **RFI-Reply**: A document consisting of supplementary details, instructions, or information issued by City that clarifies or supplements Contract Documents, and with which Contractor shall comply. RFI-Replies do not constitute changes in Contract Sum or Contract Time except as otherwise agreed in writing by City. RFI-Replies will be issued through the RFI administrative system.

53. **Samples**: Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

54. **Shop Drawings**: All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

55. **Site**: The particular geographical location of Work performed pursuant to Contract Documents.

56. **Specifications**: The written portion of the Contract Documents consisting of requirements for materials, equipment, construction systems, standards, and workmanship for the Work; performance of related services.

57. **Standard Specifications (SS)**: The current edition of the Standard Specifications as issued by the State of California Department of Transportation (Caltrans).

58. **Subcontractor**: A person or entity that has a direct contract with Contractor to perform a portion of the Work at the Site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and neutral in gender and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

59. **Substantial Completion**: The Work (or a specified part thereof) has progressed to the point where, in the opinion of City as evidenced by a Certificate of Substantial Completion, the Work is sufficiently complete, in accordance with Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if no such certificate is issued, when the Work (or specified part) is complete and ready for final payment as evidenced by written recommendation of City for final payment. The terms "Substantially Complete" and "Substantially Completed" as applied to all or part of the Work refer to Substantial Completion thereof.

60. **Supplemental Instruction**: A written directive from City to Contractor ordering alterations or Modifications that do not result in change in Contract Sum or Contract Time, and do not substantially change Drawings or Specifications.

61. **Underground Facilities**: All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities that have been installed underground to furnish any of the following services or materials: Electricity, gases, chemicals, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems, or water.

62. **Unit Price Work**: Shall be the portions of the Work for which a unit price is provided in Document 00 52 00 (Contract Agreement) or 01 11 00 (Summary of Work).

63. **Work**: The entire completed construction, or the various separately identifiable parts thereof, required to be furnished under the Contract Documents within the Contract Time. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents including everything shown in the Drawings and set forth in the Specifications. Wherever the word “work” is used, rather than the word “Work,” it shall be understood to have its ordinary and customary meaning.

64. **Working Day**: Any Day other than Saturday, Sunday, and the following days that have been designated as holidays by City. If a holiday falls on a Saturday, the preceding Friday will be the holiday. If a holiday falls on a Sunday, the following Monday will be the holiday.

    a. New Year’s Day, January 1;

    b. Martin Luther King Jr.’s Birthday, third Monday in January;

    c. Lincoln’s Birthday, February 12;

    d. Presidents’ Day, third Monday in February;

    e. Memorial Day, last Monday in May;

    f. Independence Day, July 4;

    g. Labor Day, first Monday in September;

    h. Veterans’ Day, November 11;

    i. Thanksgiving Day, as designated by the President;

    j. The Day following Thanksgiving Day;

    k. Christmas Eve, December 24;

    l. Christmas Day, December 25; and

    m. Each day appointed by the Governor of California and formally recognized by the Board as a day of mourning, thanksgiving, or special observance.

C. The following terms are not necessarily identified with initial caps; however they shall have the meaning set forth below:

    1. Wherever words “as directed,” “as required,” “as permitted,” or words of like effect are used, it shall be understood that direction, requirements, or permission of City is intended. Words “sufficient,” “necessary,” “proper,” and the like shall mean sufficient, necessary, or proper in judgment of City. Words “approved,” “acceptable,”

"satisfactory," "favorably reviewed," or words of like import, shall mean approved by, or acceptable to, or satisfactory to, or favorably reviewed by City.

2. Wherever the word "may" or "ought" is used, the action to which it refers is discretionary. Wherever the word "shall" or "will" is used, the action to which it refers is mandatory.

3. **By City**: Work that will be performed by City or its agents at the City's expense.

4. **By Others**: Work that is outside scope of Work to be performed by Contractor under this Contract, which will be performed by City, other contractors, or other means.

5. **Concealed**: Work not exposed to view in the finished Work, including within or behind various construction elements.

6. **Exposed**: Work exposed to view in the finished Work, including behind louvers, grilles, registers and various other construction elements.

7. **Furnish**: Supply only, do not install.

8. **Indicated**: Shown or noted on the Drawings.

9. **Install**: Install or apply only, do not furnish.

10. **Latent**: Not apparent by reasonable inspection, including but not limited to, the inspections and research required as a condition to bidding under Document 00 72 00 (General Conditions).

11. **Law**: Unless otherwise limited, all applicable laws including without limitation all federal, state, and local laws, statutes, standards, rules, regulations, ordinances, and judicial and administrative decisions.

12. **Material**: This word shall be construed to embrace machinery, manufactured articles, materials of construction (fabricated or otherwise), and any other classes of material to be furnished in connection with Contract, except where a more limited meaning is indicated by context.

13. **Provide**: Furnish and install.

14. **Shown**: As indicated on Drawings.

15. **Specified**: As written in Specifications.

16. **Testing and special inspection agency**: An independent entity engaged by City to inspect and/or test the workmanship, materials, or manner of construction of buildings or portions of buildings, to determine if such construction complies with the Contract Documents and applicable codes.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

-END OF DOCUMENT-

SECTION 01 51 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Temporary Electricity
2. Temporary Telephone
3. Temporary Water
4. Temporary Sanitary Facilities
5. Temporary Barriers and Enclosures
6. Tree and Plant Protection
7. Water Control
8. Noise Control
9. Traffic Control
10. Storm Water Pollution Prevention Plan
11. Removal of Temporary Facilities and Controls

1.2 DEFINITIONS

A. Dripline: The area on the ground from the trunk of any tree to the point directly below the outermost tips of the foliage of that tree.

B. Root Protection Zone (RPZ): The areas enclosed with tree protection fencing as indicated.

C. Tree damage: Tree damage shall include, but not be limited to, the following: significant injury to the root system or other parts of a tree including burning, application of toxic substances, damaging through contact with equipment or machinery, changing the natural grade within the Dripline, compacting the soil within the Dripline, interfering with the normal water requirements of the tree, unauthorized trenching or excavating within the Dripline, or unauthorized removal of more than 1/3 of the live wood, foliage, or roots.

1.3 SUBMITTALS

A. See also Section 01 33 00 (Submittal Procedures)

B. Tree Protection Plan

1.4 TEMPORARY ELECTRICITY

A. Provide, maintain, and pay for electrical power at the Site for construction purposes.

1.5 TEMPORARY TELEPHONE

A. Provide, maintain, and pay for telephone service to field office at time of Project mobilization.

1.6 TEMPORARY WATER

A. Provide, maintain, and pay for suitable quality water service required for construction operations.

B. Contractor may use City-provided water from nearby fire hydrants for use on this Project. Contact City three Days prior to commencement of Work to coordinate using City's water. City will provide and install a backflow prevention device and water meter if City determines it to be necessary. This water will only be available from 8:00 a.m. to 5:00 p.m. Mondays through Fridays (excluding holidays). Should City determine, in its sole discretion, that Contractor's use of City's water is excessive, City may terminate water delivery.

1.7 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required temporary buildings with sanitary toilets for use of all workers.

B. Comply with all minimum requirements of the Health Department or other public agency having jurisdiction; maintain in a sanitary condition at all times.

1.8 TEMPORARY BARRIERS AND ENCLOSURES

A. Provide barriers to prevent unauthorized entry to construction areas, to allow for City's use of Site, and to protect existing facilities and adjacent properties from damage from construction operations.

B. Provide barricades required by governing authorities for public access to existing buildings.

C. Provide barricades as necessary to protect vehicular traffic, stored materials, Site, and structures from damage.

1.9 TREE AND PLANT PROTECTION

A. Root protection: No storage of materials or equipment will be allowed within the Dripline. Whenever possible, excavation shall be on a radial line, diverging from the tree trunk.

B. Exposure to harmful substances: No storage or dumping of any substances that may be harmful to trees shall occur at any location on the Site.

C. Where construction is to be performed in the vicinity of trees and shrubbery, the Work shall be carried on in a manner that will cause minimum damage. City will designate any trees that are to be removed. Under no circumstances are additional trees to be removed without written permission from City. Trees and shrubbery that are not to be removed shall be protected from injury or damage resulting from Contractor's operations.

D. All damage shall be immediately reported to City, who will file a report so that penalties may be determined.

E. Any tree that is removed without City's permission or is irreparably damaged, in the opinion of City, shall cost Contractor $27.00 per square inch of cross section, measured at 4 ½ feet above ground, but not less than $250.00, such cost to be deducted from monies due or to become due under the Contract. If tree protection is not performed or is not performed adequately, and City determines that a tree has been irreparably damaged, City will impose the same penalty as for unauthorized removal of a tree.

1.10 WATER CONTROL

A. Grade Site to drain.

B. Maintain excavations free of water.

C. Protect Site from ponding or running water.

D. Provide water barriers as required to protect Site from soil erosion.

1.11 NOISE CONTROL

A. When required by OSHA Standards, construction workers shall be provided with ear protection to operate equipment.

B. Work that produces noise levels above ambient will not be permitted prior to 8:00 a.m.

1.12 TRAFFIC CONTROL

A. Notification:

1. One week prior to commencement of Work, notify residents along the Project roadway(s), in writing, that traffic flows may be subject to detours and/or delays, and that access to individual driveways may be disrupted during working hours. Provide City with a copy of the notice for review prior to distribution.

2. At least one (1) week prior to commencement of Work, post the Project area to inform drivers of impending construction Work and likely delays and detours. Provide City with a copy of the notice for review prior to distribution.

3. Notify the property occupants, in writing, at least three (3) Days in advance of the trenching across property occupants' driveways. Provide City with a copy of the notice for review prior to distribution.

4. The Contractor shall maintain private entrances and shall construct such detours as may be necessary to properly conduct the work and to provide ingress and egress to private property at all times.

5. The Contractor shall make all arrangements with property owners for the use of private land for detours and for any other purpose, and shall save the City free from any liability incurred through the use or nonuse of such private property.

6. Coordinate vehicular access with other agencies, police, fire, garbage, USPS, etc. at least three (3) Days prior to commencement of Work.

7. If any applicable permits require Contractor to notify residents or any organization of traffic detours or delays, provide City a copy of all such notices for review prior to distribution.

8. Coordinate parking, storage, staging, and Work areas with City. No-Parking signs shall be posted, at least 3 Days, prior to start of work.

B. Traffic Control Measures:

1. Traffic control and safety precautions shall conform with the current edition of Caltrans "Manual of Uniform Traffic Control Devices," all provisions of the City of San Bruno encroachment permit, and with these Specifications.

2. The Contractor shall submit a traffic control plan to the Engineer for approval prior to commencing the work. Unless otherwise approved by the Engineer, the traffic control plan shall be wet stamped by either a Registered Civil or Traffic Engineer.

3. Pay for all costs for traffic signage, including flagging.

4. Provide safe passage for vehicular and pedestrian traffic through the Work at all times.

5. Traffic on two-lane streets may be reduced to one lane provided that, with all restriction of traffic flow, flaggers, cones, signs, and barricades are furnished as required by City. Permit the traffic equal flow time in each direction.

6. Maintain access to public and private buildings, businesses and driveways. Provide approved metal "bridge" or temporary backfill for access when and where required within ½ hour after request by City except that emergency vehicles and personnel shall be provided immediate access at all times.

7. Restore access to all residences for all non-working hours, holidays, and weekends.

C. Maintain traffic control measures:

1. Maintain traffic control through the Site and provide local access as specified herein regardless of rain or other causes, either within or beyond the control of Contractor, that may force suspension or delay of the Work. At all times keep on the Site such materials, labor forces, and equipment as may be necessary to keep the streets and driveways within the Site open to traffic and in good repair. Expedite the passage of such traffic, using such labor forces and equipment as may be necessary.

1.13 STORM WATER POLLUTION PREVENTION PLAN

A. Prior to commencement of Work at the Site, provide City a Storm Water Pollution Prevention Plan (SWPPP) prepared in accordance with NPDES General Permit No. CAS 000002 (Water Quality Order 99-08-DWQ) issued by the State Water Resources Control Board.

B. Prepare the SWPPP in accordance with the requirements of Section A of the NPDES General Permit. Develop and implement a monitoring program in accordance with requirements set forth in Section B of the NPDES General Permit to verify compliance with the NPDES General Permit.

C. Submit SWPPP to City for review in accordance with Section 01 33 00 (Submittal Procedures). The SWPPP shall be reviewed by City prior to commencement of Work at the Site.

D. The SWPPP shall include a Site map. Geometric equations, notes, details, and all data not related to water pollution control work shall be removed to improve clarity. A copy of the Drawings shall be used as a base sheet with

the pertinent stage of construction drawn in as an overlay to accurately reflect Site conditions at various phases of construction.

E. Revise and update the SWPPP whenever there is a change in construction operations that may affect the Site drainage patterns or discharge of pollutants to surface waters, groundwaters, or a separate municipal storm sewer system.

F. Failure to fully comply with the requirements of the NPDES General Permit shall subject Contractor to all fines, damages, and job delays incurred due to failure to implement the SWPPP.

G. A copy of the approved SWPPP, together with updates and revisions, shall be kept at the Site. Contractor shall furnish copies of the SWPPP at the request of City.

F. At City's option, failure by Contractor to fully comply with the approved SWPPP shall subject the Contractor to a stoppage of work or fines of $250 per day until compliance as determined by the Engineer is achieved.

1.14 REMOVAL OF TEMPORARY FACILITIES AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials prior to final inspection.

B. Clean and repair damage caused by installation or use of temporary Work.

C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 – PRODUCTS – NOT APPLICABLE

PART 3 – EXECUTION – NOT APPLICABLE

-END OF SECTION-

SECTION 01 56 36

TEMPORARY SITE SECURITY AND SAFETY

PART 1 - GENERAL

1.1 SUBMITTALS

A. Health and Safety Plan

1.2 PROTECTION

A. Contractor shall continuously maintain protection as necessary to protect the Work, as a whole and in part, and adjacent property and improvements from accidents, injuries or damage.

B. Contractor shall properly protect the Work:

1. With lights, guard rails, temporary covers or barricades.

2. Enclose excavations with proper barricades.

3. Brace and secure all parts of the Work against storm and accident.

4. Provide such additional forms of protection that may be necessary under existing circumstances.

C. Contractor shall provide and maintain in good condition all protective measures required to adequately protect the public from hazards resulting from the Work and to exclude unauthorized persons from the Work. When regulated by Building Code, Cal OSHA, or other authority, such legal requirements for protection shall be considered as minimum requirements. Contractor shall be responsible for the protection in excess of such minimum requirements as required.

1.3 CONTROL OF SITE

A. Contractor shall ensure that no alcohol, firearms, weapons, or controlled substance enters or is used at the Site. Contractor shall immediately remove from the Site and terminate the employment of any employee found in violation of this provision.

1.4 SAFETY PROGRAM

A. Prior to starting any Work at the Site, Contractor shall submit a Safety Program that has been reviewed and approved by an Industrial Hygienist certified by the American Board of Industrial Hygiene or a Certified Safety Professional. The Safety Program shall include the name, certification number, and certification seal of the Industrial Hygienist or Certified Safety Professional. Contractor shall

comply with the Safety Program and all applicable federal, state, and local regulation codes, rules, law and ordinances.

B. Receipt and/or review of the Safety Program by City, Project Manager or City's Representative shall not relieve Contractor of any responsibility for complying with all applicable safety regulations.

C. It is essential that Contractor and each Subcontractor implement an effective and vigorous Safety Program to cover their respective portions of the Work. Subject to Contractor's overall responsibility for Project safety, it shall be understood that the full responsibility for providing a safe place to work with respect to their respective portions of the Work rests with each individual Contractor and Subcontractor.

D. Safety Program components:

1. Injury and Illness Prevention Program (IIPP): Conforming to the General Industrial Safety Orders (CCR Title 8, Division 1, Chapter 4, Subchapter 7, Section 3203), and the California Labor Code (Section 6401.7).

2. Site-Specific Safety and Health Plan (SSHP): Describing health and safety procedures that shall be implemented during the Work in order to ensure safety of the public and those performing the Work. Follow the guidelines for a SSHP listed in CCR Title 8, Division 1, Chapter 4, Subchapter 7, Section 5192, Item (b)(4) f.

E. The wearing of hard hats shall be mandatory at all times for personnel on Site. Contractor shall supply sufficient hard hats to equip properly all employees and visitors.

F. Whenever an exposure exists, appropriate personal protective equipment (PPE) shall be used by all affected personnel. Contractor shall supply PPE to all personnel under Contractor's direction.

1.5 SAFETY REQUIREMENTS

A. Standards: Contractor shall maintain the Project in accordance with state and local safety and insurance standards.

B. Hazards Control:

1. Contractor shall store volatile wastes in covered metal containers and remove from premises daily.

2. Contractor shall prevent accumulation of wastes that create hazardous conditions.

3. Contractor shall provide adequate ventilation during use of volatile or noxious substances.

C. Contractor shall conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.

1. Do not burn or bury rubbish or waste material on the Site

2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains

3. Do not dispose of wastes into streams or waterways

D. Provide accident information on the forms provided by Contractor. This information shall be provided on the same Day as the occurrence of said incident.

1.6 SITE SAFETY OFFICER

A. Designate one of Contractor's staff as "Site Safety Officer" whose duties shall include the responsibility for enforcing the environmental protection provisions of the Contract Documents including safety and health, the requirements of the Occupational Safety and Health Act, and other applicable federal, state and local standards. Submit for review by City Contractor's intended Traffic Control Plan(s), Safety Plan, Access Plan. After review by City, the implementation and enforcement of these plans shall become the responsibility of the Site Safety Officer. Any changes in the plans shall be requested by Contractor through the Site Safety Officer for written concurrence by City.

B. City's risk management representative(s) shall be allowed access to accident/injury and illness reports, inspection reports, scheduling and construction meetings, and safety meetings.

PART 2 - PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

-END OF SECTION-

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SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Products

B. Product Options and Substitutions

C. Product Delivery Requirements

D. Product Storage and Handling

1.2 PRODUCTS

A. Products: New material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying, and erection of the Work. Products may also include existing materials or components required for reuse.

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

C. For similar components, provide interchangeable components of the same manufacturer.

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Summary:

1. This Paragraph 1.3 describes procedures for selecting products and requesting substitutions of unlisted materials in lieu of materials named in the Specifications or approved for use in Addenda that were not already the subject of a Document 00 43 25 (Substitution Request Form) submittal as provided in Document 00 21 00 (Instructions to Bidders).

B. Contractor's Options:

1. For products specified only by reference standard: Select any product meeting that standard.

2. For products specified by naming one or more products or manufacturers:

a. Select products of any named manufacturer meeting Specifications.

b. If product becomes unavailable due to no fault of Contractor, submit Request for Substitution (RFS), including all information contained in this

Section and a fully executed Document 00 21 00, but using the term ”Contractor” each place the term ”Bidder” appears in that form.

C. Substitutions:

1. Except as provided in Document 00 21 00 (Instructions to Bidders) with respect to “or Approved Equal” items, City will consider Contractor’s substitution requests only when product becomes unavailable due to no fault of Contractor or if the product specified no longer complies with local regulations or laws. Requests for review of proposed substitute items will not be accepted from anyone other than Contractor. The RFS shall state the extent, if any, to which the evaluation and acceptance of the proposed substitute will prejudice Contractor’s achievement of Substantial Completion on time, and whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with City for work on the Project).

2. Submit separate RFS (and four copies) for each product and support each request with:

   a. Product identification

   b. Manufacturer’s literature

   c. Samples, as applicable

   d. Name and address of similar projects on which product has been used, and dates of installation

   e. Name, address, and telephone number of manufacturer’s representative or sales engineer

   f. For construction methods: Detailed description of proposed method; drawings illustrating methods

3. Where required, itemize a comparison of the proposed substitution with product specified and list significant variations including, but not limited to dimensions, weights, service requirements, and functional differences. If variation from product specified is not pointed out in submittal, variation will be rejected even though submittal was favorably reviewed. Identify all variations of the proposed substitute from that specified in the RFS and indicate available maintenance, repair, and replacement service.

4. State whether the substitute will require a change in any of the Contract Documents (or provisions of any other direct contract with City for work on the Project) to adapt the design of the proposed substitute, and whether or not incorporation or use of the substitute in connection with Work is subject to payment of any license fee or royalty. Submit data relating to changes in construction schedule.

5. Include accurate cost data comparing proposed substitution with product and amount of net change in Contract Sum including, but not limited to, an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which will be considered by City in evaluating the proposed substitute. City may require Contractor to furnish additional data about the proposed substitute.

6. City will not consider substitutions for acceptance (or, in City's sole discretion, City may make Contractor solely responsible for all resulting costs, expenses and other consequences) when a substitution:

    a. Results in delay meeting construction Milestones or completion dates.

    b. Is indicated or implied on submittals without formal request from Contractor.

    c. Is requested directly by Subcontractor or supplier.

    d. Acceptance will require substantial revision of Contract Documents.

    e. Disrupts Contractor's job rhythm or ability to perform efficiently.

7. Substitute products shall not be ordered without written acceptance of City.

8. City will determine acceptability of proposed substitutions and reserve right to reject proposals due to insufficient information.

9. Accepted substitutions will be evidenced by a Change Order or a CCD. All Contract Document requirements apply to Work involving substitutions.

D. Contractor's Representation and Warranty:

1. Contractor's RFS constitutes a representation and warranty that Contractor:

    a. Has investigated proposed product and determined that it meets or exceeds, in all respects, specified product.

    b. Will provide the same warranty for substitution as for specified product.

    c. Will coordinate installation and make other changes that may be required for Work to be complete in all respects.

    d. Waives claims for additional costs which may subsequently become apparent.

    e. Will compensate City for additional redesign costs associated with substitution.

    f. Will be responsible for Construction Schedule slippage due to substitution.

g. Will be responsible for Construction Schedule delay due to late ordering of available specified products caused by requests for substitution that are subsequently rejected by City.

h. Will compensate City for all costs; including extra costs of performing Work under Contract Documents, extra cost to other contractors, and any claims brought against City, caused by late requests for substitutions or late ordering of products.

E. City's Duties:

1. Review Contractor's RFS with reasonable promptness

2. Notify Contractor in writing of decision to accept or reject requested substitution

F. Administrative Requirements:

1. Specified products, materials, or systems for Project may include engineering or on-file standards required by the regulatory agency. Contractor's substitution of products, materials or systems may require additional engineering, testing, reviews, approvals, assurances, or other information for compliance with regulatory agency requirements or both. Provide all agency approvals or other additional information required and pay additional costs for required City services made necessary by the substitution at no increase in Contract Sum or Contract Time, and as a part of substitution proposal.

1.4 PRODUCT DELIVERY REQUIREMENTS

A. Deliver products in accordance with manufacturer's instructions.

B. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

1.5 PRODUCT STORAGE AND HANDLING

A. Store products only in staging area per provisions of Section 01 11 00 (Summary of Work).

B. Handle, store, and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate-controlled enclosures.

C. For exterior storage of fabricated products, place on appropriate supports, above ground.

D. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.

E. Store loose granular materials on solid flat surfaces in a well-drained area.

F. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

G. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

PART 2 - PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

-END OF SECTION-

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SECTION 01 71 13

MOBILIZATION, SITE MAINTENANCE, DEMOBILIZATION

PART 1 - GENERAL

1. GENERAL

Mobilization, site maintenance, and demobilization consists of moving in and establishing the work zones, establishing health and safety procedures, performing site maintenance and cleanup, and moving out of the work site.

2. PERMITS

Obtain all licenses and permits as required in Section 00 72 00 General Conditions, Subsection 13- Legal and Miscellaneous, and Section 01 33 00 Submittal Procedures of the City's Standard Specifications. Coordinate obtaining permits with City, as necessary.

3. TREE PROTECTION

Prior to commencement of any construction activity beneath or within 10' of the drip-line of a Street or Heritage tree, the Contractor shall present a Tree Protection Plan to the City for approval. The Tree Protection Plan shall be prepared by a certified arborist to assess impacts of the proposed construction to the tree(s), recommend mitigation to reduce impacts to the tree(s) to a less than significant level, and identify construction guidelines to be followed through all phases of the project, and may include care after construction.

4. FENCING

Install any temporary fencing on the locations as deemed necessary by the City or the Contractor for site security.

5. NOTIFICATION FOR PROPERTY OWNERS AND TENANTS

The Contractor shall furnish all affected property owners and/or residents and merchants written notification that describes the proposed work. The notices shall include relevant dates and describe anticipated impacts to property owners during the work, including, but not limited to, a description of landscaping and improvements that may be affected and/or removed and a statement that the owners/residents have a right to salvage all such existing landscaping, improvements and/or materials that the Contractor may remove to facilitate construction within the right-of-way. The content, format, and method of delivery of such notices shall be approved by the Engineer prior to distribution. The Contractor is advised that these notices shall not be placed in mailboxes, as it is a violation of federal postal regulations. Affected property owners and residents or merchants shall be considered all those who:

a. Front on or are contiguous to the Project limits.

b. Have ingress/egress route only from within the Project limits.

The Contractor shall provide approved notification to all affected owners/residents a minimum of **ten (10) CALENDAR DAYS** prior to the commencement of any Project site work. Failure to distribute notices shall be sufficient cause for the Engineer to suspend the work until such notices are distributed.

6. WORK ZONES

Establish exclusion, decontamination, and clean zones at the Site, using temporary chain link fence, traffic barricades, caution tape, or other appropriate method.

7. RUBBISH AND TRASH

Collect rubbish and trash daily. Do not allow rubbish and trash to collect such that a safety or fire hazard exists or nuisance or bad appearance.

8. SITE MAINTENANCE

Promptly decontaminate and remove materials or equipments that have served their use on the Site. At the end of each day, perform the following:

a. Secure the site;

b. Store equipment and materials in locations approved by City;

c. Disconnect water and power (except as needed for health and safety and security.)

9. FINAL CLEANUP AND DEMOBILIZATION

a. Upon completion of the Work, decontaminate (if necessary) and remove all materials and equipment brought to the Site.

b. Leave the Site clear of all debris, including thoroughly sweeping all paved areas.

c. Remove any temporary fencing that was installed.

d. Repair any damage to fences, buildings, streets, parking lots, curbs, landscaping, and other property caused by Contractor's activities.

e. Decontaminate all equipment, vehicles, or other items prior to removal from the Site.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

-END OF SECTION-

SECTION 01 74 00

CLEANING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Progress Cleaning

B. Final Cleaning

1.2 PROGRESS CLEANING

A. Contractor shall perform cleaning to ensure that any streets and other City and public properties are maintained free from accumulation of waste materials, dust, mud, and debris.

B. Where required, Contractor shall wet down surfaces to lay dust and prevent the blowing of dust to nearby residences or public properties.

C. Contractor shall keep all paved roads clean and free of dust, mud, and debris resulting from Contractor's operations. Daily cleanup throughout the job will be necessary as Contractor progresses with its Work, but extra attention to cleanup shall be made prior to weekends and holidays. Without limiting the foregoing, Contractor shall remove trench spoil along traveled ways daily; grade and vacuum broom surfaces initially where applicable and later water flush with high-pressure sprays, being careful to avoid downstream contamination.

D. All dust, mud, spoils, and construction debris shall be removed daily from all roadways, ditches, shoulders, and private property (fills or spoils placed on private property at private property owner's written request excepted).

E. Disposal of Materials:

1. All waste materials, debris, and rubbish shall be legally disposed of at sites to be chosen by Contractor in accordance with applicable local, state, and federal regulations.

2. Contractor is cautioned that the City of San Bruno and County of San Mateo have regulations governing the disposal of rubble, broken pavement, and similar materials.

3. Become familiarized with the requirements of the agency having jurisdiction over any contemplated disposal site and shall comply with all such requirements.

F. All excess soil from performance of Work shall be legally disposed at sites to be chosen by Contractor in accordance with applicable local, state, and federal regulations. If Contractor elects to dispose of soil on any private property, prior to any dumping, a letter allowing such dumping shall be obtained from the

property owner and presented to City. Contractor is advised that the property owner is required to obtain a grading permit from City. In addition, placement of fill in wetland areas is subject to permit procedures of the US Army Corps of Engineers. At the completion of Work, a letter from each affected property owner will be required releasing Contractor, City, and any City consultant from future liability.

G. If Contractor does not properly clean the Site, in the opinion of City, then City shall have the option of using outside equipment to perform the cleanup and such cost will be withheld from the Contract Sum.

1.3 FINAL CLEANING

A. Contractor shall execute final cleaning prior to final inspection, using only properly skilled workers.

B. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from exposed interior and exterior finished surfaces.

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

D. Clean interior and exterior surfaces exposed to view: remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

E. Clean equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment operated during construction, clean ducts, blowers and coils of units operated without filters during construction.

F. Clean Site.

G. Mechanically sweep paved areas.

H. Remove waste and surplus materials, rubbish, and construction facilities from Site.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

-END OF SECTION-

SECTION 01 77 00

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 THIS SECTION INCLUDES THE FOLLOWING DESCRIPTION OF CONTRACT CLOSEOUT PROCEDURES:

1. Removal of Temporary Construction Facilities
2. Substantial Completion
3. Final Completion
4. Project Record Documents
5. Project Guarantee
6. Warranties
7. Turn-In
8. Release of Claims

1.2 REMOVAL OF TEMPORARY CONSTRUCTION FACILITIES

A. Remove temporary materials, equipment, services, and construction prior to Substantial Completion inspection.

B. Clean and repair damage caused by installation or use of temporary facilities.

C. Restore permanent facilities used during construction to specified condition.

D. Comply with Paragraph 1.14 of Section 01 51 00 (Temporary Facilities and Controls).

1.3 SUBSTANTIAL COMPLETION

A. When Contractor considers Work or designated portion of the Work as Substantially Complete, submit written notice to City, with list of items remaining to be completed or corrected.

B. Within reasonable time, City will inspect to determine status of completion.

C. Should City determine that Work is not Substantially Complete, City will promptly notify Contractor in writing, listing all defects and omissions.

D. Remedy deficiencies and send a second written notice of Substantial Completion. City will re-inspect the Work. If deficiencies previously noted are not corrected on re-inspection, then pay the cost of the re-inspection.

E. When City concurs that Work is Substantially Complete, City will issue a Certificate of Substantial Completion, accompanied by Contractor's list of items to be completed or corrected as verified by City.

F. Manufactured units, equipment and systems that require startup must have been started up and run for periods prescribed by City before a Certificate of Substantial Completion will be issued.

G. A punch list examination will be performed upon Substantial Completion. One follow-up review of punch list items for each discipline will be provided. If further Site visits are required to review punch list items due to incompleteness of the Work by Contractor, Contractor will reimburse City for costs associated with these visits.

1.4 FINAL COMPLETION

A. Final Completion occurs when Work meets requirements for City's Final Acceptance. When Contractor considers Work is Finally Complete, submit written certification that:

1. Contractor has inspected Work for compliance with Contract Documents, and all requirements for Final Acceptance have been met.

2. Except for Contractor maintenance after Final Acceptance, Work has been completed in accordance with Contract Documents and deficiencies listed with Certificate of Substantial Completion have been corrected. Equipment and systems have been tested in the presence of City, and are operative.

3. Work is complete and ready for final inspection.

B. In addition to submittals required by Contract Documents, provide submittals required by governing authorities and submit final statement of accounting giving total adjusted Contract Sum, previous payments, and sum remaining due.

C. When City finds Work is acceptable and final closeout submittals are complete, City will issue final Change Order reflecting approved adjustments to Contract Sum not previously made by Change Order. Should City determine that Work is incomplete or defective.

1. City promptly will so notify Contractor, in writing, listing the incomplete or Defective items.

2. Promptly remedy the deficiencies and notify the City when it is ready for re-inspection.

3. When City determines that the Work is acceptable under the Contract Documents, City will request Contractor to make closeout submittals.

D. Final adjustments of accounts:

1. Submit a final statement of accounting to City, showing all adjustments to the Contract Sum and complete and execute Document 00 52 17 (Agreement and Release of Any and All Claims).

2. If so required, City shall prepare a final Change Order for submittal to Contractor, showing adjustments to the Contract Sum that were not previously made into a Contract Modification.

1.5 PROJECT RECORD DOCUMENTS

A. Contract Documents will not be closed out and final payment will not be made until completion and submittal of Project Record Documents described in Section 01 78 39 (Project Record Documents).

1.6 PROJECT GUARANTEE

A. Requirements for Contractor's guarantee of completed Work are included in Article 9 of Document 00 72 00 (General Conditions). Guarantee Work done under Contract against failures, leaks, or breaks or other unsatisfactory conditions due to defective equipment, materials, or workmanship, and perform repair work or replacement required, at Contractor's sole expense, for period of one year from date of Final Acceptance.

B. Neither recordation of Final Acceptance nor final certificate for payment nor provision of the Contract nor partial or entire use or occupancy of premises by City shall constitute acceptance of Work not done in accordance with Contract Documents nor relieve Contractor of liability in respect to express warranties or responsibility for faulty materials or workmanship.

C. City may make repairs to Defective Work as set forth in Document 00 72 00, Paragraph 9.3.

D. If, after installation, operation, or use of materials or equipment to be provided under Contract proves to be unsatisfactory to City, City shall have right to operate and use materials or equipment until said materials and equipment can, without damage to City, be taken out of service for correction or replacement. Period of use of Defective materials or equipment pending correction or replacement shall in no way decrease guarantee period required for acceptable corrected or replaced items of materials or equipment.

E. Nothing in this Section shall be construed to limit, relieve, or release Contractor's, Subcontractors', and equipment suppliers' liability to City for damages sustained as result of latent defects in equipment caused by negligence of suppliers' agents, employees, or Subcontractors. Stated in another manner, warranty contained in the Contract Documents shall not amount to, nor shall it be deemed to be, waiver by City of any rights or remedies (or time limits in which to enforce such rights or remedies) it may have for Defective workmanship or Defective materials under laws of this State pertaining to acts of negligence.

1.7 WARRANTIES

A. Execute Contractor's Submittals and assemble warranty documents, and Installation, Operation, and Maintenance Manuals described in Section 01 33 00 (Submittal Procedures), executed or supplied by Subcontractors, suppliers, and manufacturers.

1. Provide table of contents and assemble in 8½ inches by 11 inches three-ring binder with durable plastic cover, appropriately separated and organized.

2. Assemble in Specification Section order.

B. Submit material prior to final Application for Payment.

1. For equipment put into use with City's permission during construction, submit within 14 Days after first operation

2. For items of Work delayed materially beyond Date of Substantial Completion, provide updated Submittal within fourteen (14) Days after acceptance, listing date of acceptance as start of warranty period.

C. Warranties are intended to protect City against failure of Work and against deficient, Defective, and faulty materials and workmanship, regardless of sources.

D. Limitations: Warranties are not intended to cover failures that result from the following:

1. Unusual or abnormal phenomena of the elements

2. Vandalism after Substantial Completion

3. Insurrection or acts of aggression including war

E. Related Damages and Losses: Remove and replace Work which is damaged as result of Defective Work, or which must be removed and replaced to provide access for correction of warranted Work.

F. Warranty Reinstatement: After correction of warranted Work, reinstate warranty for corrected Work to date of original warranty expiration or to a date not less than one year after corrected Work was done, whichever is later.

G. Replacement Cost: Replace or restore failing warranted items without regard to anticipated useful service lives.

H. Warranty Forms: Submit drafts to City for approval prior to execution. Forms shall not detract from or confuse requirements or interpretations of Contract Documents.

1. Warranty shall be countersigned by manufacturers.

2. Where specified, warranty shall be countersigned by Subcontractors and installers.

I. Rejection of Warranties: City reserves right to reject unsolicited and coincidental product warranties that detract from or confuse requirements or interpretations of Contract Documents.

J. Term of Warranties: For materials, equipment, systems, and workmanship, warranty period shall be one (1) year minimum from date of Final Completion of entire Work except where:

1. Detailed Specifications for certain materials, equipment or systems require longer warranty periods

2. Materials, equipment or systems are put into beneficial use of City prior to Final Completion as agreed to in writing by City

K. Warranty of Title: No material, supplies, or equipment for Work under Contract shall be purchased subject to any chattel mortgage, security agreement, or under a conditional sale or other agreement by which an interest therein or any part thereof is retained by seller or supplier. Contractor warrants good title to all material, supplies, and equipment installed or incorporated in Work and agrees upon completion of all Work to deliver premises, together with improvements and appurtenances constructed or placed thereon by Contractor, to City free from any claim, liens, security interest, or charges, and further agrees that neither Contractor nor any person, firm, or corporation furnishing any materials or labor for any Work covered by Contract shall have right to lien upon premises or improvement or appurtenances thereon. Nothing contained in this paragraph, however, shall defeat or impair right of persons furnishing materials or labor under bond given by Contractor for their protection or any rights under law permitting persons to look to funds due Contractor in hands of City.

1.8 TURN-IN

A. Contract Documents will not be closed out and final payment will not be made until all keys issued to Contractor during prosecution of Work and letters from property owners, pursuant to Paragraph 1.2.F of Document 01 74 00 (Cleaning), are turned in to City.

1.9 RELEASE OF CLAIMS

A. Contract Documents will not be closed out and final payment will not be made until Document 00 52 17 (Agreement and Release of Any and All Claims) is completed and executed by Contractor and City.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

-END OF SECTION-

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for the following Project Record Documents:

   a. Project Record Drawings, Shop Drawings

   b. Project Record Specifications

   c. Project Record Product Data

   d. Miscellaneous Project Record Submittals

B. Specific Project Record Documents requirements that expand requirements of this Section may be included in the individual Sections of Division 2.

1.2 SUBMITTAL

A. At completion of Project, Contractor shall deliver Project Record Documents to City. Project Record Documents required include:

1. Marked-up copies of Drawings
2. Marked-up copies of Shop Drawings
3. Marked-up copies of Specifications, Addenda, Change Orders, and CCDs
4. Marked-up Product Data submittals
5. Final set of Project Record Drawings, including electronic version
6. Final set of Project Record Specifications
7. Final set of Project Record Product Data
8. Record Samples
9. Field records for variable and concealed conditions
10. Record information on Work that is recorded only schematically

B. Contractor shall accompany submittal with transmittal letter containing:

1. Date

2. Project title and City's Contract number

3. Contractor's name and address

4. Number and title of each Project Record Document

5. Certification that each document as submitted is complete and accurate, and signature of Contractor or Contractor's authorized representative.

1.3 GENERAL

A. City will provide one full size set of Drawings and one copy of the Project Manual for Contractor's use for recording as-built conditions.

B. Contractor shall post changes and Modifications to the Contract Documents as they occur. Do not wait until the end of the Project. City may periodically review Project Record Documents to assure compliance with this requirement.

C. Contractor shall refer instances of uncertainty to City for resolution.

D. Maintenance of Documents and Samples:

1. Contractor shall store Project Record Documents and Samples in the field office apart from Contract Documents used for construction.

2. Do not permit Project Record Documents to be used for construction purposes.

3. Contractor shall maintain Project Record Documents in good order and in a clean, dry, legible condition.

4. Contractor shall make Project Record Documents and Samples available at all times for inspection by City.

1.4 PROJECT RECORD DRAWINGS, SHOP DRAWINGS, AND SAMPLES

A. Quality Draftsmanship: All Work on Project Record Drawings and Project Record Shop Drawings shall be performed by competent drafters and shall be clear and fully legible. City shall be the sole judge of the acceptability of the Project Record Drawings and Project Record Shop Drawings.

B. Mark-up Procedure: During the construction period, Contractor shall maintain a set of Drawings of Drawings and Shop Drawings for Project Record Documents purposes ("Field Set"). Contractor shall stamp each document (on each sheet or page) "PROJECT RECORD" in 2-inch high letters. Contractor shall also

maintain a set of Samples for Project Record Documents purposes. Contractor shall keep record documents current. Note: A reference by number to a Change Order, CCD, RFI, RFQ, RFP, Field Order or other such document is not acceptable as sufficient record information on any record document. Do not permanently conceal any Work until required information has been recorded.

1. Mark Drawings and Shop Drawings to indicate the actual installation where the installation varies appreciably from the installation shown originally. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later. Items required to be marked include but are not limited to:

    a. Dimensional changes to the Drawings and Shop Drawings

    b. Revisions to details shown on the Drawings and Shop Drawings

    c. Depths of various elements of foundation in relation to main floor level or survey datum

    d. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements

    e. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure

    f. Locations of underground Work, points of connection with existing utilities, changes in direction, valves, manholes, catch basins, capped stub outs, invert elevations, and similar items

    g. Actual numbering and set points of each electrical circuit

    h. Field changes of dimension and detail

    i. Revisions to routing of piping and conduits

    j. Revisions to electrical circuitry

    k. Actual equipment locations

    l. Duct, conduit, and cable size and routing

    m. Changes made by Change Order or CCD

    n. Details not on original Drawings or Shop Drawings

2. Mark completely and accurately Drawings or Shop Drawings, whichever is the most capable of showing actual physical conditions. Where Shop Drawings are marked, show cross-reference on Drawings location.

3. Mark important additional information that was either shown schematically or omitted from original Drawings

4. Note CCD numbers, Alternate numbers, Change Order numbers, and similar identification

5. **Mark Contract Drawings and Shop Drawings with red, erasable colored pencil.**

6. Mark Samples to record changes made after review

7. Responsibility for Mark-up: Where feasible, the individual or entity who obtained Project Record Drawing or Shop Drawing data, whether the individual or entity is the installer, Subcontractor, or similar entity, is required to prepare the mark-up on Project Record Drawings or Shop Drawings

    a. Accurately record information in an understandable and legible drawing technique.

    b. Record data as soon as possible after it has been obtained. In the case of concealed installations, record and check the mark-up prior to concealment.

C. Preparation of Project Record Drawings and Project Record Shop Drawings: Immediately prior to inspection for Certification of Substantial Completion, review completed marked-up Project Record Drawings and Project Record Shop Drawings with City. When authorized, prepare final Project Record Drawings and Project Record Shop Drawings.

1.5 PROJECT RECORD SPECIFICATIONS

A. During the construction period, Contractor shall maintain one copy of the Specifications, including Addenda and Modifications issued, for Project Record Documents purposes.

B. Mark the Project Record Specifications to indicate the actual installation where the installation varies substantially from that indicated in Specifications and Modifications issued. Note related Project Record Drawing information, where applicable. Give particular attention to substitutions, selection of product options, Change Order and CCD Work, and information on concealed installation that would be difficult to identify or measure and record later.

1. In each Specification Section where products, materials or units of equipment are specified or scheduled, mark the copy with the proprietary name and model number of the product furnished.

2. Record the name of the manufacturer, catalog number, supplier and installer, and other information necessary to provide a record of selections made and to document coordination with Project Record Product Data submittals and Installation, Operation, and Maintenance Manuals.

3. Note related Project Record Product Data, where applicable, for each principal product specified, indicate whether Project Record Product Data has been submitted in Installation, Operation, and Maintenance Manuals instead of submitted as Project Record Product Data.

C. Preparation of Project Record Specifications: Immediately prior to inspection for Certification of Substantial Completion, review completed Field Set Project Record Specifications with City. When authorized, prepare final Project Record Specifications.

1. After Substantial Completion and before Final Completion, carefully transfer all data shown on the Field Set to a separate clean set of Specifications provided by City. Include the printed designation “PROJECT RECORD SPECIFICATION” in a prominent location on the Specifications.

1.6 PROJECT RECORD PRODUCT DATA

A. During the construction period, maintain one copy of each Product Data submittal for Project Record Document purposes.

1. Mark Project Record Product Data to indicate the actual product installation where the installation varies substantially from that indicated in Project Record Product Data submitted. Include significant changes in the product delivered to the Site, and changes in manufacturer’s instructions and recommendations for installation.

2. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

3. Note related Change Orders and mark-up of Project Record Drawings, where applicable.

4. Upon completion of mark-up, submit a complete set of Project Record Product Data to City for City’s records.

5. Where Project Record Product Data is required as part of maintenance manuals, submit marked-up Project Record Product Data as an insert in the manual, instead of submittal as Project Record Product Data.

6. The Contractor is responsible for mark-up and submittal of Project Record Product Data for the Work.

B. Material, Equipment, and Finish Data:

1. Provide data for primary materials, equipment, and finishes as required under each Specification Section

2. Submit two sets prior to final inspection, bound in 8-1/2 inches by 11 inches three-ring binders with durable plastic covers; provide typewritten table of contents for each volume

3. Arrange by Specification Section number and give names, addresses, and telephone numbers of Subcontractors and suppliers. List:

    a. Trade names

    b. Model or type numbers

    c. Assembly diagrams

    d. Operating instructions

    e. Cleaning instructions

    f. Maintenance instructions

    g. Recommended spare parts

    h. Product data

1.7 MISCELLANEOUS PROJECT RECORD SUBMITTALS

A. Refer to other Specification Sections for miscellaneous record keeping requirements and submittals in connection with various construction activities. Immediately prior to Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Submit to the City for City's records. Categories of requirements resulting in miscellaneous records include, but are not limited to, the following:

    1. Field records on excavations and foundations

    2. Field records on underground construction and similar Work

    3. Survey showing locations and elevations of underground lines

    4. Invert elevations of drainage piping

    5. Surveys establishing lines and levels

    6. Authorized measurements utilizing unit prices or allowances

    7. Ambient and substrate condition tests

    8. Certifications received in lieu of labels on bulk products

    9. Batch mixing and bulk delivery records

    10. Testing and qualification of tradespersons

    11. Documented qualification of installation firms

12. Load and performance testing
13. Inspections and certifications by governing authorities
14. Leakage and water-penetration tests
15. Final inspection and correction procedures

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

-END OF SECTION-

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DOCUMENTS FOR THE CONSTRUCTION OF

CITY OF SAN BRUNO
SNEATH AND LAKE PUMP STATION REHABILITATION PROJECT

VOLUME 1

BID SUBMITTAL DESIGN DOCUMENTS TECHNICAL SPECIFICATIONS

July 2025

ENGINEER:

WATERWORKS ENGINEERS

Project No. 19-077

VOLUME 1
TECHNICAL SPECIFICATIONS
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SECTION 01 61 03

GENERAL PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

A. All products furnished and installed under this contract shall conform to the general stipulations set forth in this Section except as otherwise specified in other Sections.

1.2 COORDINATION

A. The CONTRACTOR shall coordinate all details of the products and equipment with other related parts of the work, including verification that all structures, piping, wiring, and equipment components are compatible. The CONTRACTOR shall be responsible for all structural and other alterations in the work required to accommodate products or equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

1.3 DESIGN REQUIREMENTS

A. Where CONTRACTOR design is specified, design and installation of systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions of 2019 edition of the California Building Code (CBC).
   1. Basic Wind Speed: 103 mph, Exposure C.
   2. Seismic:

   Lake Drive PS Building:
      a. S_S (maximum short-term spectral response acceleration) = 2.446
      b. S_1 (maximum 1-second spectral response acceleration) = 1.026
      c. S_{DS} (design short-term spectral response acceleration) = 1.957
      d. S_{D1} (design 1-second spectral response acceleration) = 0.958
      e. I_e (Seismic Importance Factor) = 1.5
      f. Risk Category = IV
      g. Seismic Design Category = F

   Sneath Lane PS Building:
      h. S_S (maximum short-term spectral response acceleration) = 2.419
      i. S_1 (maximum 1-second spectral response acceleration) = 1.014
      j. S_{DS} (design short-term spectral response acceleration) = 1.935
      k. S_{D1} (design 1-second spectral response acceleration) = 0.946
      l. I_e (Seismic Importance Factor) = 1.5
      m. Risk Category = IV
      n. Seismic Design Category = F
   3. Maximum Rain Intensity: 2.84-inches/hour

B. Proof of Compliance:
   1. Structural integrity and anchorage shall be certified by an approved calculation that demonstrates the adequacy of the anchorage system for seismic forces. This calculation may be based on principles of structural analysis and engineering mechanics, or based on similarity to approved shake-table tests.

2. The CONTRACTOR shall submit for review and approval test data or calculations certified by a Civil or Structural Engineer registered in the State of California to show compliance with the above requirements.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 300 and 750 feet above sea level.

B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of -10 degrees F to 120 degrees F.

1.5 WORKMANSHIP AND MATERIALS

A. The CONTRACTOR shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

B. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and gages so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

C. Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4 inch thick.

D. Except where otherwise specified, all metal which will be exposed to weather, submerged or otherwise exposed to moisture shall be either non-ferrous or stainless steel, as the application may require.

1.6 LUBRICATION

A. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.

B. Lubricants of the type recommended by the equipment manufacturer shall be provided in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by OWNER. Unless otherwise specified or permitted, the use of synthetic lubricants will not be acceptable.

C. Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

1.7 ELECTRIC MOTORS

A. Unless otherwise specified, motors furnished with equipment shall meet the following requirements:
   1. Designed and applied in accordance with NEMA, ANSI, IEEE, AFBMA, and NEC for the duty service imposed by the driven equipment, such as frequent starting, intermittent overload, high inertia, mounting configuration, or service environment.
   2. Rated for continuous duty at 40 degrees C ambient, unless the application is well recognized for intermittent duty service as a standard industry practice.
   3. Insulated with Class F insulation and designed for a service factor of 1.15, or greater.
   4. Three phase motors used in conjunction with variable speed drives shall have Class F insulation with a Class B temperature rise at rated nameplate horsepower, and 1.15 service factor.
   5. When operating at service factor load, maximum observable temperature rise of insulation and motor parts, as determined by resistance or thermometer methods, shall not exceed the NEMA allowable limits for the type of motor, the type of enclosure, and the particular application with regard to continuous or intermittent duty.
   6. To ensure long motor life, nameplate horsepower, regardless of service factor, shall be at least 115 percent of the maximum load imposed by the driven equipment.
   7. Designed for full voltage starting.
   8. Designed to operate from an electrical system that may have a maximum of 5 percent voltage distortion per IEEE Standard 519.
   9. Derated, if required, for the altitude at which the equipment is installed.
   10. Clamp-type grounding terminal shall be inside motor conduit box.
   11. External conduit boxes shall be oversized at least one size larger than NEMA standard.
   12. Totally enclosed motors shall have a continuous moisture drain which also excludes insects.
   13. Bearings shall be either oil or grease lubricated.
   14. Manufacturer's standard motor may be supplied on integrally constructed, packaged assemblies such as appliances, tools, unit heaters, and similar equipment specified by model number, in which case a redesign of the unit would be required to furnish motors of other than the manufacturer's standard design. However, in all cases, totally enclosed motors are preferred and shall be furnished if offered by the manufacturer as a standard option.
   15. Totally enclosed motors shall be furnished on:
       a. Equipment for installation below grade.
       b. Equipment operating in wet or dust-laden locations.
   16. Drip-proof motors, or totally enclosed motors at the supplier's option, shall be furnished on equipment in indoor, above-grade, clean, and dry locations.
   17. Explosion-proof or submersible motors shall be furnished as required by applicable codes, as specified in other Sections, or at the supplier's option.
   18. Motors shall be rated and constructed as follows:
       a. Below 1/2 hp:
          1) 115 volts, 60 Hz, single phase.
          2) Built-in manual-reset thermal protector, or integrally mounted stainless steel enclosed manual motor starter.
       b. 1/2 hp and above:
          1) 460 volts, 60 Hz, 3 phase.

2) Where specified or required by the drawings, motors used on 240 volt systems shall be 230 volts, 60 Hz, 3 phase.

1.8 DRIVE UNITS

A. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Drive units shall be designed for 24 hours continuous service.

B. Unless otherwise specified, the use of gearmotors will not be acceptable.

C. Gear reducers:
   1. Each gear reducer shall be a totally enclosed unit with oil or grease lubricated antifriction, rolling element bearings throughout.
   2. Helical, spiral bevel, combination bevel-helical, and worm gear reducers shall have a service factor of at least 1.50 based on the nameplate horsepower of the drive motor. Shaft-mounted and flange-mounted gear reducers shall be rated AGMA Class II. Helical gear reducers shall have a gear strength rating to catalog rating of 1.5. Each gear reducer shall bear an AGMA nameplate.
   3. The thermal horsepower rating of each unit shall equal or exceed the nameplate horsepower of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100°F above the ambient air temperature in the vicinity of the unit and shall not exceed 200°F.
   4. Bearings:
      a. Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic regreasing of the bearing by means of a manually operated grease gun.
      b. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and to prevent overgreasing of the bearing.
      c. The use of permanently sealed, grease lubricated bearings will not be acceptable.
      d. An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings.
      e. A dipstick or sight glass arranged to permit visual inspection of lubricant level shall be provided on each unit.
   5. Gear reducers that require the removal of parts or periodic disassembly of the unit for cleaning and manual regreasing of bearings will not be acceptable.
   6. Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.

D. V-belt drives:
   1. Each V-belt drive shall include a sliding base or other suitable tension adjustment. V-belt drives shall have a service factor of at least 1.6 at maximum speed based on the nameplate horsepower of the drive motor.

1.9 SAFETY GUARDS

A. All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard.

B. Safety guards shall be fabricated from 16 USS gauge or heavier galvanized or aluminum-clad sheet steel or 1/2 inch mesh galvanized expanded metal.

C. Each guard shall be designed for easy installation and removal.

D. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized.

E. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

1.10 ANCHOR BOLTS

A. Equipment suppliers shall furnish suitable anchor bolts for each item of equipment.

B. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed.

C. Anchor bolts shall comply with Section 05 05 06, Anchors, Inserts and Epoxy Dowels and, unless otherwise specified, shall have a minimum diameter of 1/2-inch.

D. Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2 inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

1.11 EQUIPMENT BASES

A. Unless otherwise indicated or specified, all equipment shall be installed on concrete bases at least 6 inches high.

B. Cast iron or welded steel baseplates shall be provided for pumps, compressors, and other equipment.

C. Each unit and its drive assembly shall be supported on a single baseplate of neat design.

D. Baseplates shall have pads for anchoring all components and adequate grout holes.

E. Baseplates for pumps shall have a means for collecting leakage and a threaded drain connection.

F. Baseplates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with grout as specified in Section 03 60 03, Grout.

1.12 SPECIAL TOOLS AND ACCESSORIES

A. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

1.13 SHOP PAINTING

A. Surface Protection:
   1. All steel and iron surfaces shall be protected by suitable paint or coatings applied in the shop.
   2. Surfaces that will be inaccessible after assembly shall be protected for the life of the equipment.
   3. Exposed surfaces shall be finished smooth, thoroughly cleaned, and filled as necessary to provide a smooth uniform base for painting.
   4. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with a high-grade oil-resistant enamel suitable for coating in the field with an alkyd enamel.
   5. Coatings shall be suitable for the environment where the equipment is installed.

B. Shop Primer:
   1. Surfaces to be painted after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer.
   2. Unless otherwise specified, the shop primer for steel and iron surfaces shall be:
      a. Cook "391-N-167 Barrier Coat",
      b. Koppers "No. 10 Inhibitive Primer",
      c. Tnemec "37H Chem-Prime HS",
      d. Valspar "13-R-28 Chromox Primer",
      e. Or equal.

C. Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust-preventive compound, Houghton "Rust Veto 344", Rust-Oleum "R-9", or equal.

1.14 PREPARATION FOR SHIPMENT

A. All equipment shall be suitably packaged to facilitate handling and protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times.

B. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of ENGINEER.

C. Grease and lubricating oil shall be applied to all bearings and similar items.

D. Each item of equipment shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

1.15 STORAGE

A. Upon delivery, all equipment and material shall immediately be stored and protected until installed in the work.

B. Pumps, motors, electrical equipment, and all equipment with antifriction or sleeve bearings shall be stored in weathertight structures maintained at a temperature above 60° F. Equipment, controls, and insulation shall be protected against moisture and water damage. All space heaters furnished in equipment shall be connected and operated continuously.

C. Equipment and materials shall not show any pitting, rust, decay, or other deleterious effects of storage when installed in the work.

1.16 INSTALLATION AND OPERATION

A. Equipment shall not be installed or operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary for proper results. When so specified, or when employees of the CONTRACTOR or their subcontractors are not qualified, such personnel shall be field representatives of the manufacturer of the equipment or materials being installed.

B. All equipment installed under this Contract, including that furnished by OWNER shall be placed into successful operation according to the written instructions of the manufacturer or the instructions of the manufacturer's field representative. All required adjustments, tests, operation checks, and other startup activity shall be provided.

C. Acceptance of work in connection with the installation of equipment furnished by others will be subject to approval of the field representative. The CONTRACTOR shall be responsible for planning, supervising, and executing the installation of work, and the approval or acceptance of ENGINEER or the field representative will not relieve the CONTRACTOR of responsibility for defective work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

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SECTION 02 41 03

DEMOLITION

PART 1 - GENERAL

1.1 DEFINITIONS

A. "Demolish": CONTRACTOR shall remove from the site as property of CONTRACTOR. Demolition includes disconnecting, removal, loading, repairs, cleanup, transportation, unloading, disposal permits and fees, disposal, and all other items required to remove the material from the site.

B. "Salvage": CONTRACTOR shall remove from area of Work and place in location designated by ENGINEER. Equipment is property of OWNER. Salvage includes disconnecting, removal, repairs, cleanup, loading, transportation, unloading, and all other items required to remove and relocate the material.

C. "OWNER to Remove": OWNER will remove from area of Work prior to CONTRACTOR commencing demolition Work for this area.

D. "Relocate": CONTRACTOR shall relocate material shown to new locations shown on Drawings or stated herein. Relocation includes disconnecting, removal, reconnecting, attaching, repairs, and all other items required to relocate material to new location.

E. "Abandon": CONTRACTOR shall disconnect and leave in place as specified.

F. "Materials": Any and all items and objects that are scheduled, specified, or shown to be demolished, salvaged, removed, relocated, or abandoned.

1.2 RELATED REQUIREMENTS

A. REGULATORY REQUIREMENTS	Section 01 41 00
B. TEMPORARY FACILITIES AND CONTROLS	Section 01 51 00
C. TEMPORARY SITE SECURITY AND SAFETY	Section 01 56 36
D. CLEANING	Section 01 74 00
E. BASIC SITE MATERIALS AND METHODS	Section 02 00 01

1.3 SUBMITTALS

A. Informational Submittals:
   1. Plan and schedule phased demolition, including limits of demolition, as part of and consistent with the Progress Schedule.
   2. Methods of demolition and equipment proposed to demolish materials.
   3. Copies of any authorizations and permits required to perform Work.
   4. Copies of Hazardous Materials Inspection Reports.

5. Repair procedures for demolition of materials beyond limits shown on Drawings.

B. Submit prior to start of Work photographs of existing damage to structures adjacent to but not a part of the Work, where such damage could be misconstrued as caused by CONTRACTOR.

PART 2 - PRODUCTS

2.1 GENERAL

A. CONTRACTOR shall provide all materials and equipment in suitable and adequate quantity as required to accomplish the Work shown, specified herein, and as required to complete the Project.

PART 3 - EXECUTION

3.1 GENERAL

A. Drawings are based on available information. The Work may differ slightly from what is shown. CONTRACTOR shall be responsible for determining the work required by inspecting the site.

3.2 SAFETY REQUIREMENTS

A. All Work shall be done in conformance with all applicable rules and regulations pertaining to safety.

B. Hazardous Materials:
   1. See General Conditions.
   2. Existing facilities, or portions thereof, to be demolished may contain hazardous materials such as asbestos cement piping, residual chemicals in existing or abandoned piping, lead-based paint, mercury seals, or other unknown hazardous materials.
   3. Post hazard warning signage compliant with requirements of 29 CFR 1926.200, "Accident Prevention Signs and Tags", and recommendations of ANSI Z535.5 at perimeter of construction zone. Promptly remove signage after Engineer verifies that demolition hazards no longer exist.

3.3 SEQUENCE

A. Contractor shall be responsible for the sequence of Work.

B. Construction under this Contract involves modification of facilities at existing, operating, drinking water pump stations and tanks which must continue to operate and meet water system demands and the requirements of State and Federal regulating agencies during all phases of construction activities. The existing pump stations (as a whole or as individual sub-processes or sub-systems) and tanks are currently and continuously receiving and transporting drinking water, and those functions shall not be interrupted except as specified herein.

C. The Contractor shall coordinate the work to avoid any interference with normal operation of pump station equipment and processes except as allowed herein. In addition to the requirements specified elsewhere in these Contract Documents, the Contractor is advised of the following constraints to the work sequence and schedule. The Contractor shall note that not all valves that may be used to isolate lines and facilities will completely seal. The Contractor shall allow for leakage in planning its work and may request the City test certain valves before work involving isolation is begun. The Contractor shall provide adequate temporary pumping and piping facilities to clear the work areas as necessary of water that may leak by existing valves.

3.4 TEMPORARY FACILITIES AND CONTROLS

A. Contractor shall be responsible to provide temporary power, electrical, communications, piping, supports and mechanical connections to ensure that all existing pressure transmitters, chlorine analyzers, level transmitters, hatch alarms, etc. at each site are relocated as needed to ensure that they are fully operational and protected during the course of the contractor's work and that communication of all existing I/O back and forth with the City's SCADA system and local Operator Interface are kept in service until transitioned over to the new systems.

B. Work specified herein shall also be coordinated with Section 33 31 50, Bypass Pumping.

3.5 COORDINATION

A. Coordination with ENGINEER:
   1. Only materials specified herein, shown on the Demolition Photographs or the Drawings, or approved by ENGINEER in the field shall be demolished, salvaged, removed, relocated, or abandoned.
   2. Verify materials scheduled to be demolished, salvaged, removed, relocated, or abandoned with ENGINEER prior to performing Work.
   3. Do not remove materials without prior approval of ENGINEER.
   4. Provide at least 3 working days' notice to ENGINEER prior to start of Work.
   5. Notify ENGINEER to turn off affected services or facilities before starting Work.
   6. Provide temporary services during interruptions to affected services or facilities as acceptable to ENGINEER.
   7. ENGINEER will indicate limits of Work if not clearly shown.

B. Coordination with City:
   1. Notify City to turn off affected services or facilities before starting Work.
   2. Shutdowns shall be planned and scheduled as far in advance as possible (minimum 7 days notice) in order to allow City staff to coordinate personnel, equipment, and materials to accommodate the contractor's request.
   3. Provide temporary services during interruptions to affected services or facilities as acceptable to utility owners.
   4. Shutdown of existing facilities will be performed by City personnel or by the Contractor only under City's personnel's supervision and with prior approval.
   5. The work under this contract shall be conducted in a manner that will minimize shutdowns, roadway closures, or traffic obstructions caused by 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.

6. The Contractor shall note that only certain structures, tie-ins and constraints are addressed in this section. All work, whether or not addressed here, shall be governed by applicable parts of this section, and schedules and procedures further submitted for approval.
7. Changes to existing utilities or any new connection thereto must be coordinated to provide the least possible interference with pumping operations. Prior to any shutdown or flow diversion, all materials, fittings, supports, equipment and tools shall be on the site and all necessary labor scheduled prior to starting any connection work.
8. The Contractor shall include all work described in this section in the construction schedule. The sequence and constraints identified in this section shall be followed in the construction of the work. However, alternatives to these sequences and constraints may be submitted by the contractor for review by the Construction Manager.

3.6 LIMITS

A. Drawings define minimum portions of materials to be demolished. Unless otherwise shown, rough cuts or breaks may be made to limits of demolition shown. If rough cuts or breaks are made exceeding limits shown, CONTRACTOR shall repair the cuts or breaks back to the dimensions shown on Drawings at CONTRACTOR's expense.

B. If limits are not clear on the Drawings or Demolition Photographs, limits shall be as directed by ENGINEER.

C. All areas not within the limits of demolition Work shown on the Drawings, or as specified herein, shall be left undisturbed, unless necessary for demolition of materials.

3.7 DEMOLITION

A. General:
   1. Inspect condition of materials to be demolished prior to bidding to assess potential for salvage value.
   2. Remove all materials associated with existing equipment that is to be demolished.
   3. Materials within limits of demolition will become the property of CONTRACTOR.
   4. All materials from the demolition process shall be removed safely from the project site as soon as possible. They shall be disposed of in accordance with applicable federal, state, and city regulations. CONTRACTOR is responsible for determining these regulations and shall bear all costs associated with disposal of the materials.
   5. Dust from demolition activities shall be controlled in conformance with all local, state, and federal regulations.
   6. No debris shall be allowed to enter storm drains.

B. Pavement and Curbs:
   1. Provide saw cut at all concrete and pavement surfaces and curb removal limits and where neat connection lines are required.
   2. Surfaces exposed by demolition activities shall be repaired and finished to provide a uniform, smooth, level transition between adjacent surfaces.

C. Concrete, CMU, and Reinforcing:

1. In areas where concrete or CMU portions are to be removed from a structure, the edge of removal shall be cut with a concrete saw to leave a perpendicular edge or by core-drilling where a circular hole is required.
2. Damaged concrete shall be removed to solid concrete. Damaged concrete shall include concrete that is soft, spalled, cracked, or otherwise damaged as determined by ENGINEER.
3. Depth of removal shall be as determined by ENGINEER unless otherwise shown or specified.
4. Reinforcing shall be cut and removed unless otherwise shown or instructed by ENGINEER.
5. Spalled edges may be required to be resawn at the discretion of the ENGINEER.
6. Protect adjacent structures and equipment from damage during Work.
7. Exposed surfaces following demolition activities shall be repaired and finished to provide a uniform, smooth, and level transition between adjacent surfaces.
8. Remove and repair designated cracked and damaged concrete areas shown in accordance with this section and Section 03 30 03, Cast-in Place Concrete.

D. Concrete Embedded Items:
   1. Except for core drills, demolish anchor bolts, reinforcing steel, conduit, and other materials that are concrete embedded to a minimum of 1 inch below final finished surface. For core drills, coat rebar exposed by core drilling with System No. 304 in accordance with Section 09 91 03, Painting.
   2. Plug empty pipes and conduits with fireproof sealant to maintain fire ratings for floors or walls.
   3. Patching:
      a. Demolish damaged concrete. Damaged concrete shall be removed to solid concrete. Damaged concrete shall include concrete that is soft, spalled, cracked, or otherwise damaged as determined by ENGINEER.
      b. Coat with approved bonding agent.
      c. Patch with nonshrink, nonmetallic grout.

E. Piping:
   1. Pressurized Services: Install restrained caps or plugs at the demolished ends, unless otherwise shown.
   2. Gravity Services: Install concrete plugs, 5-foot minimum length.

F. Utilities:
   1. Excavate utility lines serving structures to be demolished.
   2. Demolish electrical, sanitary, and storm drainage lines serving structures to be demolished.
   3. Support or relocate utility lines exposed by Work.
   4. For water and gas lines to be demolished or capped and terminated, provide a permanent leakproof closure. Closure type shall be as recommended by utility owner.

G. Electrical:
   1. Remove conduits and wiring from materials to be demolished back to nearest junction box.
   2. For existing circuits to remain operational, intercept existing conduit at the most convenient location, or as shown, and splice and extend conduit to new location.

Install new conductors as required to accomplish intended results. New conductors shall be continuous without splices between junction boxes.
3. For existing circuits no longer needed, demolish conductors from conduits.
4. Demolish all surface-mounted conduit which is no longer needed.
5. For conduit below grade or concealed within walls, cap and abandon in place.

3.8 SALVAGE

A. Salvage materials for OWNER's own use where shown.

B. No on-site sale of salvage will be allowed. No removals shall be made from the site by any person other than the Contractor or employees of the CONTRACTOR.

C. Remove materials with extreme care so as not to damage.

D. Promptly remove materials from Work area.

E. Store materials in location designated by ENGINEER.

F. Clean and protect materials from dust, dirt, natural elements, and store as directed.

3.9 RELOCATION

A. ENGINEER will determine condition of materials prior to removal.

B. Remove all materials associated with items to be relocated.

C. Existing materials shall not be damaged during removal.

D. Properly store and maintain materials in same condition as when removed.

E. Clean and protect materials from dust, dirt, natural elements, and store as directed.

3.10 ABANDONMENT

A. Structures: Break holes into or core drill floor slabs, catch basins, and other below-grade concrete structures to be abandoned in place to allow water to freely migrate through.

B. Piping and Conduits:
1. General: Piping and conduits to be abandoned shall be capped with a watertight plug at demolished end in a manner that will prevent entrance of soil, groundwater, or moisture.
2. Pressurized Services: Install restrained caps or plugs at the demolished ends, unless otherwise shown.
3. Gravity Services: Install concrete plugs, 5-foot minimum length.

3.11 REPAIR AND REPLACEMENT

A. Any damaged materials scheduled to be salvaged or relocated shall be repaired by the CONTRACTOR to the satisfaction of ENGINEER or replaced at the CONTRACTOR's expense.

B. Any damage to areas not within the limits of demolition Work shown on the Demolition Photographs, Drawings, or as specified herein shall be repaired or replaced to original precontract conditions at the CONTRACTOR's sole expense.

3.12 DISPOSAL

A. All demolition material to be the property of the CONTRACTOR. Dispose of materials offsite in licensed landfills and in accordance with all local, state, and federal regulations. CONTRACTOR is responsible for obtaining any and all necessary permits for disposal.

++ END OF SECTION ++

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SECTION 02 80 30

HAZARDOUS WASTE REMOVAL

PART 1 - GENERAL

1.1 SUMMARY

A. Existing facilities or portions thereof, may contain hazardous materials such as asbestos, lead-based paint, mercury seals, or other unknown hazardous materials. Work includes salvage; rehabilitation; and demolition, removal from site and disposal of existing above and below grade structures and mechanical equipment as shown on plans and further defined herein.

B. A Hazardous Materials Abatement Survey of materials containing lead and asbestos is included in Appendix B. The Contractor shall remove materials professionally in accordance with all applicable codes and regulations and as defined herein. Asbestos containing materials and lead containing paints are present Site testing was completed to confirm and quantify (where possible) these materials. Asbestos materials were identified to be in pipe flange gaskets at both Lake Drive and Sneath Lane Pump Station and shall be assumed to be contained in all existing gaskets encountered, unless proven otherwise. At Sneath Lane Pump Station the following coatings were found to be lead containing: gray exterior siding paint containing up to 2,000 ppm, gray interior floor coatings up to 53 ppm, and blue interior pipe coating up to 280 ppm.

1.2 SUBMITTALS

A. Prior to the start of work:
    1. Contractor’s Work Plan including (as applicable):
        a. Air Monitoring and Dust Control Plan
        b. Health and Safety submittals, including: site-specific Health and Safety Plan, respiratory protection plan, respirator fit testing, Safety Data Sheets (SDS)
        c. Contractor’s license and certifications
        d. Documentation of agency notifications
        e. Hazardous Waste Disposal Facilities
        f. Documentation of worker/supervisor training and certifications
        g. Documentation of worker medical monitoring
        h. Manufacturer's certifications that vacuums, negative air pressure equipment, and other local exhaust ventilation equipment conform to ANSI Z9.2

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. All labor, materials and expenses to complete the hazardous materials abatement and disposal, including lead-in-paint, and asbestos-containing materials shall be included in Contractor's Bid.

3.2 ASBESTOS MATERIAL REMOVAL AND DISPOSAL

A. All work involving asbestos containing material (ACM) must be performed in accordance with the California Department of Industrial Regulations (DIR), Title 8, and all other pertinent laws, rules, regulations, codes, ordinances, decrees and orders.

B. It is anticipated that the total quantity of ACM removed during the project will be under 100 square feet, and therefore a licensed asbestos contractor is not required. It is also anticipated that the total removed ACM will be under 50 lbs and may be transported by the Contractor to an approved landfill which is capable of accepting ACM. ACM shall be packaged and labeled in accordance with the California DIR regulations.

3.3 LEAD IN PAINT REMOVAL AND DISPOSAL

A. Any work performed which disturbs the paints identified as containing some amount of lead must be performed in accordance with the California Department of Industrial Regulations (DIR), and all other pertinent laws, rules, regulations, codes, ordinances, decrees and orders. All lead related construction work shall meet at minimum the following requirements:
    1. All employees of the Contractor and Subcontractors which will disturb paint surfaces must receive, at a minimum, Hazard Communication training which includes lead safe practices.
    2. Lead-safe work practices such as wet methods, establishment of a regulated area, and prompt cleanup must be employed during the disturbance of the painted materials if disturbance may result in airborne exposure of lead in concentrations over the Cal/OSHA Permissible Exposure Limit for lead or are considered "trigger task activities" as described in 8 CCR 1532.1. It is assumed that preparation of interior wet well walls for rehabilitation will likely be considered such an event and Contractor shall assume such when developing contract unit bid price.
    3. Lead waste characterization testing should be performed for the debris resulting from any paint scraping conducted. These tests include the toxic threshold limit concentration, soluble threshold limit concentration, and the toxicity.

+ + END OF SECTION + +

SECTION 03 11 03

CONCRETE FORMWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Falsework and formwork, as required to construct cast-in-place concrete, including placing of all items such as sleeves, anchor bolts, inserts and all other items to be embedded in concrete for which placement is not specifically provided under other Sections.

B. REFERENCES
   1. American Concrete Institute (ACI)
      a. ACI 301, Specifications for Structural Concrete for Buildings.
      b. ACI 347, Guide for Concrete Formwork.

1.2 SYSTEM DESCRIPTION

A. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the formwork.
   2. Coordinate formwork specifications herein with the requirements for finished surfaces specified in Section 03 30 03, Cast-In-Place Concrete.

1.3 SUBMITTALS

A. Submit for information purposes the following: Copies of manufacturer's data and installation instructions for all proprietary materials, including form coatings, manufactured form systems, ties and accessories.

B. Shop Drawings: Forming, shoring and bracing drawings for footings, walls and roofs.

C. Calculations: Calculations verifying the selection of form ties, horizontal and vertical stiff-backs or braces for wall panels, forming and form openings, falsework or roof forms, or any other part of forming, shoring or bracing which may be considered critical by the ENGINEER. The drawings, with supporting calculations, must be signed and sealed by a Civil or Structural Engineer registered in the State of California.

1.4 QUALITY ASSURANCE

A. Allowable Tolerances: Construct formwork to provide completed concrete surfaces complying with tolerances specified in ACI 347, Chapter 3.3, except as otherwise specified.

B. Furnish and install all items for permanent or temporary facilities in accordance with manufacturer’s instructions.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Unless otherwise shown or specified, construct formwork for exposed concrete surfaces with plywood overlaid with MDO or HDO specifically designed for concrete forms, metal, metal-framed plywood-faced or other acceptable panel materials, to provide continuous, straight, smooth as-cast surfaces. Furnish in largest practical sizes to minimize number of joints. Provide form material with sufficient thickness to remain watertight and withstand pressure of newly placed concrete without bow or deflection.
   1. At circular structures wall forms shall conform to the circular shape of the structure. Straight panels not exceeding 2 feet in horizontal width and installed with angular deflection not greater than 3-1/2 degrees per joint may be substituted for circular forms.

B. Forms for Unexposed Finish Concrete: Form concrete surfaces that will be unexposed in the finished structure with plywood, lumber, metal, or other acceptable material. Provide lumber that is dressed on at least 2 edges and 1 side.

C. Form Ties:
   1. Form ties on exposed surfaces shall be located in a uniform pattern or as indicated on the Drawings. Form ties shall be constructed so that the tie remains embedded in the wall, except for a removable portion at each end. Form ties shall have conical or spherical type inserts, inserts shall be fixed so that they remain in contact with forming material, and shall be constructed so that no metal is within 1 inch of the concrete surface when the forms, inserts, and tie ends are removed. Wire ties will not be permitted. Ties shall withstand all pressures and limit deflection of forms to acceptable limits.
   2. Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of 1 inch and sufficient dimensions to permit proper patching of the tie hole.
   3. Ties for water-holding structures or dry structures with access such as basements, pipe galleries, etc., that are below finish grade, shall have either an integral steel water stop 0.103 inch thick and 0.625 inch in diameter that is tightly and continuously welded to the tie, or a neoprene water stop 3/16-inch thick and 15/16 inch in diameter whose center hole is ½ the diameter of the snap tie, or a molded plastic water stop of comparable size. Flat snap ties complying with above requirements and other sections of this Specification may be used. The water stop shall be considerably larger in area than the tie cross sectional area, and shall be oriented perpendicular to the tie and symmetrical about the center of the tie. The ties shall be constructed to provide a positive means of preventing rotation or disturbance of the center portion of the tie during removal of the ends.

D. Alternative Form Ties – Through-Bolts:
   1. Alternate form ties consisting of tapered through-bolts at least 1 inch in diameter at smallest end, or through-bolts that utilize a removable tapered sleeve of the same minimum size may be used at the CONTRACTOR's option. Clean and roughen, fill, and seal form tie hole as shown on the Drawings; or where not shown on the Drawings, the CONTRACTOR shall provide a shop drawing submittal of his proposed method of sealing the through-bolt hole by sandblasting or mechanically cleaning and roughening the entire interior surface of the hole, epoxy coating the roughened

surface and driving a vinyl plug and then dry packing the entire hole on each side of the plug with nonshrink grout, meeting these Specifications. Dry packing shall be done while the epoxy is tacky or remove the epoxy by mechanical means and reapply new epoxy. The CONTRACTOR shall be responsible for watertightness and any repair needed. Any leaks or dampness on the exterior of through-bolt patches during or after water testing shall require repair or replacement of the patch.

2. The elastic plug to be inserted into the form tie hole as shown on the Drawings shall be a Dayton Sure Plug, or approved equal, sized to allow insertion using the insertion tool to elongate the plug, place it at the correct location, and allow the plug to return to its original length and diameter upon removal to form a watertight seal. The plugs shall be as manufactured and supplied by Dayton Superior, Dayton OH, phone: 888/977-9600.

E. Forms Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.
   1. For concrete structures which will be in contact with potable water, the manufacturer shall certify that the form coating used is NSF 61 approved.

2.2 DESIGN OF FORMWORK

A. The CONTRACTOR shall design all formwork prior to fabrication. The design shall account for all the tolerances, form ties, finishes, architectural features, rebar supports, construction joint locations, and other features and other nonstructural formwork requirements specified. Forms shall contain pouring and observation windows to allow placement of concrete through windows or shall be staged to allow visual observation at all times of the fresh concrete to ensure correct placement and vibration. Provide a formwork and placement design that will limit free fall of concrete in forms 8-inch or less in width to 5 feet; and for forms wider than 8 inches, limit this fall to 8 feet, except as hereinafter specified. Review methods with ENGINEER prior to start of work. Use placement devices, such as chutes, pouring spouts, pumps, as required.

B. Wall forms shall be designed such that wall sections can be poured full height without creating horizontal cold joints and without causing snapping of form ties which shall be of sufficient strength and number to prevent spreading of the forms during the placement of concrete and which shall permit ready removal of the forms without spalling or damaging the concrete.

C. Reuse of forms will be permitted only if a "like new" condition, unless otherwise approved in writing, is maintained. The ENGINEER shall be notified 1 full working day prior to concrete placement so that the forms can be inspected. The CONTRACTOR shall correct any defective work, found in the ENGINEER's inspection, prior to delivery of concrete to the project. Formwork surfaces that were in good condition and accepted for use, but were damaged during removal and handling shall not be reused on additional pours. The CONTRACTOR is expected to take care in the handling of forms and to obtain approval of form surfaces prior to each reuse.

D. Roof forms and falsework supports for structural slabs shall be sufficiently rigid and strong to support the wet concrete and the men and equipment necessary for its

placement without appreciable deflections. A minimum of 50 PSF for live load shall be allowed in the design.

E. All forms, falsework, shoring, and other structural formwork required shall be structurally designed by the CONTRACTOR and the design shall comply with all applicable safety regulations, current OSHA regulations, and other codes. Where federal or state agencies require a licensed engineer to prepare and/or seal all formwork, falsework or shoring designs, the CONTRACTOR shall hire this engineer and pay all costs. The designs shall be made available to any governing agency upon request. Comply with applicable portions of ACI 347, ACI 318 current edition, and theses Specifications. All design, supervision, and construction for safety of property and personnel shall be the CONTRACTOR's full responsibility.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the substrate and the conditions under which Work is to be performed with installer and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 FORM CONSTRUCTION

A. Construct forms complying with ACI 347; to the exact sizes, shapes, lines and dimensions shown; as required to obtain accurate alignment, location and grades; to tolerances specified; and to obtain level and plumb work in finish structures. Provide for openings, offsets, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required. Use selected materials to obtain required finishes. Finish shall be as determined by approved mock-up or sample panel, if specified.

B. Fabricate forms for easy removal without damaging concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.

C. Provide temporary form windows where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Brace temporary closures and set tightly to forms to prevent loss of concrete mortar. Locate form windows on forms in locations as inconspicuous as possible, consistent with requirements of the Work. Form intersecting planes of openings to provide true, clean-cut corners, with edge grain of plywood not exposed as form for concrete.

D. Falsework:
   1. Erect falsework and support, brace and maintain it to safely support vertical, lateral and asymmetrical loads applied until such loads can be supported by in-place concrete structures. Construct falsework so that adjustments can be made for take-up and settlement.

2. Provide wedges, jacks or camber strips to facilitate vertical adjustments. Carefully inspect falsework and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure; make necessary adjustments to produce finished Work of required dimensions.

E. Forms for Exposed To View Concrete:
   1. Do not use metal cover plates for patching holes or defects in forms.
   2. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections.
   3. Use extra studs, walers and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Do not use narrow strips of form material that will produce bow.
   4. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.
   5. Form molding shapes, recesses, rustication joints and projections with smooth-finish materials, and install in forms with sealed joints to prevent displacement.

F. Corner Treatment:
   1. Form exposed corners of beams, walls, foundations, bases and columns to produce smooth, solid, unbroken lines, except as otherwise shown. Except as specified below for reentrant or internal corners, exposed corners shall be chamfered.
   2. Form chamfers with ¾-inch x ¾-inch strips, unless otherwise shown, accurately formed and surfaced to produce uniformly straight lines and tight edge joints. Use rigid PVC chamfers for all architecturally formed concrete. Extend terminal edges to require limit and miter chamfer strips at changes in direction.
   3. Reentrant or internal corners and unexposed corners need not be formed chamfered.

G. Openings and Built-In Work:
   1. Provide openings in concrete formwork shown or required by other Sections or other contracts.
   2. Accurately place and securely support items to be built into forms.

H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is to be placed. Retighten forms immediately after concrete placement as required to eliminate mortar leaks.

3.3 FORM COATINGS

A. Coat form contact surfaces with a non-staining form-coating compound before reinforcement is placed. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces that will be bonded to fresh concrete. Apply in compliance with manufacturer's instructions.

B. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.4 INSTALLATION OF EMBEDDED ITEMS

A. Set and build into the formwork, anchorage devices and other embedded items, shown, specified or required by other Sections and other contracts. Use necessary setting drawings, diagrams, instructions and directions.

B. Edge Forms and Screeds Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. Provide and secure units to support screeds.

3.5 FIELD QUALITY CONTROL

A. Before concrete placement, check the formwork, including tolerances, lines, ties, tie cones, and form coatings. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems.

B. During concrete placement check formwork and related supports to ensure that forms are not displaced and that completed Work is within specified tolerances.

C. If forms are unsatisfactory in any way, either before or during placing of concrete, postpone or stop placement of concrete until the defects have been corrected, and reviewed by ENGINEER.

3.6 REMOVAL OF FORMS

A. Conform to the requirements of ACI 301, Chapter 2 and ACI 347, Chapter 3.7 except as specified below.
   1. Removal of Forms and Supports: Continue curing in accordance with Section 03 30 03, Cast-In-Place Concrete, Paragraph 3.7. Forms are to remain in-place for the time specified below following the end of concrete placement. The durations shown represent a cumulative number of days, or hours, not necessarily consecutive, during which the temperature of the air surrounding the concrete is above or below 50°F.

Temperature:	Above 50°F	Below 50°F or when retarders are used
Walls	12 hours	48 hours
Columns	12 hours	48 hours
Sides of Slabs	6 hours	12 hours
Structural Floor or Roof Slabs	Do not remove forms until site-cured test cylinders develop 100% of 28-days strength.	

   2. When wall or column forms also support formwork for slab or beam soffits, the removal times of the latter should govern.
   3. When high-early strength concrete is specified, a schedule for removal of forms will be developed in the field from the age/ strength relationships established for the materials and proportions used by tests in accordance with ACI 301, Section 2.3.4.
   4. When construction loads are approximately equal to the structural live load, the forms for structural slabs, joists, and beams shall remain in place until the concrete has reached the specified compressive strength.

B. Leave form-facing material in place a minimum of 4 days after concrete placement, unless otherwise approved by ENGINEER.

3.7 PERMANENT SHORES

A. Provide permanent shores as defined in ACI 347 Chapter 3.7. Reshores will not be permitted.

3.8 RE-USE OF FORMS

A. Clean and repair surfaces of forms to be re-used in the Work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces. Form surfaces shall be subject to ENGINEER'S approval.

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SECTION 03 15 16

CONCRETE JOINTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes installation of concrete joints including, construction joints, expansion joints and fillers, waterstops, and contraction (control) joints.

1.2 REFERENCES

A. American Concrete Institute (ACI)
   1. ACI 301, Specifications for Structural Concrete for Buildings.

B. American Society for Testing and Materials (ASTM)
   1. ASTM A36, Standard Specification for Structural Steel.
   2. ASTM D1752, Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
   3. ASTM D570, Standard Test Method for Water Absorption of Plastics.

C. NSF/ANSI Standard 61 Drinking Water Systems Components.

1.3 SYSTEM DESCRIPTION

A. All joints subject to hydrostatic pressure shall be provided with continuous waterstop.

1.4 SUBMITTALS

A. Product Data: Submit for approval, Manufacturer's specifications and installation instructions for all materials required.

B. Shop Drawings: Submit for approval:
   1. Layout of all construction joint locations prior to the submittal of steel reinforcing drawings. The concrete pour sequence and placement schedule shall be stated in the construction joint shop drawing layout.

C. Samples: Submit for approval:
   1. Waterstops for joints.
   2. Expansion joint fillers.

1.5 QUALITY ASSURANCE

A. Install all manufactured items in accordance with manufacturer's instructions.

B. Store materials off the ground and protected from moisture, dirt and other contaminants. Protect installed and uninstalled materials from UV exposure in accordance with manufacturer’s instruction.

PART 2 - PRODUCTS

2.1 PREFORMED EXPANSION JOINT FILLER

A. Bituminous type conforming to ASTM D994 or D1751, unless otherwise shown or specified.

2.2 CONCRETE CONSTRUCTION JOINT ROUGHENER

A. Provide a water-soluble non-flammable, surface-retardant roughener.

B. Product and Manufacturer: Provide one of the following:
   1. Rugasol-S, as manufactured by Sika Corporation for horizontal joints.
   2. MBT EAC-S, as manufactured by Master Builders for horizontal joints.
   3. MBT Tuf-Cote (Deep Etch), as manufactured by Master Builders for vertical joints.
   4. Or approved equal.

2.3 EPOXY BONDING AGENT

A. Provide an epoxy-resin bonding agent, two component type.

B. Product and Manufacturer: Provide one of the following:
   1. Sikadur 32 Hi-Mod LPL, as manufactured by Sika Corporation.
   2. Dural LPL, as manufactured by the Euclid Chemical Company.
   3. Epoxtite Binder (Code # 2390), as manufactured by A.C. Horn, Incorporated.
   4. Or approved equal.

2.4 RUBBER BONDING AGENT

A. Product and Manufacturer: Provide one of the following:
   1. Scotch-Grip 1300 Rubber Adhesive, as manufactured by 3M Company.
   2. Or approved equal.

2.5 MORTAR

A. Mortar must be composed of cement, sand and water. Materials for mortar must comply with Section 03 30 03, Cast-in-Place Concrete. The proportion of sand to cement measured by volume must be 2 to 1 respectively. Mortar must contain only enough water to allow placing.

2.6 BOND BREAKER

A. Tape for Joints: Adhesive-backed glazed butyl or polyethylene tape, same width as joint that will adhere to premolded joint material or concrete surface.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine substrate and conditions under which Work is to be performed with installer and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 CONSTRUCTION JOINTS

A. Comply with ACI 301, Chapter 2.2, and as specified below.

B. Locate and install construction joints as shown. Locate additional construction joints as required to satisfactorily complete all Work.

C. Horizontal Joints:
   1. Roughen concrete at the interface of construction joints by sandblasting to expose the aggregate (1/4-inch minimum amplitude) and remove accumulated concrete on rebar immediately subsequent to form stripping. When sandblasting adjacent to installed waterstops, shield installed waterstops from the sandblasting operation. Immediately before placing fresh concrete, thoroughly clean the existing contact surface using a stiff brush or other tools and a stream of water under pressure. The surface shall be clean and wet, but free from pools of water at the moment the fresh concrete is placed.
   2. Remove laitance, waste mortar or other substance that may prevent complete adhesion.
   3. At the base of walls with waterstops, place a 3-inch thick coat of mortar over the surface of the old concrete. Place fresh concrete before the mortar has attained its initial set.

D. Vertical Joints:
   1. Remove accumulated concrete on rebar.
   2. Roughen concrete at the interface of the construction joints to expose the aggregate (1/4-inch minimum amplitude) through one of the following:
      a. Apply roughener to the form in a thin, even film by brush, spray or roller in accordance with the manufacturer's instructions. After roughener is dry, concrete may be placed. When concrete has been placed and the form removed, wash loosened material off with high-pressure water spray to obtain roughened surface subject to approval by ENGINEER.
      b. Sandblast after concrete has fully cured.
      c. Waterblast after concrete has partially cured.
      d. Perform cleaning so as not to damage waterstop, if one is present.

3.3 EXPANSION JOINTS

A. Locate and install expansion joints as shown. Install bituminous joint filler in accordance with manufacturer's instructions. Install caulking and sealants as specified in Section 07 92 03, Joint Sealants.

3.4 WATERSTOPS

A. General:
   1. Comply with ACI 301, Chapter 2, and as specified below. Make all joints in accordance with manufacturer's instructions.
   2. Obtain ENGINEER'S approval for waterstop locations not shown.
   3. Provide waterstops in all basements, tanks and other substructures up to an elevation at least 12 inches above grade or to an elevation at least 12 inches above highest liquid level in tanks, whichever is higher, except where otherwise shown or noted.

B. shown in accordance with manufacturer's recommendations.

3.5 BONDING WITH EPOXY ADHESIVE

A. Use adhesive for the following:
   1. Bonding of fresh concrete to concrete cured at least 45 days or to existing concrete.
   2. Bonding of horizontal surfaces, which will receive a topping.

B. Handle and store epoxy adhesive in compliance with the manufacturer's printed instructions, including safety precautions.

C. Mix the epoxy adhesive in complete accordance with the instructions of the manufacturer.

D. Before placing fresh concrete, thoroughly roughen and clean hardened concrete surfaces and coat with epoxy adhesive not less than 1/16-inch thick. Place fresh concrete while the epoxy material is still tacky, without removing the in-place grout coat, and as directed by the epoxy manufacturer.

++ END OF SECTION ++

SECTION 03 21 03

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Fabrication and placement of reinforcement including bars, ties and supports, and welded wire fabric for concrete, encasements and fireproofing.

1.2 SUBMITTALS

A. Shop Drawings:
   1. Manufacturer's specifications and installation instructions for all materials and reinforcement accessories.
   2. Drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315, Parts A and B. For walls, show elevations to a minimum scale of 1/4-inch to 1-foot. For slabs, show top and bottom reinforcing on separate plan views. Show bar schedules, stirrup spacing, diagrams of bent bars, arrangements and assemblies, as required for the fabrication and placement of concrete reinforcement, unless otherwise noted. Keep splices to a minimum. Avoid splices in regions of maximum tension stresses whenever possible.

B. Certificates: Submit one (1) copy of steel producer's certificates of mill analysis, tensile and bend tests for reinforcing steel.

1.3 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. American Concrete Institute (ACI):
      a. ACI 315, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.
      b. ACI 318, Building Code Requirements for Reinforced Concrete.
   2. Concrete Reinforcing Steel Institute:
      a. Manual of Standard Practice, includes ASTM standards referred to herein.

B. Allowable Placing Tolerances: Comply with ACI 318, Chapter 7 - Details of Reinforcement.

1.4 DELIVERY, HANDLING AND STORAGE

A. Deliver concrete reinforcement materials to the site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

B. Store concrete reinforcement material at the site to prevent damage and accumulation of dirt or excessive rust. Store on heavy wood blocking so that no part of it will come in contact with the ground.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing Bars: ASTM A615, Grade 60 for all non-welded bars. ASTM A706, Grade 60 for welded bars.

B. Smooth Steel Dowels: ASTM A36.
   1. Epoxy coated conforming to ASTM A775 or ASTM A934.

C. Mechanical Couplers: Reinforcement bars may be spliced with a mechanical connection. Provide a full mechanical connection which shall develop in tension or compression, as required, at least 125% of specified yield strength (f_y) of the bar in accordance with ACI 318 Section 12.14.3.2. The locations of the connections are subject to the approval of the ENGINEER.
   1. Dayton Superior Bar Lock S/CA Series.
   2. Or approved equal

D. Threaded Splicing Systems: Dowel Bar Splicer System shall comply with ICC Report #4028. The completed splice shall exceed 160% of the specified yield strength (f_y) of the bar.
   1. Dayton Superior DB/DI parallel threaded couplers.
   2. Or approved equal

E. Steel Wire: ASTM A82.

F. Welded Wire Fabric: ASTM A185. Furnish in flat sheets, not rolls.

G. Column Spirals: Hot-rolled rods for spirals, ASTM A615.

H. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place.
   1. Use wire bar type supports complying with CRSI recommendations, except as specified below. Do not use wood, brick, or other unacceptable materials.
   2. For slabs on grade, use 5000 psi concrete blocks.
   3. At all formed surfaces, provide supports complying with CRSI "Manual of Standard Practice" as follows: Plastic protected or stainless steel legs.
   4. For all PVC lined concrete surfaces, provide supports complying with CRSI "Manual of Standard Practice" as follows: Either plastic or metal plastic protected legs.

2.2 FABRICATION

A. General: Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI, "Manual of Standard Practice". In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken the material.

B. Unacceptable Materials: Reinforcement with any of the following defects will not be permitted in the Work:
   1. Bar lengths, bends, and other dimensions exceeding specified fabrication tolerances.
   2. Bends or kinks not shown on approved Shop Drawings.

3. Bars with reduced cross-section due to excessive rusting or other cause.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine substrate and conditions under which concrete reinforcement is to be placed with installer, and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

A. Comply with the applicable recommendations of specified codes and standards, and CRSI, Manual of Standard Practice, for details and methods of reinforcement placement and supports.

B. Clean reinforcement to remove loose rust and mill scale, oil, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Position, support, and secure reinforcement against displacement during formwork construction or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.
   1. Place reinforcement to obtain the minimum concrete cover as shown. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcement accurately in position during concrete placement operations. Slab and wall bars shall be tied at every intersection around the periphery of the slab or wall and not less than every 48 inches in the field at walls and 60 inches in the field at slabs.
   2. Bar supports shall be placed no further than 4 feet apart in each direction. Supports must be completely concealed in the concrete and shall not discolor or otherwise mar the surface of the concrete.
   3. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
   4. Do not secure reinforcing steel to forms with wire, nails or other ferrous metal. Do not permit metal supports subject to corrosion to touch or be within the required clearance to formed or exposed concrete surfaces.

D. Install welded wire fabric in as long lengths as practical. Lap adjoining pieces at least one full mesh and lace splices with wire. Do not make end laps midway between supporting beams or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps.

E. Provide sufficient numbers of supports of strength required to carry reinforcement. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment or similar construction loads.

F. Splices: Provide reinforcement lap splices by placing bars in contact, and tying tightly with wire. Comply with requirements shown for minimum lap of spliced bars.

G. Mechanical Couplers in Lieu of Lap Splicing:
   1. Provide mechanical butt splices in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Flame dry bars before butt splicing. Provide adequate jigs and clamps or other devices to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

H. Reinforcement Around Openings: Place an equivalent area of steel around the pipe or opening and extend on each side sufficiently to develop bond in each bar. See the Details on Drawings for bar extension length each side of opening. Where welded wire fabric is used, provide extra reinforcing using fabric or deformed bars.

I. Field Bending: Field bending of reinforcing steel bars is not permitted when rebending will later be required to straighten bars. Rebending of bars at the same place where strain hardening has taken place due to the original bend will damage the bar. Consult with the ENGINEER prior to any pour if the CONTRACTOR foresees a need to work out a solution to prevent field bending.

3.3 INSPECTION OF REINFORCEMENT

A. Do not place concrete until the reinforcing steel is inspected and permission for placing concrete is granted by ENGINEER. All concrete placed in violation of this provision will be rejected.

++ END OF SECTION ++

SECTION 03 30 03

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Place, finish, cure, strip, and repair concrete.

1.2 REFERENCES

A. American Concrete Institute (ACI)
   1. ACI 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
   2. ACI 214, Recommended Practice for Evaluation of Strength Test Results of Concrete.
   3. ACI 301, Specifications for Structural Concrete for Buildings, (includes ASTM Standards referred to herein).
   4. ACI 304, Guide for Measuring, Mixing, Transporting and Placing Concrete.
   5. ACI 305, Hot Weather Concreting.
   6. ACI 306, Cold Weather Concreting.
   7. ACI 309, Guide for Consolidation of Concrete.
   8. ACI 311, Guide for Concrete Inspection.
   9. ACI 318, Building Code Requirements for Reinforced Concrete.
   10. ACI 347, Guide to Formwork for Concrete
   11. ACI 350, Environmental Engineering Concrete Structures.

1.3 SYSTEM DESCRIPTION

A. Class A Concrete shall be steel reinforced and includes:
   1. Foundations.
   2. Walls.
   3. Slabs.
   4. Beams.
   5. Girders.
   6. Columns.
   7. Equipment bases.
   8. Pipe supports.

B. Class B Concrete shall be placed without forms or with simple forms, with little or no reinforcing, and includes:
   1. Concrete fill.
   2. Curbs and gutters.
   3. Sidewalks.
   4. Thrust blocks.
   5. Encasements.

1.4 SUBMITTALS

A. Samples: Submit samples of materials as specified and as otherwise may be requested by ENGINEER, including names, sources and descriptions.

B. Product Data: Submit for approval the following:
   1. Manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
   2. List of concrete materials and concrete mix designs proposed for use. Include the results of all tests performed to qualify the materials and to establish the mix designs.

C. Laboratory Test Reports: Submit copies of laboratory test reports for materials and mix design tests

D. Delivery Tickets: Furnish to ENGINEER copies of all weighmaster certificate delivery tickets for each load of concrete delivered to the site. Provide items of information as specified in ASTM C94, Section 16. Delivery tickets shall be signed by a Certified Weighmaster.

1.5 QUALITY ASSURANCE

A. Tests for Concrete Materials: Submit written reports to ENGINEER, for each material sampled and tested, prior to the start of Work. Provide the Project identification name and number, date of report, name of CONTRACTOR, name of concrete testing service, source of concrete aggregates, material manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material, and test results. Indicate whether or not material is acceptable for intended use.

B. If the concrete mix designs specified herein have not been used previously by the ready-mix supplier, mix proportions and concrete strength curves for regular cylinder tests shall be established by an approved ready-mix supplier or an independent testing laboratory based on the relationship of 7, 14 and 28 day strengths versus slump values of 2, 4 and 6 inches, all conforming to these Specifications. A laboratory, independent of the ready-mix supplier, shall be required to prepare and test all concrete cylinders. The costs for preparation of mix designs, not previously used by the ready-mix supplier, and testing of concrete and materials shall be borne by CONTRACTOR.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement:
   1. Portland cement, ASTM C150, Type II; or blended hydraulic cement, ASTM C595, Type 1P (MS).
   2. Do not use cement which has deteriorated because of improper storage or handling.

B. Aggregates: ASTM C33 and as herein specified.

1. Do not use aggregates containing soluble salts, substances such as iron sulfides, pyrite, marcasite, ochre, or other materials that can cause stains on exposed concrete surfaces.
2. Fine Aggregate: Provide clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.
3. Coarse Aggregate: Provide clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
   a. Crushed stone, processed from natural rock or stone.
   b. Coarse Aggregate Size: Size to be ASTM C33, Nos. 57 or 67, except that No. 467 may be used for footings, foundation mats and walls 16 inches or greater in thickness.

C. Water: Clean, free from injurious amounts of oils, acids, alkalis, organic materials or other substances that may be deleterious to concrete or steel.

2.2 CONCRETE ADMIXTURES

A. Provide admixtures produced by established reputable manufacturers, and use in compliance with the manufacturer's printed instruction. Do not use admixtures that have not been incorporated and tested in the accepted mixes, unless otherwise authorized in writing by ENGINEER.

B. Air-Entraining Admixtures: ASTM C260.
   1. Product and Manufacturer: Provide one of the following:
      a. SIKA AER, as manufactured by Sika Corporation.
      b. MasterAir AE 200, as manufactured by BASF.
      c. Daravair, as manufactured by W.R. Grace & Conn.
      d. Or approved equal.

C. High-Range Water-Reducing Admixture ("Superplasticizer"): ASTM C494, Type F/G.
   1. Superplasticizer shall be used in all Class A Concrete. Do not use high range water-reducing admixture containing more chloride ions than are contained in municipal drinking water. Add only at the job site to concrete in compliance with the manufacturer's printed instruction.
   2. Product and Manufacturer: Provide one of the following:
      a. Sikament 320, as manufactured by Sika Corporation.
      b. MasterGlenium, as manufactured by BASF.
      c. Daracem-100, as manufactured by W.R. Grace & Conn.
      d. Or approved equal.

D. Water-Reducing Admixture: ASTM C 494, Type A.
   1. A water-reducing, aqueous solution of a modification of the salt of polyhydroxylated organic acids. Do not use admixture containing any lignin, nitrates or chlorides added during manufacture.
   2. Product and Manufacturer: Provide one of the following:
      a. Eucon WR-75, as manufactured by The Euclid Chemical Company.
      b. MasterPozzolith, as manufactured by BASF.
      c. WRDA series, as manufactured by W.R. Grace & Conn.
      d. Or approved equal.

E. Pozzolanic Admixtures:

1. Pozzolanic admixtures shall not be used in structures with concrete in contact with potable water, but may be used in other concrete.
2. Provide Mineral admixtures, when used, meeting the requirements of ASTM C618 Class F.
3. A substitution by weight, of the portland cement by pozzolan, so that the total tricalcium aluminate content of the resulting cement plus pozzolan is not greater than 8%, will be considered. However, the pozzolan shall not exceed 20% by weight of the cement plus pozzolan.

F. Set-Control Admixtures: ASTM C494, as follows:
1. Type B, Retarding.
2. Type C, Accelerating.
3. Type D, Water-reducing and Retarding.
4. Type E, Water-reducing and Accelerating.
5. Type F, Water-reducing, high range admixtures.
6. Type G, Water-reducing, high range, and retarding admixtures.

G. Color Pigments:
1. Color pigments for colored concrete must be of iron oxides complying with ASTM C979.

H. Calcium Chloride: Do not use calcium chloride in concrete, unless otherwise authorized in writing by ENGINEER. Do not use admixtures containing calcium chloride where concrete is placed against galvanized steel.

2.3 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes of concrete. Mixes subject to the following limitations:
1. Class A Concrete
a. Specified 28-day Compressive Strength: 4,000 psi minimum.
b. Air content: 5% ± 1%. For concrete placed at least 2 feet below the adjacent grade, an air-entraining admixture is not required unless otherwise specified.
c. Slump, before addition of superplasticizer: 3½ inches ± ½ inches
d. Slump, after addition of superplasticizer: 8-inch maximum

Coarse Aggregate Size	Cementitious Content-Pounds Per Cubic Yard	Water-Cement Ratio by Weight
¾”	625 min, 800 max	0.375
1”	600 min, 800 max	0.385
1 ½”	590 min, 800 max	0.400

e. Use superplasticizer in all Class A Concrete. Use water reducers in combination with superplasticizers as required for mixing.
2. Class B Concrete
a. Specified 28-day Compressive Strength: 2,500 psi.
b. Maximum Water-Cement Ratio by Weight: 0.49.
c. Slump: 3-inch Minimum, 5-inch Maximum.

B. Use an independent testing facility acceptable to ENGINEER for preparing and reporting proposed mix designs.

C. Admixtures:
   1. Use air-entraining admixture in all concrete, except interior slabs subject to abrasion, unless otherwise shown or specified. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at the point of placement having air content within the prescribed limits.
   2. Use amounts of admixtures as recommended by the manufacturer for climatic conditions prevailing at the time of placing. Adjust quantities and types of admixtures as required to maintain quality control.

D. Colored Concrete:
   1. The dosage of colored pigments for colored concrete must not exceed 10 percent by weight of cementitious materials in the concrete mix design.
   2. When test panels are specified, cementitious materials and aggregates from the same sources used in the authorized test panel must be used for the colored concrete in the completed work.

2.4 EPOXY BONDING AGENT

A. For use in all dry-packed holes, concrete repair and for unplanned cold-joints.

B. Provide an epoxy-resin bonding agent, two component, polysulfide type.

C. Product and Manufacturer: Provide one of the following:
   1. Sikadur 32, Hi-Mod LPL, as manufactured by Sika Corporation.
   2. Eucopoxy LPL, as manufactured by the Euclid Chemical Company.
   3. Or approved equal.

2.5 CONCRETE CURING MATERIALS

A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 10 ounces per square yard and complying with AASHTO M182, Class 3.

B. Moisture-Retaining Cover: One of the following, complying with ASTM C171.
   1. Waterproof paper.
   2. Polyethylene film.
   3. White burlap-polyethylene sheet.

C. Curing Compound: ASTM C309 Type 1-D (water retention requirements):
   1. Product and Manufacturer: Provide one of the following:
      a. Super Aqua Cure VOX, as manufactured by The Euclid Chemical Company.
      b. Sealtight 1100, as manufactured by W.R. Meadows, Incorporated.
      c. Or approved equal.

D. Concrete Densifier and Chemical Hardener (Surface Applied)
   1. Product and Manufacturer: Provide one of the following:
      a. LS, as manufactured by Consolideck.
      b. Liqui-Hard, as manufactured by W. R. Meadows.
      c. Duro-Nox LS, as manufactured by Nox-Crete.

d. Or approved equal.

2.6 EMBEDDED ITEMS

A. Provide and install items such as plates, angles, inserts, bolts and similar items not specified elsewhere under this Section. Carbon steel embedded items shall be hot dip galvanized after fabrication.

B. Abrasive Stair Nosings
   1. Provide single-component stair nosing
   2. 3-inch width
   3. Aluminum Extrusion, with provisions for anchoring into concrete
   4. Extruded with multiple channels, dovetail shaped, filled with aluminum oxide grit set in epoxy resin
   5. Designed for installation before concrete sets, at the front edge of the stair
   6. Provide continuous stair nosings, width of stairway less 3 inches on each side. No splices in stair nosings.
   7. Manufacturers/Models:
      a. Balco; Model R-315P
      b. Babcock Davis; Model BSTTB
      c. Or Equal

PART 3 - EXECUTION

3.1 CONCRETE MIXING

A. Provide concrete produced by the ready-mixed process.

B. Comply with the requirements of ASTM C 94, and as herein specified. Proposed changes in mixing procedures, other than herein specified, must be accepted by ENGINEER before implementation.
   1. Plant equipment and facilities: Conform to National Ready- Mix Concrete Association "Plant and Delivery Equipment Specification."
   2. Mix concrete in revolving type truck mixers that are in good condition and which produce thoroughly mixed concrete of the specified consistency and strength.
   3. Do not exceed the proper capacity of the mixer.
   4. Mix concrete for a minimum of two minutes after arrival at the job site, or as recommended by the mixer manufacturer.
   5. Mix concrete during transit only as recommended by the mixer manufacturer.
   6. Mix at proper speed until concrete is discharged.
   7. Maintain adequate facilities at the job site for continuous delivery of concrete at the required rates.
   8. Provide access to the mixing plant for ENGINEER at all times.

3.2 TRANSPORTING CONCRETE

A. Transport and place concrete not more than 90 minutes after water has been added to the dry ingredients or before 250 revolutions of the drum or blades, whichever occurs first.

B. If an admixture is used to retard the set time and the concrete temperature does not exceed 85 degrees F, the travel and placing time may be extended to 120 minutes or 300 revolutions of the drum or blades, whichever occurs first.

C. Take care to avoid spilling and separation of the mixture during transportation.

D. Do not place concrete in which the ingredients have been separated.

E. Do not retemper partially set concrete.

F. Use suitable and approved equipment for transporting concrete from mixer to forms.

3.3 CONCRETE PLACEMENT

A. General: Place concrete continuously so that no concrete will be placed on concrete, which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as specified in Section 03 15 16, Concrete Joints. Deposit concrete as nearly as practical in its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure that will cause segregation.
   1. Screed concrete that is to receive other construction to the proper level to avoid excessive skimming or grouting.
   2. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from the job site and dispose of it in an acceptable location.
   3. Do not place concrete until all forms, bracing, reinforcement, and embedded items are in final and secure position.
   4. Do not place in cold weather, unless adequate precautions are taken against frost action.
   5. Do not place footings, piers or pile caps on frozen soil.
   6. Unless otherwise approved, place concrete only when ENGINEER is present.
   7. Allow a minimum of 3 days of curing before placing new concrete against a slab or wall already in place.

B. Concrete Conveying:
   1. Handle concrete from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit as rapidly as practical by methods that will prevent segregation and loss of concrete mix materials.
   2. Provide mechanical equipment for conveying concrete to ensure a continuous flow of concrete at the delivery end. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, ice and other deleterious materials.
   3. Pumping concrete is permitted, however do not use aluminum pipe for conveying.

C. Placing Concrete into Forms:
   1. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place concrete at such a rate that concrete that is being integrated with fresh concrete is still plastic.

2. Do not permit concrete to free fall within the form from a distance exceeding 8 feet, except as noted in Section 03 11 03, Concrete Formwork. Use "elephant trunks" or "wall pipes" to prevent free fall and excessive splashing on forms and reinforcement.
3. Remove temporary spreaders in forms when concrete placing has reached the elevation of such spreaders.
4. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with the applicable recommended practices of ACI 309. Vibration of forms and reinforcing will not be permitted.
5. Vibrators shall have a frequency of at least 8,000 vpm, with amplitude required to consolidate the concrete in the section being placed. At least one stand-by vibrator in operable condition shall be at the placement site prior to initiating placement of the concrete.
6. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the layer of concrete and at least 6 inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.
7. The forms shall contain sufficient windows or be limited in height to allow visual observation of the concrete and the vibrator operators shall be required to see the concrete being consolidated to ensure good quality workmanship or the CONTRACTOR shall have a person who is actually observing the vibration of the concrete at all times and advising the vibrator operators of any changes needed to assure complete consolidation.
8. Do not place concrete in beam and slab forms until the concrete previously placed in columns and walls is no longer plastic.
9. Force concrete under pipes, sleeves, openings and inserts from one side until visible from the other side to prevent voids.

D. Placing Concrete Slabs and Footings:
1. Deposit and consolidate concrete in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.
2. Consolidate concrete during placing operations using mechanical vibrating equipment, so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Consolidate concrete placed in beams and girders of supported slabs, and against bulkheads of slabs on ground, as specified for formed concrete structures.
4. Bring surfaces to the correct level. Smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the surfaces prior to beginning finishing operations.

E. Bonding for Next Concrete Pour: Per Section 03 15 16, Concrete Joints.

F. Quality of Concrete Work:
1. Make all concrete solid, compact and smooth, and free of laitance, cracks and cold joints.
2. All concrete for liquid retaining structures, and all concrete in contact with earth, water, or exposed directly to the elements shall be watertight.

3. Cut out and properly replace to the extent ordered by ENGINEER, or repair to the satisfaction of ENGINEER, surfaces which contain cracks or voids, are unduly rough, or are in any way defective. Thin patches or plastering will not be acceptable.
4. Repair all leaks through concrete, and cracks, holes or other defective concrete in areas of potential leakage and make watertight.
5. Repair, remove, and replace defective concrete as ordered by ENGINEER at no additional cost to OWNER.

G. Cold Weather Placing:
1. Protect all concrete Work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 306 and as herein specified.
2. When the air temperature has fallen to or may be expected to fall below 40°F, provide adequate means to maintain the temperature, in the area where concrete is being placed, at between 50°F and 70°F for at least seven days after placing. Provide temporary housings or coverings including tarpaulins or plastic film. Maintain the heat and protection, if necessary, to ensure that the ambient temperature does not fall more than 30°F in the 24 hours following the seven-day period. Avoid rapid dry-out of concrete due to overheating, and avoid thermal shock due to sudden cooling or heating.
3. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat all water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 55°F and not more than 85°F at point of placement.
4. Do not use frozen materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Ascertain that forms, reinforcing steel, and adjacent concrete surfaces are entirely free of frost and ice before placing concrete.
5. When temperatures are expected to be below 32°F the night before the concrete is placed, then all reinforcing steel, forms and the ground shall be preheated, for a minimum of 12 hours, under a minimum temperature of 50°F.
6. Do not use salt and other materials containing antifreeze agents or chemical accelerators, or set-control admixtures, unless approved by ENGINEER, in mix designs.
7. Weather predictions made by the nearest NOAA station, and corrected for the local elevation and environmental conditions, may be used to determine whether cold weather protection shall be required. Thermometers will be used by ENGINEER and these readings shall determine whether cold weather protection shall be required and whether cold weather protection is adequate.

H. Hot Weather Placing:
1. When hot weather conditions exist as any combination of high air temperature, low relative humidity and wind velocity that would seriously impair the quality and strength of concrete, place concrete as recommended by ACI 305 and as herein specified.
2. Cool ingredients before mixing to maintain concrete temperature at time of placement below 85°F. No concrete shall be placed if its temperature exceeds 90°F. Mixing water may be chilled, or chopped ice may be used, or liquid nitrogen may be added. Ice, when introduced into the mixer shall be in such form that it will be completely melted and dispersed throughout the mix at the completion of the mixing time. The addition of ice shall not increase the specified water to cement ratio.

3. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
4. Thoroughly wet forms before placing concrete. Forms shall be free of standing water when concrete is placed.
5. Do not use set-control admixtures, unless approved by ENGINEER in mix designs.
6. Fog spray shall be used during finishing operations whenever necessary to avoid surface plastic shrinkage cracking. Fog spray shall also be used after finishing and before the specified curing is commenced to avoid surface plastic shrinkage cracking.
7. Obtain ENGINEER'S approval of other methods and materials proposed for use.

I. Removal of Forms:
1. The CONTRACTOR shall be responsible for all damage resulting from improper and premature removal of forms. Satisfy all applicable OSHA requirements with regard to safety of personnel and property.
2. Forms and shoring for elevated structural slabs or beams shall remain in place in accordance with ACI 318, Chapter 6, and until the concrete has reached a compressive strength equal to the specified 28-day compressive strength as determined by test cylinders unless noted otherwise in Section 03 11 03, Concrete Formwork. Removal of all supports prior to obtaining adequate field cured cylinder results and reshoring shall not be permitted.

J. Backfill Against Walls:
1. Do not place backfill against walls until the concrete has obtained a compressive strength equal to the specified 28-day compressive strength. Where backfill is to be placed on both sides of the wall, the backfill shall be placed simultaneously on both sides to prevent differential pressures.
2. Since the walls of some structures are laterally restrained or supported by suspended slabs and/or slabs on grade and are not designed as cantilever retaining walls, the CONTRACTOR shall submit a schedule of wall shoring, bracing, and backfilling that is coordinated with the concrete curing, test cylinder reports and the design assumptions and obtain a review from the ENGINEER prior to proceeding.

K. Patching:
1. Patching of concrete shall provide an acceptable and structurally sound surface finish uniform in appearance or the CONTRACTOR shall upgrade the finish by other means at no additional cost.
2. Tie Holes: All tie holes, except where sealant is indicated, shall be filled with dry pack nonshrink grout. White cement shall be added as needed so the color of grout after curing matches the color of adjacent concrete. Tie holes shall be thoroughly sandblasted or roughened. Flush the patch area with water and allow to dry. Coat the surface of the existing concrete with an approved bonding agent prior to filling with nonshrink grout. Complete the repair in the time duration specified by the bonding agent manufacturer. The grout shall be rammed into place in thin layers and leveled to the plane of the surrounding concrete. Cure in accordance with the manufacturer’s recommendations.
3. Defective Areas: Remove all defective concrete such as honeycombed areas and rock pockets out to sound concrete. Small shallow holes caused by air entrapment at the surface of the forms shall not be considered defects unless the amount is so great as to be considered not the standard of the industry and due primarily of poor workmanship. If chipping is required, the edges shall be perpendicular to the

surface. Feather edges shall not be permitted. The defective area shall be filled with a nonshrink, nonmetallic, grout. Use an approved bonding agent on horizontal patches prior to placing nonmetallic, non shrink grout. Since some bonding agents may not be compatible for some vertical surface patching techniques, demonstrate all methods for repair of vertical surfaces using the actual materials, methods, and curing procedures required by the manufactures of the materials on the project site. The CONTRACTOR shall consult with representatives of the bonding agent manufacturer and the nonshrink grout manufacturer, and these representatives shall be onsite and assist in the demonstration.

4. Blockouts at Pipes or Other Penetrations: Conform to details shown or submit proposed blockouts for review. Use nonshrink, nonmetallic grout.

3.4 FINISH OF FORMED SURFACES

A. Rough Form Finish:
   1. Standard rough form finish is with concrete surface having the texture imparted by the form material, with tie holes and defective areas repaired and patched with mortar of 1 part cement to 1½ parts sand & all fins and other projections exceeding ¼ inches in height rubbed down or chipped off.
   2. Use rough form finish for the following:
      a. Exterior vertical surfaces up to 1 foot below grade.
      b. Interior exposed vertical surfaces of liquid containers up to 1 foot below liquid level.
      c. Interior and exterior exposed beams and undersides of slabs.
      d. Other areas shown.

B. Smooth Form Finish:
   1. Produce smooth form finish (Class A, as defined by ACI-347) by selecting form materials that will impart a smooth, hard, uniform texture. Arrange panels in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas as above with all fins or other projections completely removed and smoothed.
   2. Use smooth form finish for surfaces that are to be covered with a coating material. The material may be applied directly to the concrete or may be a covering bonded to the concrete such as waterproofing, damp proofing, painting or other similar system.

C. Smooth Rubbed Finish:
   1. Provide smooth, rubbed finish to concrete surfaces which have received smooth form finish as follows:
      a. Rubbing of concrete surfaces not later than the day after form removal.
      b. Moistening of concrete surfaces and rubbing with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.
   2. Except where surfaces have been previously covered as specified above, use smooth rubbed finish for the following:
      a. Interior exposed walls and other vertical surfaces.
      b. Exterior exposed walls and other vertical surfaces down to 1 foot below grade.
      c. Interior and exterior horizontal surfaces, except exterior exposed slabs and steps.
      d. Interior exposed vertical surfaces of liquid containers down to 1 foot below liquid level.
      e. Other areas shown.

D. Sack Rubbed Finish:
   1. Before applying the sack-rubbed finish, fill all tie rod holes and large cavities and remove or correct all fins and irregularities as specified in the Smooth Rubbed Finish.
   2. Produce a sack rubbed finish by rubbing the concrete surface with a clean rubber float or wad of burlap and mortar. Use mortar made of premixed sacking mortar or one part portland cement and 1.5 parts, by volume, clean sand passing a No. 16 sieve, mixed with sufficient water to provide a consistency equal to that of a thick cream. Use the same type and brand cement as used in the concrete or colored premixed sacking mortar. The mortar finish color shall match the surrounding concrete. If necessary, blend white cement into the mortar to match the surrounding concrete surface.
   3. Thoroughly wet the surface of the concrete and then perform sack rubbing while the surface is damp but not wet. Thoroughly rub the mortar over the area with a rubber float or wad of burlap, filling all pits. While the mortar is still plastic in the pits, rub the surface with the rubber float or burlap using a dry mix of the above proportions, removing all excess plastic material and placing enough dry material in the pits to stiffen and solidify the mortar, then finish the mortar fillings flush with the surface. At the end of the rubbing, no mortar or material shall remain on the surface other than that within the pits.
   4. Ensure the completed surface is free of surface voids and blemishes, and is uniform in appearance and texture, except for the difference in texture between the filled voids and the remainder of the surface.
   5. A thorough wash-down with stiff bristle brushes shall follow the final bagging or stoning operation. No extraneous materials shall remain on the surface of the wall. The wall shall be sprayed with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after the application.
   6. Use a sack rubbed finish for the following areas or as indicated in the Drawings:
      a. Interior exposed walls and other vertical surfaces.
      b. Exterior exposed walls and other vertical surfaces down to 1 foot below grade.
      c. Interior and exterior horizontal surfaces, except exterior exposed slabs and steps.
      d. Or other areas shown.

E. Related Unformed Surfaces:
   1. At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces, unless otherwise shown.

3.5 MONOLITHIC SLAB FINISHES

A. Float Finish:
   1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently. Check and level the surface plane to a tolerance not exceeding ¼ inch in 10 feet when tested with a 10-foot straightedge. Cut down high spots and fill all low spots. Uniformly slope surface to drains as shown. Immediately after leveling, refloat the surface to a uniform, smooth, granular texture.
   2. Use float finish for the following:
      a. Interior horizontal surfaces of liquid containers, except those to receive grout topping.
      b. Exterior below grade horizontal surfaces.

c. Surfaces to receive additional finishes, except as shown or specified.

B. Trowel Finish:
   1. After floating, begin the first trowel finish operation using a power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.
   2. Consolidate the concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8 inch in 10 feet when tested with a 10-foot straight edge. Grind smooth surface defects that would telegraph through applied floor covering system.
   3. Use trowel finish for the following:
      a. Interior exposed slabs, unless otherwise shown or specified.
      b. Slabs to receive resilient floor finishes.

C. Non-Slip Broom Finish:
   1. Immediately after trowel finishing, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use fiber-bristle broom, unless otherwise directed. Coordinate the required final finish with ENGINEER before application.
   2. Use Non-Slip Broom Finish for the following:
      a. Exterior exposed horizontal surfaces subject to light foot traffic.
      b. Interior and exterior concrete steps and ramps.
      c. Horizontal surfaces which will receive a grout topping or a concrete equipment base slab.

3.6 CONCRETE CURING AND PROTECTION

A. General:
   1. Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.
   2. Start initial curing after placing and finishing concrete as soon as free moisture and bleed water sheen has disappeared from the concrete surface. Keep concrete continuously moist during initial curing.
   3. Begin final curing procedures immediately following initial curing and before the concrete has dried. The total curing duration shall not be less than ten (10) days. For concrete sections over 30-inch thick, continue curing for an additional seven (7) days, minimum. Avoid rapid drying at the end of the final curing period.

B. Use one of the following methods as approved by ENGINEER:
   1. Walls:
      a. Method 1: Leave concrete forms in place and keep entire surfaces of forms and exposed concrete surfaces wet for the entire curing duration. If forms are loosened and the contact between the concrete surface and forms is broken then the entire wall shall be wet cured.
      b. Method 2: Continuously sprinkle or fog with water 100 percent of the exposed surfaces for the curing duration immediately after removal of forms.
      c. Method 3: When approved by ENGINEER and as noted below, apply curing compound immediately after removal of forms.

2. Slab and Curbs:
    a. Method 1: Protect surface by water ponding for the entire curing duration.
    b. Method 2: Cover concrete surfaces and exposed edges with the specified absorptive cover, thoroughly saturating the cover with water, and keeping the absorptive cover continuously wet with sprinklers or porous hoses during the curing duration. Lap adjacent absorptive cover sections 3-inches minimum.
    c. Method 3: Cover the concrete surfaces and exposed edges with the specified moisture-retaining cover during the curing duration. Seal edges and seams with waterproof tape, adhesive or sand berm. Water must be introduced between the moisture-retaining cover and the concrete surface whenever moist drops cannot be detected on the concrete side of the cover or the concrete surface is noticeably dry.
    d. Method 4: Cover all exposed surfaces with 1-inch minimum layer of wet sand, earth, or sawdust and keep continuously wet for the curing duration.
    e. Method 5: Continuously sprinkle or fog exposed surfaces for the curing duration.
    f. Method 6: When approved by ENGINEER and as noted below, apply liquid curing compound immediately after final finishing when surface will no longer be damaged by traffic necessary to apply curing compound.

C. Liquid curing compound:
    1. Apply the specified curing compound to concrete surfaces when permitted by ENGINEER. Slabs to receive terrazzo floors, concrete/grout topping or ceramic tile, concrete of water bearing structures, and concrete that will receive coatings shall not be cured with liquid curing compound. The compounds shall be applied by power spray equipment in accordance with the manufacturer's directions. Recoat areas, which are subjected to heavy rainfall within 3 hours after initial application. Maintain the continuity of the coating and repair damage to the coat during the entire curing period. Remove curing compound from exposed surfaces at the end of the curing duration. For concrete surfaces, which will be in contact with potable water, the manufacturer shall certify that the curing compound used is NSF 61 approved.

D. Temperature of Concrete During Curing:
    1. When the nighttime low temperature may drop to 40°F or below, maintain the concrete temperature between 50°F and 70°F continuously throughout the curing period, by heating, covering, insulation or housing as required.
    2. When the daytime high temperature may rise to 90°F or above, maintain the concrete temperature at a minimum and reduce temperature variations by providing moist curing continuously for the concrete curing period.
    3. During either of the conditions specified above, the minimum curing time shall be 10 days (240 hours), after which coverings, housings, and insulation shall remain on the work for an additional 3 days, to allow gradual temperature equalization with the atmosphere.

E. Protection from Mechanical Injury: During the curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations.

3.7 FIELD QUALITY CONTROL

A. The CONTRACTOR will employ a testing laboratory to perform field quality control testing. ENGINEER will direct the number of tests and cylinders required. Furnish all necessary assistance required by ENGINEER.

B. Quality Control Testing During Construction:
   1. Perform sampling and testing for field quality control during the placement of concrete, as follows:
      a. Sampling Fresh Concrete: ASTM C172.
      b. Slump: ASTM C143; one test for each concrete load at point of discharge; and one for each set of compressive strength test specimens.
      c. Air Content: ASTM C231; one for the first concrete load, and one for every two concrete loads thereafter, or when required by an indication of change. Adjust mix if test results are unsatisfactory and resubmit for ENGINEER'S approval.
      d. Compressive Strength Tests: ASTM C39; one set of 4 standard compression cylinders for each 100 cubic yards or fraction thereof, of each mix design placed in any one day; 1 specimen tested at 7 days, and 2 specimens tested at 28 days, 1 held. Cast, store and cure specimens as specified in ASTM C31.
         1) Adjust mix if test results are unsatisfactory and resubmit for ENGINEER'S approval.
         2) Concrete that does not meet the strength requirements is subject to rejection and removal from the Work, or to other such corrective measures as directed by ENGINEER, at the expense of CONTRACTOR.
      e. Concrete Temperature: Test each time a slump test is made.
   2. Where questionable field conditions may exist during placing concrete or immediately thereafter, strength tests of specimens cured under field conditions will be required by ENGINEER to check the adequacy of curing and protecting of the concrete placed. Specimens shall be molded at the same time and from the same samples as the laboratory cured specimens.
      a. Provide improved means and procedures for protecting concrete when the 28-day compressive strength of field- cured cylinders is less than 85% of companion laboratory-cured cylinders.
      b. When laboratory-cured cylinder strengths are appreciably higher than the minimum required compressive strength, field-cured cylinder strengths need not exceed the minimum required compressive strength by more than 500 psi even though the 85 percent criterion is not met.
   3. The testing laboratory shall submit certified copies of test results directly to ENGINEER and CONTRACTOR after tests are made.

C. Evaluation of Quality Control Tests:
   1. Do not use concrete delivered to the final point of placement that has slump or temperature outside the specified values, nor that which is older than specified in section 3.2.
   2. Compressive strength tests for laboratory-cured cylinders will be considered satisfactory if the averages of all sets of three consecutive compressive strength tests results equal or exceed the 28 day design compressive strength of the type or class of concrete; and, no individual strength test falls below the required compressive strength by more than 500 psi.

3. If the compressive strength tests fail to meet the minimum requirements specified, the concrete represented by such tests will be considered deficient in strength and subject to replacement, reconstruction or to other action approved by ENGINEER.

D. Testing Concrete Structure for Strength:
   1. When there is evidence that the strength of the in-place concrete does not meet specification requirements, provide the services of a concrete testing service to take cores drilled from hardened concrete for compressive strength determination at no additional expense to OWNER. Provide tests complying with ASTM C42 and the following:
      a. Take at least three (3) representative cores from each member or suspect area at locations directed by ENGINEER.
      b. Strength of concrete for each series of cores will be considered satisfactory if their average compressive strength is at least 85% and no single core is less than 75% of the 28 day required compressive strength.
      c. Report test results, in writing, to ENGINEER on the same day that tests are made. Include in test reports the Project identification name and number, date, name of CONTRACTOR, name of concrete testing service, location of test core in the structure, type or class of concrete represented by core sample, nominal maximum size aggregate, design compressive strength, compression breaking strength and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plane of the concrete as placed, and the moisture condition of the core at time of testing.
   2. Fill core holes solid with non-shrink, high strength grout, and finish to match adjacent concrete surfaces.

E. Water Leakage Tests for All Water-Holding Structures:
   1. All water-holding structures shall be subjected to leakage tests after the concrete has been cured and obtained its design strength, and before backfill, brick facing, or other work which will cover the concrete surfaces of the walls is begun. Water leakage tests shall be conducted by the CONTRACTOR as follows:
      a. All water-holding structures shall be filled with water to the maximum liquid level shown on the Drawings prior to leak testing at a rate less than 4 ft/hr. After these structures have been kept full for 3-days, it will be assumed for the purpose of the test that the absorption of moisture by the concrete in the basin is complete. All valves and gates to the structure shall then be closed and the change in water surface measured over a 48-hour period. The vertical distance to the water surface shall be measured to within 1/16-inch from a fixed point on the containment structure above the water surface. Measurements shall be recorded at 24-hour intervals.
      b. During the test period, all exposed portions of the structure shall be examined for dampness or leaks and all visible leaks or damp spots shall be marked; such leaks or damp spots shall be later patched or corrected in a manner acceptable to the ENGINEER prior to additional leakage testing. If the drop in water surface in the 48-hour period exceeds 0.05% of the normal volume of liquid contained in the water-holding structure, after accounting for evaporation, precipitation and temperature in open basins, or if damp spots or any seepage is present on the walls or other areas exposed to view where moisture can be picked up on a dry hand, the leakage shall be considered excessive and the leakage test will be considered to have failed. A floating, restrained, partially filled, calibrated, open

container for evaporation and precipitation measurement should be positioned in open containment structures, and the water level in the container recorded. Determination of evaporation by a shallow pan-type measuring device is discouraged as the heating of the bottom of a shallow pan can cause accelerated evaporation of water when compared with that taking place from a deep containment structure.

1) Wet areas on top of wall footings shall not be considered cause of a qualitative failure of the leakage test unless the water can be observed to be flowing.

c. If the leakage is excessive, and if damp spots and observed seepage is present on exposed surfaces, the water-holding structure shall be drained, all leaks and damp spots previously marked shall be patched, and the necessary repairs made, and the basin shall be retested. The CONTRACTOR's method of repair shall be subject to the requirements of these specifications and submitted for review and approval by the ENGINEER.

d. The water-holding structure shall then be refilled and again tested for leakage and this testing and repair process shall be repeated as many times as necessary until the leakage test passes. This process shall be continued until the drop in water surface in specified test period with the basin full is less than the quantity specified above and all damp spots and seepage disappears when the structures are full of water. All repairs of faulty workmanship and materials, and additional tests, shall be made by the CONTRACTOR in an acceptable manner, at no additional cost to the OWNER. Both the correction for excessive leakage and the removal of the damp or wet spots on exposed surfaces shall be required to pass the leakage test.

e. The purpose of this test is to determine the integrity of the finished concrete and to show that the exposed wall surfaces are visually acceptable. Therefore, all other equipment, e.g., stop gates, sluice gates, etc. or temporary bulkheads, should be made watertight prior to the test.

f. As an alternative to having watertight bulkheads, gates or valves, the CONTRACTOR shall accurately measure the leakage through gates, valves, and bulkheads with methods acceptable to the ENGINEER.

g. An assumed leakage through gates and valves based on the manufacturer's recommendations is not acceptable.

3.8 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In: Fill-in holes and openings left in concrete structures for the passage of work by other contractors, unless otherwise shown or directed, after the work of other contractors is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete the Work.

B. Curbs:
   1. Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
   2. Exterior curbs shall have rubbed finish for vertical surfaces and a broomed finish for top surfaces.

C. Equipment Bases:

1. Unless specifically shown otherwise, provide concrete bases for all pumps and other equipment. Construct bases to the dimensions shown, or as required to meet manufacturers; requirements and drawing elevations. Where no specific elevations are shown, bases shall be 6-inches thick and extend 3-inches outside the metal equipment base or supports. Bases to have smooth trowel finish, unless a special finish such as terrazzo, ceramic tile or heavy duty concrete topping is required. In those cases, provide appropriate concrete finish.
2. Include all concrete equipment base work not specifically included under other Sections.
3. In general, place bases up to 1-inch below the metal base. Properly shim equipment to grade and fill 1-inch void with non-shrink grout as specified in Section 03 60 03, Grout.

D. Installation of embedded items
1. Install all embedded items prior to concrete placement, or, if necessary, as soon after concrete placement as possible, before concrete is set.
2. Use temporary support and bracing to keep embedded items in place while concrete cures.
3. Protect all embedded items from damage during concrete installation.

3.9 CONCRETE REPAIRS

A. Repair of Formed surfaces:
1. Repair exposed-to-view formed concrete surfaces that contain defects which adversely affect the appearance of the finish. Surface defects that require repair include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, and holes left by the rods and bolts; fins and other projections on the surface; and stains and other discolorations that cannot be removed by cleaning.
2. Repair concealed formed concrete surfaces that may contain defects that adversely affect the durability of the concrete. Surface defects that require repair include cracks in excess of 0.01-inch wide, cracks of any width and other surface deficiencies which penetrate to the reinforcement or completely through non-reinforced sections, honeycomb, rock pockets, holes left by tie rods and bolts, and spalls except minor breakage at corner.
3. Repair structural cracks and cracks in water-holding structures.

B. Method of Repair of Formed Surfaces:
1. Repair and patch defective areas with cement mortar immediately after removal of forms and as directed by ENGINEER.
2. Cut out honeycomb, rock pockets, voids over ½-inch diameter, and holes left by tie rods and bolts, down to solid concrete but, in no case, to a depth of less than 1-inch. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water, and brush-coat the area to be patched with the specified bonding agent.
   a. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, the patching mortar color will match the color of the surrounding concrete. CONTRACTOR shall impart texture to repaired surfaces to match texture of existing adjacent surfaces. Provide test areas at inconspicuous locations to verify mixture, texture and color match before proceeding with the patching. Compact mortar in place and strike off slightly higher than the surrounding surface.

3. Cracks which require repair shall be pressure grouted, epoxy injected, using one of the following. Apply in accordance with the manufacturer's directions and recommendations.
    a. Sikadur 35, Hi-Mod L.V. and Sikadur 31, Hi-Mod Gel, as manufactured by Sika Corporation Company.
    b. Euco Epoxy #452 Epoxy System, as manufactured by The Euclid Chemical Company.
    c. Or approved equal.
4. Fill holes extending through concrete by means of a plunger- type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to ensure completely filling.
5. Sandblast exposed-to-view surfaces that require removal of stains, grout accumulations, sealing compounds, and other substances marring the surfaces. Use sand finer than No. 30 and air pressure from 15 to 25 psi.

C. Repair of Unformed Surfaces:
1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to the tolerances specified for each surface and finish. Correct low and high areas as herein specified.
2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope. Correct high and low areas as herein specified.
3. Repair finish of unformed surfaces that contain defects which adversely affect the durability of the concrete. Surface defects, as such, include crazing, cracks in excess of 0.01-inch wide or which penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
4. Repair structural cracks and cracks in water-holding structures.

D. Methods of Repair of Unformed Surfaces:
1. Correct high areas in unformed surfaces by grinding, after the concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.
2. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Use one of the following. Apply in accordance with the manufacturer's directions and recommendations.
    a. Euco Poly-Patch, as manufactured by The Euclid Chemical Company.
    b. Sikatop 122, as manufactured by Sika Corporation.
    c. Or approved equal.
3. Repair defective areas, except random cracks and single holes not exceeding 2-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least ¾-inch clearance all around. Dampen all concrete surfaces in contact with patching concrete and brush with the specified bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same materials and proportions to provide concrete of the same type or class as the original adjacent concrete. Place, compact and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

4. Repair isolated random cracks, as approved be ENGINEER, and single holes not over 2-inch diameter, by the dry-pack method. Groove the top of cracks, and cut out holes to sound concrete and clean of dust, dirt and loose particles. Dampen all cleaned concrete surfaces and brush with the specified bonding agent. Place dry-pack before the cement grout takes its initial set. Mix dry-pack, consisting of 1 part portland cement to 2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours.
5. Cracks which extend through the full member section, or any cracks determined by ENGINEER to require pressure grouting repair, shall be pressure grouted, epoxy injected, using one of the following. Apply in accordance with the manufacturer's directions and recommendations.
   a. Sikadur 35, Hi-Mod L.V. and Sikadur 31, Hi-Mod Gel, as manufactured by Sika Corporation.
   b. Euco Epoxy #452 Epoxy System, as manufactured by The Euclid Chemical Company.
   c. Or approved equal.
6. Assure that surface is acceptable for flooring material to be installed in accordance with manufacturer's recommendations.

E. Other Methods of Repair:
   1. Repair methods not specified above may be used if approved by ENGINEER.

++ END OF SECTION ++

SECTION 03 40 03

PRECAST CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes all plant-precast products, including, but not limited to, wet wells, catch basins, manholes, vaults, and wheel stops.

1.2 SYSTEM DESCRIPTION

A. Precast products shall be designed for the indicated service, the loadings specified in the Contract Documents, and all transportation, handling, and erection loads, in accordance with requirements and recommendations of the references.
   1. Precast products not subjected to traffic loads shall be designed to meet and exceed the requirements of ACI 318-14.
   2. Precast products subjected to traffic loads shall be designed to meet and exceed the requirements of the current AASHTO LRFD Bridge Design Specifications.
   3. Liquid containing precast products shall be designed for the additional requirements of ACI 350-06.

B. If precast products are proposed as substitutes for cast-in-place designed structures, such precast products shall meet the above requirements and any other requirements for which the cast-in-place structures were designed by the ENGINEER. Such products shall be designed by an engineer licensed to practice in the State where the project is performed.

C. Items located in or adjacent to traffic areas shall be designed to resist AASHTO HL93 loading, unless otherwise indicated.

D. Lifting inserts shall have a minimum safety factor of 4.

1.3 QUALIFICATIONS

A. Manufacturer:
   1. Manufacturer shall have at least 5 years experience in the design and manufacture of precast concrete products substantially similar to those required for this project.

B. Installer:
   1. Precast Items shall be installed by the Manufacturer or by an installer regularly engaged for at least 5 years in erection of precast products similar to those required on this project.

1.4 REFERENCES

1. 01 61 03 – General Product Requirements
2. 03 15 16 – Concrete Joints
3. 03 21 03 – Concrete Reinforcing
4. 08 35 00 – Access Hatches

1.5 SUBMITTALS

A. Shop Drawings:
   1. CONTRACTOR shall as built existing pipeline depths prior to preparation of shop drawings for precast vaults.
   2. Submit to the ENGINEER for review, shop drawings of the proposed details, and design calculations; all calculations and shop drawings shall be stamped and signed by a Civil or Structural Engineer registered in the State of California.
   3. Material specifications.
   4. All dead, live and other applicable loads used in the design.
   5. Applicable standards (from "References") met by the item(s).
   6. Setting plans locating and designating all items furnished by the manufacturer, with all major openings shown and located.
   7. Details to indicate quantities, location and type of reinforcing and prestressing steel.
   8. Sections and details showing connections, edge conditions, support conditions, and connections of the items.
   9. Description of all embeds, including stripping, lifting and erection inserts, with piece mark and location, including those cast into products or sent loose to the job site.
   10. Description and drawings of all frames and covers.
   11. Dimensions and special finishes.

B. Mix Designs: Submit all precast mix designs for approval. Mix designs shall be prepared by an independent testing facility or qualified employee of the Precast Manufacturer.

C. Design Modifications:
   1. Submit design modifications necessary to meet performance requirements and field conditions.
   2. Variations in details or materials shall not adversely affect the appearance, durability or strength of products.
   3. Maintain general design concept without altering size of members, profiles and alignment unless otherwise approved by the Architect/Engineer.

1.6 QUALITY ASSURANCE

A. In-Plant Quality Control
   1. The Manufacturer shall have an established PCI quality control program in effect prior to bidding. If requested, a copy of this program shall be submitted to the ENGINEER.
   2. Testing of materials and inspection of production techniques shall be the responsibility of the Manufacturer's Quality Control Department.
   3. Keep quality control records available for two years after final acceptance.
   4. Keep certificates of compliance available for five (5) years after final acceptance.

B. All other testing and inspection, if any, to be provided by OWNER.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handle and transport products in a position consistent with their shape and design in order to avoid excessive stresses or damage.

B. Lift or support products only at the points shown on the Shop Drawings.

C. Installer shall be responsible for the repair of damage to items except that caused by others.

D. After items are installed in their final positions, the CONTRACTOR shall be responsible for their protection. The CONTRACTOR shall be responsible for the repair of any damage to the items caused by someone other than the Manufacturer/Installer.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement ASTM C150 Type I, II or III cement.

B. Aggregates:
   1. Fine and coarse aggregate for mix shall conform to ASTM C33 or C330.
   2. Aggregates shall be clean, hard, strong, durable, inert, and free of staining and deleterious materials.

C. Water Potable, free from deleterious material.

D. Admixtures:
   1. Conforming to ASTM C260 and/or ASTM C494.
   2. Calcium chloride or admixtures containing chlorides shall not be used.

E. Concrete Strength: Concrete strength shall be determined by design with a minimum 28 day design strength of 4,000 psi.

2.2 STEEL MATERIALS

A. Products:
   1. Structural Shapes, Bars & Plates (1.6mm and thicker): ASTM A36
   2. Pipe: ASTM A53 Grades A or B
   3. Tube Steel: ASTM A500 Grades A or B
   4. Reinforcing Steel: ASTM A615 Grades 300 & 420 or ASTM A706
   5. Prestressing Strand: ASTM A416 Grade 270, low relaxation
   6. Deformed Steel Bar Mats: ASTM A184
   7. Deformed Bar Anchors: ASTM A496
   8. Deformed Welded Wire Fabric: ASTMA497
   9. Plain Welded Wire Fabric: ASTM A185
   10. Welded Headed Studs: AWS D1.1 Type B
   11. Standard Machine Bolts: ASTM A307 Grade A or SAE J429 Grade 2
   12. Standard Studs/Threaded Round Stock: ASTM A307 Grade C, ASTM A572 Grade 345
   13. Nuts for Standard Machine Bolts and Threaded Studs: ASTM A563 Grade A Hex Nuts
   14. High Strength Bolts: ASTM A325 Type 1, ASTM A449 Type 1, or SAE J429 Grade 5
   15. Nuts for High-Strength Bolts and Threaded Studs: ASTM A563 Grade DH Heavy Hex Nuts
   16. Coil Rods and Bolts: ASTM A108 - SAE 1016 to 1026, F_u/F_Y = 480/380 MPa minimum
   17. Coil Nuts for Coil Rods and Bolts: Nuts passing a proof load stress of 80 ksi, based on the tensile stress area of the matching coil rods and bolts.
   18. Carbon Steel Castings: ASTM A27 Grade 415-205

B. Protective Coatings:
   1. All connection hardware permanently exposed to weather after completion shall be protected. All connection hardware not exposed to weather after completion may be uncoated, except as otherwise explicitly required by the contract drawings. Fasteners can have either an electroplated zinc or cadmium coating.
   2. Alkyd Rust Inhibitive Primers (shop primers such as red iron oxide) :
      a. Tnemec Series FD88 Azeron Primer
      b. Ameron 5105
      c. Weld-Thru Primer, Red, 2-0101 & Gray, 2-0102
   3. Zinc Coatings:
      a. Hot-Dip Galvanizing: ASTM A123, or ASTM A153
      b. Electroplated Zinc for Steel Products and Steel Hardware: ASTM B633
      c. Zinc Rich Paints: DOD-P-21035
   4. Cadmium Coatings:
      a. Electrodeposited Coatings of Cadmium: ASTM B766

2.3 MISCELLANEOUS PRODUCTS

A. Grout:
   1. Cement Grout: Portland cement, sand and water sufficient for placement and hydration.
   2. Non-Shrink Grout: Premixed, packaged non-ferrous aggregate shrink resistant.
   3. Epoxy Resin Grout: Two-component mineral-filled resin: ASTM C881.

B. Joint Sealing Compound: The joint sealing compound shall be a permanently flexible plastic material complying in every detail to Federal Specification SS S-00210 (GSA-FSS) dated July 26, 1965. "Quickseal", or approved equal.

C. Frames and Covers: Catch basins, manholes, and vaults shall be provided with fabricated aluminum or steel frames and covers as specified or shown on the drawings and shall be built up so that the cover is flush with the surrounding surface unless otherwise specified.

D. Access Hatches: Where identified on the drawings, Precast items shall be designed and furnished to incorporate access hatches. Reference Specification 08 35 00 for Access Hatch requirements.

2.4 FABRICATION

A. Unless otherwise noted, precast concrete structure dimensions called out on the Drawings are interior dimensions.

B. Manufacturing procedures shall be in general compliance with PCI MNL-116.

C. Manufacturer shall provide for those openings 10 inch or larger, round or square as shown on the drawings. Other openings shall be located and field drilled or cut by the trade requiring them after the units have been erected. Openings and/or cutting of prestressing strand shall be approved by ENGINEER and manufacturer before drilling or cutting.

D. Forms:

1. Forms for precast products shall be rigid and constructed of materials that will result in finished products conforming to the profiles, dimensions and tolerances indicated by this Section, the Contract Documents and the reviewed Shop Drawings.
2. Construct forms to withstand vibration method selected.
3. Release agents shall be applied and used according to manufacturer's instructions.

E. Concreting:
   1. Batching of Concrete shall be in accordance with approved Mix Design(s).
   2. Convey concrete by methods which will prevent separation, segregation or loss of material.
   3. Consolidate all concrete in the form to minimize honeycombing or entrapped air.

F. Curing: Procedures sufficient to insure specified concrete strength of all products must be employed. Stripping of a panel shall not occur until concrete strength is sufficient to prevent cracking or damage of the panel.

G. Manufacturing Tolerances:
   1. Cross Sectional Dimensions:
      a. Less than 24 inches: ±1/4 inch"
      b. 24 to 36 inches: ±3/8"
      c. Over 36 inches: ±1/2"
   2. Length:
      a. Less than 25 ft: ±1/2"
      b. 25 to 50 ft: ±3/4"
      c. Over 50 ft: ±1"
   3. Variation from square or designed skew (difference in length of two diagonal measurements): Max. ±3/4"

H. Identification: Mark each precast item to correspond to identification mark on Shop Drawings for product location, and with casting date.

PART 3 - EXECUTION

3.1 PREPARATION

A. Access: Clear unloading areas and access roadways to point of component placement shall be provided and maintained by the CONTRACTOR. The CONTRACTOR shall provide all required traffic controls, barricades, warning lights and/or signs to insure a safe installation.

B. Sitework: The CONTRACTOR shall excavate and prepare the subgrade, including 2 inches of clean sand, graded level and to the proper elevation.

C. Installer Responsibility: Prior to installation of the precast products, notify the CONTRACTOR of any discrepancies discovered which affect the work under this contract.

3.2 INSTALLATION

A. General: Precast products shall be lifted with suitable lifting devices at points provided by the Manufacturer to prevent excessive stresses or damage to the products. Brace and secure items before unhooking.

B. Sitework:
   1. Openings or "knockouts" shall be located as shown on the drawings and shall be sized sufficiently to permit passage of the largest dimension of pipe and/or coupling flange. Upon completion of installation, all voids or openings in the vault walls around pipes shall be filled with 4,000-psi concrete or mortar, using an approved epoxy for bonding concrete surfaces.
   2. All joints between precast sections shall be made watertight using preformed mastic material. The sealing compound shall be installed according to the manufacturer's recommendations to provide a watertight joint which remains impermeable throughout the design life of the structure. All joints shall be filled with dry-pack non-shrink grout. If plastic liner system is used, after the joint has been made and is cured, install plastic liner weld strip at all joints and seams.
   3. Frames and covers shall be built up so that the cover is flush with the surrounding surface unless otherwise specified. The CONTRACTOR is responsible for placing the cover at the proper elevation where paving is to be installed and shall make all necessary adjustments so that the cover meets these requirements.
   4. After the structure and all appurtenances are in place and approved, and after any required disinfection or testing, backfill shall be placed to the original ground line or to the limits designated on the plans.

3.3 FIELD QUALITY CONTROL

A. Hydrostatic Testing:
   1. All Manholes, Wetwells, Junction Boxes, or other water bearing structures shall be hydrostatically tested prior to acceptance.
   2. Test Procedure:
      a. Plug all inlets and outlets with temporary plugs
      b. Fill water bearing structure with clean, potable water
      c. Let stand for 24 hours, if desired, to allow for "soaking-in"
      d. Fill to rim elevation
      e. Let stand for a minimum of 2 hours
      f. Check distance from rim to water surface
      g. Calculate water loss. Leakage in each manhole may not exceed 0.1-gallon per hour per foot of water depth during the test.
   3. Repair all structures which do not meet the above test requirements with a method approved by the ENGINEER and re-test until passing.

3.4 PATCHES AND REPAIRS:

A. Patching of products, when required, shall be performed to industry standards for structural concrete. Repairs shall be sound, permanent and flush with adjacent surface.

3.5 WARRANTY:

A. All labor and materials under the Precast Manufacturers contract shall be warranted by the Precast Manufacturer for a period of one (1) year after substantial completion.

++ END OF SECTION ++

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GROUT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes epoxy, non-metallic, non-shrink, and ordinary Portland cement-sand grouts.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. ASTM C33, Standard Specification for Concrete Aggregates.
   2. ASTM C150, Standard Specification for Portland Cement.
   3. ASTM C595, Standard Specification for Blended Hydraulic Cements.
   4. ASTM C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout.

1.3 SYSTEM DESCRIPTION

A. Furnish ordinary cement-sand grout for the following:
   1. Foundation grout.
   2. Construction joint grout.
   3. As shown in the Drawings.

B. Furnish non-shrink, non-metallic grout for the following:
   1. Equipment bases, 25 hp or less.
   2. Base plates.
   3. Guardrail and railings.
   4. Through-bolt and form tie openings.
   5. As shown in the Drawings.

C. Furnish epoxy grout for the following:
   1. Equipment bases, 26 hp or more and/or sole plates with vibration, thermal movement, etc.
   2. Blockouts for gate guides.
   3. Retrofit waterstop installation.
   4. As shown in the Drawings.

1.4 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications and installation instructions for all proprietary materials.
   2. Proposed method for keeping existing concrete surfaces wet prior to placing grout.
   3. Forming method for fluid grout placements.
   4. Curing method for grout.

B. Laboratory Test Reports and Certificates:
   1. For proprietary materials, submit copies of reports on quality control tests.

2. Submit certification that materials meet specification requirements for nonproprietary materials.
3. For ordinary cement-sand grout, copies of grout mix design and laboratory strength test reports.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Deliver grout materials from manufacturers in unopened containers and bearing intact manufacturer's labels.

B. Storage of Materials: Store grout materials in a dry shelter and protected from moisture.

PART 2 - PRODUCTS

2.1 MATERIALS

A. High-Strength Epoxy Grout.
   1. Use 100% solids, prepackaged, solvent-free, moisture insensitive, high-strength epoxy grout.
   2. Product and Manufacturer: Provide one of the following:
      a. E^3-HP, as manufactured by The Euclid Chemical Company.
      b. Sikadur 42 Grout Pak, as manufactured by Sika Corporation.
      c. Five Star HP Epoxy Grout by Five Star Products, Incorporated.
      d. Or approved equal.

B. Non-shrink, Non-metallic Grout:
   1. Prepackaged non-staining cementitious grout which shall meet the minimum requirements of ASTM C1107 and requiring only the addition of water at the jobsite.
   2. Product and Manufacturer: Provide one of the following:
      a. NS, as manufactured by The Euclid Chemical Company.
      b. Five Star Grout, as manufactured by Five Star Products, Incorporated.
      c. Sika Grout 212, as manufactured by Sika Corporation.
      d. Or approved equal.

C. Ordinary Cement-Sand Grout: Prepare design mix for ordinary cement grout.
   1. Cement: Portland cement, ASTM C150, Type II; or blended hydraulic cement, ASTM C595, Type 1P.
   2. Aggregates: ASTM C33 and as herein specified.
      a. Do not use aggregates containing soluble salts or other substances such as iron sulfides, pyrite, marcasite, ochre, or other materials that can cause stains on exposed concrete surfaces.
      b. Fine Aggregate: Clean, sharp, natural sand, free from loam, clay, lumps or other deleterious substances.
         1) Dune sand, bank run sand and manufactured sand are not acceptable.
      c. Coarse Aggregate: Coarse aggregate not permitted.
   3. Admixtures: Provide admixtures produced by established reputable manufacturers and use in compliance with the manufacturer's printed instruction. Do not use admixtures that have not been incorporated and tested in the accepted mixes, unless otherwise authorized in writing by ENGINEER. Refer to Section 03 30 03 - Cast-In-Place Concrete, for additional admixture requirements.

4. Proportioning and Design of Mixes: Mixes are subject to the following limitations:
   a. Specified 28-day Compressive Strength: 4,000 psi.
   b. Minimum amount of water necessary for the mixture to flow under its own weight.
   c. Fine Aggregate meeting ASTM C33.
   d. Air Content Percentage: ±1.5%.
   e. Minimum Cement Content in Pounds per Cubic Yard: 658.
   f. Slump at point of placement: 5 inch ±1 inch.
5. Proportion mix by either laboratory trial batch or field experience methods, using materials to be employed on the Project for grout required. Comply with ACI 211.1 and provide a complete report, from an independent testing laboratory, to ENGINEER, at least 30 days prior to start of Work. Do not begin grout production until ENGINEER has approved mix.
6. Laboratory Trial Batches: When laboratory trial batches are used to select grout proportions, prepare test specimens and conduct strength tests as specified in ACI 301, Chapter 3 - Proportioning.
7. Field Experience Method: When field experience methods are used to select grout proportions, establish proportions as specified in ACI 301, Chapter 4.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the substrate and conditions under which grout is to be placed with installer and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

A. General:
   1. Mix, place and cure grout as shown and in accordance with manufacturer's instructions. If manufacturer's instructions conflict with the Specifications, do not proceed until ENGINEER provides clarification.
   2. Manufacturers of proprietary products shall make available upon 72 hours notification the services of a qualified, full time employee to aid in assuring proper use of the product under job conditions. The cost of this service, if any, shall be borne by CONTRACTOR.
   3. When placing grout conform to temperature and weather limitations in Section 03 30 03, Cast-In-Place Concrete.

B. Through-bolt and form-tie holes: Fill space with dry pack dense grout hammered in with steel tool and hammer. Coordinate dry pack dense grout application with bonding agent in Section 03 15 16 - Concrete Joints.

C. Columns, Beams and Equipment Bases: Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material prior to setting base plates and machinery. After shimming columns, beams and equipment indicated to be grouted on the plans to proper grade, securely tighten anchor bolts. Properly form around the base plates allowing sufficient room around the edges for placing the grout.

Adequate depth between the bottom of the base plate and the top of concrete base must be provided to assure that the void is completely filled with grout.

D. Guardrails and Railings: After posts and rails have been properly inserted into holes or sleeves, fill the annular space between posts and cast-in-place sleeves and/or below base plates with non-shrink grout. Bevel grout at juncture with post so that moisture flows away from posts.

E. Construction Joints: Ordinary cement-sand grout may be used in place of mortar over the contact surface of the old concrete at the interface of horizontal construction joints as outlined in Section 03 15 16, Concrete Joints, and Section 03 30 03, Cast-In-Place Concrete, of these Specifications.

F. Curing: Cure all grout in accordance with manufacturer's written instructions. Wet cure ordinary cement-sand grout and non-shrink non-metallic grout for a minimum of three (3) days unless directed otherwise by the ENGINEER.

++ END OF SECTION ++

SECTION 04 20 00

CONCRETE MASONRY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: All masonry work shown on the Drawings. It also includes providing openings in masonry, to accommodate the Work under other Sections, and building into the masonry all items such as sleeves, anchor bolts, inserts and all other embedded items for which placement is not specifically provided under other Sections.

1.2 REFERENCES

A. American Concrete Institute (ACI)
   1. ACI 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures."

B. American Society for Testing and Materials (ASTM)
   1. ASTM A36, Carbon Structural Steel, Standard Specification for.
   2. ASTM A82, Steel Wire, Plain, for Concrete Reinforcement, Standard Specification for.
   3. ASTM A153, Zinc Coating (Hot Dip) on Iron and Steel Hardware, Standard Specification for.
   4. ASTM A167, Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip, Standard Specification for.
   5. ASTM A240, Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels, Standard Specification for.
   6. ASTM A366, Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality, Standard Specification for.
   7. ASTM A569, Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial Quality, Standard Specification for.
   8. ASTM A580, Stainless Steel Wire, Standard Specification for.
   9. ASTM A615, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, Standard Specification for.
   10. ASTM A663, Steel Bars, Carbon, Merchant Quality, Mechanical Properties, Standard Specification for.
   11. ASTM C5, Quicklime for Structural Purposes.
   12. ASTM C67, Standard Methods of Sampling and Testing Brick.
   13. ASTM C90, Load-bearing Concrete Masonry Units, Standard Specification for.
   14. ASTM C91, Masonry Cement.
   15. ASTM C136, Sieve or Screen Analysis of Fine and Coarse Aggregates.
   16. ASTM C140, Sampling and Testing Concrete Masonry Units, Standard Test Methods of.
   17. ASTM C144, Aggregate for Masonry Mortar.
   18. ASTM C150, Portland Cement.
   19. ASTM C180, Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
   20. ASTM C207, Hydrated Lime for Masonry Purposes.
   21. ASTM C270, Mortar for Unit Masonry.

22. ASTM C331, Lightweight Aggregates for Concrete Masonry Units, Standard Specification for.
23. ASTM C404, Aggregates for Masonry Grouts.
24. ASTM C426, Linear Drying Shrinkage of Concrete Masonry Units, Standard Test Method for.
25. ASTM C476, Grout for Masonry.
26. ASTM C744, Prefaced Concrete and Calcium Silicate Masonry Units, Standard Specification for.
27. ASTM C1019, Standard Test Method of Sampling and Testing Grout.
28. ASTM D2240, Rubber Property - Durometer Hardness, Standard Test Method for.
29. ASTM E84, Surface Burning Characteristics of Building Materials, Standard Test Method for.
30. ASTM E119, Fire Tests of Building Construction and Materials, Standard Test Methods for.

C. Brick Institute of America
   1. "Technical Notes on Brick and Tile Construction."
   2. Technical Bulletin 1A, "Construction and Protection Recommendations for Cold Weather Masonry Construction."

D. National Concrete Masonry Association,
   1. "Guide Specifications"
   2. "Technical Bulletins."

E. Underwriters Laboratories (UL)
   1. Design Numbers U901 through U914.

1.3 SYSTEM DESCRIPTION

A. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the masonry Work.
   2. Masonry Work advanced without built-in flashings and other items shall be removed and rebuilt, at no additional cost to OWNER, even if discovered after masonry has been completed.
   3. Coordinate the work of other Sections to avoid delay of the masonry Work.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Complete layout of all masonry walls showing modular planning and all special shapes to be used. Show all details for each condition encountered in the Work. Provide plans and elevations drawn at 1/4-inch scale and details drawn at 1½-inch scale. Show all items required to be built into masonry.
   2. Masonry control joint locations and details.
   3. Fabrication, bending, and placement of reinforcing bars. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcing for masonry Work.
   4. Explanation of where each masonry accessory will be used in the Work, quantities purchased and intended spacings.

B. Samples:
   1. One unit of each type of concrete masonry unit specified.
   2. One unit or one modular length of each accessory item specified.
   3. Each type of colored mortar, showing the range of color that can be expected in the Work.

C. Product Data:
   1. Complete selection of manufacturer's standard and custom colors.
   2. Mix designs for grout and mortar.
   3. Manufacturer's specifications and instructions for each manufactured product. Include data substantiating that materials comply with specified requirements.

1.5 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:
   1. Comply with the applicable requirements of International Building Code, including the requirements for Special Inspection.
   2. Wherever a fire-resistance classification is shown or scheduled for masonry Work (4-hour, 3-hour, and similar designations), comply with applicable requirements for materials and installation established by UL and other governing authorities.

B. Source Quality Control:
   1. Obtain all concrete masonry units from one manufacturer, cured by one process and of uniform texture and color or in an established uniform blend thereof. Cure units by autoclave treatment at minimum temperature of 350°F, and a minimum pressure of 125 psi.
   2. Do not change source or brands of materials during the course of the Work.
   3. No change shall be made in the proportions for mortar or grout, unless resubmitted and re-approved by the ENGINEER.

C. Construction Tolerances:
   1. Variation from Plumb: For lines and surfaces of columns, walls, and expansion joints, do not exceed 1/4-inch in 10-feet, or 3/8-inch in one story height or 20-feet maximum, nor ½-inch in 40-feet or more.
   2. Variation from Level: For lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4-inch in any bay or 20-feet maximum, nor 1/2-inch in 40-feet or more.
   3. Variation of Linear Building Line: For position shown and related portion of columns, walls and partitions, do not exceed 3/8-inch in any bay or 20-feet maximum, nor 1/2-inch in 40' or more.
   4. Variation in Cross-Sectional Dimensions: For columns and thickness of walls, do not exceed +1/2-inch-1/4-inch from dimensions shown.

D. Job Mock-up: Prior to installation of masonry Work, but after ENGINEER'S approval of samples, erect job mock-up using materials, pattern bond and joint tooling shown or specified for final Work.
   1. Provide special features, including finished opening 16-inchx 16-inch and finished end.
   2. Build mock-up at the site, in location approved by ENGINEER, of full required wall thickness and approximately 4'x 4', unless otherwise shown.

3. Indicate the proposed range of color, texture and workmanship to be expected in the completed Work.
4. Obtain ENGINEER'S acceptance of the mock-up before start of Work.
5. Retain and protect mock-up during construction as a standard for judging completed masonry. Do not alter, move or destroy mock-up until given written permission by ENGINEER.
6. Build as many job mock-up panels as required to obtain ENGINEER'S acceptance of the Work.
7. Masonry construction that does not meet the standards approved on the sample panel shall be removed and rebuilt as required by ENGINEER.

E. Preconstruction Conference: Prior to the installation of masonry Work, CONTRACTOR shall schedule a Preconstruction Conference at the project site.
   1. Review foreseeable methods and procedures related to the masonry Work including, but not necessarily limited to, the following:
      a. Project requirements, including Contract Documents.
      b. Method of sequence of masonry construction.
      c. Special masonry details.
      d. Required submittals, both completed and yet to be completed.
      e. Standards of workmanship.
      f. Quality control requirements.
      g. Job organization and availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.
      h. Modular planning requirements.
      i. Weather and forecasted weather conditions and procedures for coping with unfavorable conditions.
      j. Required inspection, testing and certifying procedures.
      k. Regulations concerning building code compliance.
   2. Attendance is mandatory for the following:
      a. CONTRACTOR'S job superintendent.
      b. Masonry subcontractor's job superintendent.
      c. Masonry subcontractor's foreman.
      d. Authorized representative of concrete unit masonry supplier.
      e. ENGINEER'S authorized representative.
   3. Reconvene the meeting at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration and to resolve any outstanding issues.
   4. CONTRACTOR shall record the discussions of the conference and the decisions and agreements (or disagreements) and furnish a copy of the record to each party attending.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:
   1. Deliver concrete masonry units in original, unopened and undamaged packages and pallets, plainly marked with identification of materials and name of approved manufacturer. Delivery shall be by the manufacturer or manufacturer’s agent.
   2. Deliver reinforcing to the site, bundled, tagged and marked. Use metal tags indicating size, lengths and other markings shown on approved Shop Drawings.

3. Manufactured materials, such as cement and lime, shall be delivered and stored in their original containers plainly marked with identification of materials and manufacturer.

B. Storage of Materials:
   1. Store materials off the ground, protected from dirt, construction traffic and contamination. Cover using tarpaulins or polyethylene sheets to prevent damage such as wetting, staining, and chipping.
   2. Do not stack concrete masonry units higher than recommended by manufacturer.

C. Handling Materials:
   1. Handle materials in a manner that minimizes chips, cracks, voids, discolorations or other defects that might be visible or cause staining in finished Work.

1.7 JOB CONDITIONS

A. Site Facilities: Supplemental heat sources, as may be required, should CONTRACTOR wish to continue masonry Work in cold weather if not available at the project site. The provision of all supplemental heat energy sources and equipment is the responsibility of CONTRACTOR.

B. Environmental Requirements:
   1. Do not place any masonry Work when air temperature is below 28°F, on rising temperatures or below 36°F, on falling temperatures, without temporary heated enclosures or without heating materials or other precautions necessary to prevent freezing.
   2. No frozen materials shall be used, nor shall frozen masonry Work be built upon.
   3. Remove and replace all masonry Work damaged by frost or freezing.

C. Protection:
   1. Protect all masonry against freezing for at least 48 hours after being placed.
      a. Mean Daily Air Temperature 40°F to 32°F: Protect masonry from rain for 48 hours after installation.
      b. Mean Daily Temperature 32°F to 20°F: Completely cover masonry with insulating blankets for 48 hours.
      c. Mean Daily Air Temperature 20°F and Below: Maintain masonry above 32°F for 48 hours by enclosure and supplementary heat.
   2. Protect partially completed masonry against rapid heat loss and from water entering it when Work is not in progress, by covering top of walls with strong, waterproof, nonstaining membrane. Extend membrane at least 2' down both sides of walls and secure in place using wall cover clamps spaced at intervals of 4' and at each end and joint of covering.
   3. Do not apply distributed floor or roof loading for at least 3 days after completing masonry columns or walls.
   4. Do not apply concentrated loads for at least 7 days after completing masonry columns or walls.

D. Cold Weather Masonry Work:
   1. All mortar for use in masonry Work, when the mean daily temperature is below 40°F, shall be portland cement- lime-sand mortars using high early strength portland cement.

2. Air Temperature 40°F to 32°F: Heat sand or mixing water to 70°F-160°F.
3. Air Temperature 32°F to 20°F: Heat sand and mixing water to 70°F-160°F. Provide heat on both sides of wall under construction to heat constructed masonry to 40°F. Employ wind breakers when wind is in excess of 15 mph.
4. Air Temperature below 20°F: Heat sand and mixing water to 70°F-120°F. Provide enclosure and auxiliary heat to maintain air temperature above 32°F. Heat constructed masonry to 40oF. Temperature of masonry units when laid shall not be less than 20°F.

E. Hot Weather Masonry Work:
1. Preparation – Prior to conducting masonry work:
   a. When the ambient air temperature exceeds 100°F, or exceeds 90°F with a wind velocity greater than 8 mph:
      1) Maintain sand piles in a damp, loose condition.
      2) Provide necessary conditions and equipment to produce mortar having a temperature below 120°F.
   b. When the ambient air temperature exceeds 115°F, or exceeds 105°F with a wind velocity greater than 8 mph implement the requirements above and shade materials and mixing equipment from direct sunlight.
2. Construction – While masonry work is in progress:
   a. When the ambient air temperature exceeds 100°F, or exceeds 90°F with a wind velocity greater than 8 mph:
      1) Maintain temperature of mortar and grout below 120°F.
      2) Flush mixer, mortar transport container, and mortar boards with cool water before they come into contact with mortar ingredients or mortar.
      3) Maintain mortar consistency by retempering with cool water.
      4) Use mortar within 2 hours of initial mixing.
   b. When the ambient temperature exceeds 115°F, or exceeds 105°F with a wind velocity greater than 8 mph implement the requirements listed above and use cool mixing water for mortar and grout. Ice is permitted in the mixing water prior to use. Ice is not permitted in the mixing water when added to the other mortar or grout materials.
3. Protection – When the mean daily temperature exceeds 100°F, or exceeds 90°F with a wind velocity greater than 8 mph, fog spray newly constructed masonry until damp, at least three times a day until the masonry is three days old.

PART 2 - PRODUCTS

2.1 GENERAL CONCRETE UNIT MASONRY

A. General: Unless specifically modified by other requirements specified, provide concrete masonry units in compliance with the following classifications, weights, grades, colors, textures, scores, thermal resistance values and other features specified.

B. Hollow Load-bearing Concrete Masonry Units: Provide the following:
1. ASTM C90 medium weight.
2. Minimum Compressive Strength: 1,900 pounds per square inch average of three units; 1,700 pounds per square inch minimum for an individual unit. The manufacturer shall certify that the masonry units meet all requirements of ASTM C90

including the moisture content and linear shrinkage requirements for intermediate conditions.

C. Color and Texture: Provide the following:
   1. Manufacturer's complete selection of all standard and all custom colors. Submit preliminary color selection for review by ENGINEER.
   2. Color, surface texture and aggregate uniform within the normal range established by sample submission and as approved by ENGINEER.

D. Special Shapes: Provide the following where required:
   1. Lintels, bond beams, reinforcing units, and flush-end reinforcing units, interior and exterior corner shapes, solid jambs, sash block, coves, premolded control joint blocks, headers, and other special conditions.
   2. Split-face, scored, and other facings, and special sizes, as shown on the Drawings.

E. Waterproofing Admixture: Manufacture all types of concrete unit masonry, used in construction of exterior walls with an integral waterproofing admixture as follows:
   1. Material: Cross-linking acrylic polymer.
   2. Proportion: In strict accordance with manufacturer's instructions.
   3. Product and Manufacturer: Provide one of the following:
      a. DRY-BLOCK Admixture by W. R. Grace & Company Construction Products Division.
      b. Moxie Shield 1800 by Moxie International.
      c. Or equal.

2.2 MORTAR

A. General: Anti-freeze admixture or agents, including calcium chloride are not permitted.

B. Mortar for All Unit Masonry: Type S. Comply with ASTM C270, Table 2, except limit materials to those specified herein.
   1. Portland cement-Lime: Provide the following proportions by volume:
      a. Portland Cement: 1 part.
      b. Hydrated Lime or Lime Putty: 1/4 to 1/2.
      c. Aggregate (sand in damp, loose condition): 2¼ to 3 times the sum of cementitious materials.
      d. Pigment: as required to match approved sample.
   2. Properties:
      a. Average Compressive Strength, ASTM C270: 1,800 pounds per square inch.
      b. Minimum Water Retention, ASTM C270: 75%.
      c. Maximum Air Content, ASTM C270: 12% for Portland cement - lime mortars.

2.3 MASONRY GROUT

A. Proportion coarse grout mixes subject to the following limitations:
   1. Specified 28-day Compressive Strength: 2,000 psi
   2. Minimum Cementitious Content: 550 lb/cu yd
      a. Fly ash per ASTM C618 may be used replace cement but shall not exceed 20% by weight of cement plus fly ash.
   3. Maximum Water-Cement Ratio by Weight: 0.52
   4. Slump at point of placement: 8-inch to 11-inch

B. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the Project for grout required. Comply with ACI 211.1.

2.4 MATERIALS

A. Portland Cement:
   1. ASTM C150: Use Type II.
   2. Nonstaining and of natural color or as required to be compatible with the approved pigment.

B. Hydrated Lime: ASTM C207, Type S, or lime putty ASTM C5.

C. Aggregates: ASTM C33 and as herein specified.
   1. Do not use aggregates containing soluble salts or other substances such as iron sulfides, pyrite, marcasite, ochre, or other materials that can cause stains on exposed surfaces.
   2. Fine Aggregate: Clean, sharp, natural sand, free from loam, clay, lumps or other deleterious substances. For mortar, ASTM C144, except for mortar for joints less than 1/4-inch use aggregate graded with 100% passing the No. 16 sieve.
   3. Colored/ White Mortar Aggregates: Provide ground marble, granite or other sound stone, as required to match the approved sample.
   4. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
      a. Crushed stone, processed from natural rock or stone.
      b. Washed gravel, natural or crushed. Use of slag and pit or bank run gravel is not permitted.
      c. Coarse Aggregate Size: ASTM C33, No. 8 or 89.

D. Admixtures:
   1. Provide admixtures produced by established reputable manufacturers and use in compliance with the manufacturer's printed instruction. Do not use admixtures that have not been incorporated and tested in the accepted mixes. Refer to Section 03300, Cast-In-Place Concrete, for additional admixture requirements.
   2. Waterproofing Admixture for Exterior Concrete Unit Masonry: Provide a cross-linking acrylic polymer integral waterproofing system, proportioned and mixed in strict accordance with manufacturer's instructions. Provide one of the following:
      a. DRY-BLOCK Mortar Admix by W.R. Grace & Company Construction Products Division.
      b. Moxie Shield 1800 by Moxie International.
      c. Or equal.

E. Colored Mortar Pigments:
   1. Commercial iron oxide, manganese dioxide, ultramarine blue, chromium oxide, or carbon black, compounded for use in mortar mixes.
   2. Do not exceed pigment to cement ratios, by weight, of 1 to 35 for carbon black and 1 to 7 for other pigments.
   3. Product and Manufacturer: Provide one of the following:
      a. Truetone Mortar Colors by Frank D. Davis Co., subsidiary of Rockwood Industries, Inc.
      b. Sonobrite by Sonneborn Building Products Division Rexnord Chemical Products, Inc.

c. Or equal.

F. Water: Clean and free from injurious amounts of oils, acids, alkalis, or organic matter.

2.5 REINFORCING

A. Reinforcing Bars: ASTM A615, Grade 60 for all bars. Shop-fabricate reinforcing bars that are shown or required to be bent or hooked. Comply with ACI 315 for the fabrication of reinforcing steel for masonry Work.

B. Wire products: Ties, and rebar positioners shall be fabricated from cold-drawn steel wire complying with ASTM A82 and hot-dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A153.

C. Rebar Positioners: Nine gage reinforcing bar positioners which accommodate both horizontal and vertical reinforcing steel. Provide one of the following:
   1. #RB Series Rebar Positioners by Hohmann & Barnard, Inc.
   2. Or equal.

2.6 MISCELLANEOUS ACCESSORIES

A. Compressible Filler: Provide watertight joint filler where masonry abuts structural framework members, and as shown. Provide the following:
   1. Polyurethane foam strip saturated with polybutylene waterproofing material which when installed at A compression ratio of 2:1 is impermeable to water.
   2. Resilient to -40°F with 100% movement recovery.
   3. Elongation of 140% with a tensile strength of not less than 53 psi.
   4. Product and Manufacturer: Provide one of the following:
      a. Polyseal by Sandell Construction Solutions.
      b. Or equal.

B. Premolded Control Joint Strips: Provide complete selection of solid extruded rubber strips with a Shore A durometer hardness of 80 to 90 complying with ASTM D2240, designed to fit standard sash block and maintain lateral stability in masonry wall. Provide one of the following:
   1. #RS Series - Rubber Control Joints by Hohmann & Barnard, Incorporated.
   2. Or equal.

C. Sealants: Refer to Section 07900, Joint Sealants.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR and his installer shall examine areas and conditions under which masonry Work is to be installed, and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

B. Special Masonry Inspection:

1. The OWNER will employ a testing laboratory to perform Special Masonry Inspections in accordance with Chapter 17 of the current Building Code.
2. Masonry inspection services will be provided during the following construction activities:
    a. During laying of units:
        1) During the first day of the masonry construction, inspect proportions of site prepared mortar, construction of mortar joints, location of all reinforcing and connectors, size and location of structural elements, type, size and location of anchors, protection of masonry during cold weather.
        2) Inspection to be continuous the first full day of masonry construction which requires special inspection.
            a) Thereafter, a minimum of 3 hours every third day of construction until the concrete masonry work is complete.
        3) Inspection while laying masonry units may be made concurrently with other inspection duties provided all inspection duties are adequately performed.
        4) When deficiencies are found, additional inspection shall be provided as required until deficiencies have been corrected.
        5) If masonry crews change, an additional full day of inspection is required during the first day the new crew is on-site.
    b. Placement of reinforcing steel:
        1) Verification of all reinforcing including size, grade, lap lengths, and type.
        2) Inspection may be periodic as required to verify all reinforcing at Risk Category II and III structures. Inspection of all reinforcing shall be continuous at Risk Category IV structures.
        3) Inspector to be present during the concrete pour in which any dowels connecting concrete to masonry are cast to verify proper location of dowels.
    c. Prior to each grouting operation, verify that grout space is clean, reinforcing and connectors are properly placed, proportions of site-prepared grout are correct and mortar joints have been properly constructed.
        1) Inspection may be periodic as required to verify proper grout space at Risk Category II and III structures.
        2) Inspection shall be continuous prior to and during grout placement at Risk Category IV structures.
    d. Verify compliance with International Building Code and Specifications continuously during all grouting operations.
    e. Provide special inspection in accordance with ACI 530 Table 3.1.2 for Risk Category II and III structures and ACI 530 Table 3.1.3 for Risk Category IV structures including observation of masonry work for conformance to the Contract Documents:
        1) Provide inspection reports to the ENGINEER, Building Official and OWNER.
            a) Notify CONTRACTOR of discrepancies for correction.
            b) Notify ENGINEER, Building Official and OWNER, in writing, when discrepancies have been satisfactorily corrected.
        2) Submit final signed report stating that Work requiring special inspection was, to the best of the inspector's knowledge, in conformance to the Contract Documents and the applicable workmanship previsions of the International Building Code.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses as shown or required by others. Provide not less than 8-inch of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

B. Leave openings for equipment, piping, ducts, and other items to be installed subsequent to starting of masonry Work. After installation of said items, complete masonry Work to match Work immediately adjacent to openings.

C. Cut masonry units using motor driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining Work neatly. Use full size units without cutting wherever possible.

3.3 LAYING MASONRY WALLS

A. General:
   1. Lay out walls in advance for accurate spacing of surface pattern bond with uniform joint widths and to properly locate openings, masonry control joints, returns and offsets. Avoid the use of less than half size units at corners, jambs and wherever possible at other locations.
   2. Lay up walls plumb and true to comply with specified tolerances, with courses level, accurately spaced and coordinated with other Work.
   3. Pattern Bond:
      a. Lay all concrete masonry Work in running bond with vertical joints in each course centered on units in courses above and below unless otherwise shown.
      b. Bond and interlock each course of each wythe at corners.
      c. Do not use units with less than 8-inch horizontal face dimensions at corners or jambs.

B. Mortar Bedding and Jointing:
   1. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout.
      a. Lay walls with 3/8-inch joints.
   2. Cut joints flush for masonry walls that are to be concealed or to be covered by other materials, except paint, unless otherwise shown.
   3. Tool exposed joints when mortar is "thumbprint" hard, slightly concave, unless otherwise required to match existing joint treatment. Rake out mortar in preparation for application of caulking or sealants where required.
   4. Concave-tool exterior joints below grade.
   5. Do not use mortar that has begun to set or if more than 30 minutes have elapsed since initial mixing. Do not retemper mortar.
   6. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

C. Stopping and Resuming Work: Rack back 1/2-unit masonry length in each course, and do not tooth. Clean exposed surfaces of set masonry, wet units lightly, if required, and remove loose masonry units and mortar prior to laying new masonry.

D. Built-in Work: As the Work progresses, build in items shown, specified or required by others. Fill cores in one block width solidly with masonry grout around built-in items.

E. Structural Reinforced Masonry:
   1. Shape and dimension reinforcement as shown and are required by governing codes.
   2. Position reinforcing accurately at the spacing shown. Support and secure vertical bars against displacement with rebar positioners.
   3. For columns, piers and pilasters, provide a clear distance between vertical bars as shown, but not less than 1½-inch. Provide lateral ties.
   4. For horizontal bars, provide fully-lapped "L" shaped corner bars at corners and intersections.
   5. Provide lapped splices with reinforcing steel placed in contact with rebar positioners or tied. Provide 48 bar diameter lap length, unless otherwise shown.

F. Grouting Structural Reinforced Masonry:
   1. Place grout within 1.5 hours from introducing water in the mixture and prior to initial set. Discard grout that does not meet the specified slump, has exceeded the 1.5 hour timeframe or has reached initial set.
   2. Solid grout all walls, beams, piers and pilasters, unless noted otherwise.
   3. Provide temporary dams where required or barriers to control horizontal flow of grout at ends of wall sections. Build dams full height of grout pour. If masonry units are used, do not bond into permanent masonry wythes. Remove temporary dams after completion of grout pour.
   4. Grout pour height shall not exceed 5.33 feet for grouting cells of hollow units with dimensions equal to or greater than 2.5-inch x 3-inch.
   5. Grout pour height shall not exceed 1 foot for grouting cells of hollow units with dimensions less than or equal to 1.5-inch x 3-inch.
   6. Terminate pour 1½-inch below top of highest course in pour.
   7. Provide metal wall ties, if required, to prevent blow outs.

3.4 ANCHORING MASONRY WORK:

A. Anchor masonry to structural members where masonry abuts or faces, such members to comply with the following:
   1. Provide an open space, not less than 1/2-inch in width, between masonry and structural member, unless otherwise shown. Keep open space free of mortar or other rigid materials.
   2. Anchor masonry to structural members with metal ties embedded in masonry joints and attached to structure. Provide anchors with flexible tie sections, unless otherwise shown.
   3. Space anchors as shown, but not more than 8-inch on center vertically and 36-inch on center horizontally.
   4. Provide end blocks, where masonry abuts structural support, to facilitate installation of compressible filler, backer rod and sealant.

B. Lintels and Bond Beams: Provide masonry lintels and bond beams where shown. Use specially formed "U" shaped lintel and bond beam units with reinforcing bars placed as shown, filled with grout. Temporarily support formed-in-place lintels and bond beams.

3.5 REPAIR, POINTING AND CLEANING

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point up all joints at corners, openings and adjacent Work to provide a neat, uniform appearance, properly prepared for application of sealant compounds.

C. Cleaning Exposed, Unglazed Masonry Surfaces:
   1. Wipe off excess mortar as the Work progresses. Dry brush at the end of each day's Work.
   2. Final Cleaning: After mortar is thoroughly set and cured, clean sample wall area of approximately 20-square feet as described below. Obtain ENGINEER'S acceptance of sample cleaning before proceeding to clean remainder of masonry Work.
      a. Dry clean to remove large particles of mortar using wood paddles and scrappers. Use chisel or wire brush if required.
      b. Presoak wall by saturating with water and flush off loose mortar and dirt.
      c. Acid type cleaners shall not be permitted.
      d. Protect other Work from cleaning operations.

D. Protection: Protect the masonry Work from deterioration, discoloration or damage during subsequent construction operations.

+ + END OF SECTION + +

SECTION 05 05 03

MISCELLANEOUS METALS

PART 1 - GENERAL

1.1 SUMMARY

A. Work necessary to furnish and install, complete, fabricated metalwork and castings as shown or as required to secure various parts together and provide a complete installation.

1.2 SUBMITTALS

A. Shop Drawings: Submit shop drawings for the fabrication and erection of the miscellaneous metal Work. Include plans, elevations and details of sections and connections. Clearly show all field connections. Show anchorage and accessory items.

B. Product Data: Submit copies of manufacturer's specifications, load tables, dimensions, diagrams, anchor details, and installation instructions for manufactured products.

C. Samples: Submit representative samples of manufactured products.

1.3 QUALITY ASSURANCE

A. Field Measurements: Take field measurements prior to preparation of Shop Drawings and fabrication to ensure proper fitting of the Work.

B. Shop Assembly: Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units to the extent necessary for shipping limitations. Clearly mark units for reassembly and coordinated installation.

C. Qualifications: Qualify welding operators in accordance with requirements of current AWS Standard Performance Qualification Procedures in the applicable structural welding code.
   1. Qualification Tests: Performed by a recognized testing laboratory.

D. Certification: Certify welders of structural and reinforcing steel for all positions of welding in accordance with such procedure.

PART 2 - PRODUCTS

2.1 GENERAL

A. Like Items of Materials: Provide end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, replacement, and manufacturer’s service.

B. Lifting Lugs: Provide on equipment and equipment components weighing over 100 pounds.

C. Furnish miscellaneous items:
   1. Miscellaneous metalwork and castings as shown, or as required to secure various parts together and provide a complete installation.
   2. Items specified herein are not intended to be all-inclusive. Provide metalwork and castings shown, specified, or which can reasonably be inferred as necessary to complete the project.

2.2 MATERIALS

A. Carbon steel structural shapes:
   1. Wide flange sections: ASTM A992 Grade 50.
   2. Steel pipe columns: ASTM A53 Grade B.
   3. Hollow Structural Sections (HSS): ASTM A500 Grade B.
   4. Plates, Angles, Channels, and S Shapes: ASTM A36.

B. Stainless Steel:
   1. Plates and Sheets: ASTM A240, Type 304L or 316
   2. Structural shapes: ASTM A276, A479 or A1069, Type 304L or 316.
   3. Fasteners and fittings: ASTM A320, Type 316
      a. Where stainless steel bolts are in contact with dissimilar metals provide insulating sleeves and phenolic washers to electrically isolate the bolts and nuts.

C. Aluminum, Structural Shapes and Plates: Alloy 6061-T6, meeting Aluminum Assoc. Specification for Aluminum Structures

D. Cast Iron: A48, Class 30

E. Light Gauge Steel Framing:
   1. Manufactured by SSMA ICC ESR-3064P, or equivalent, to meet the requirements of AISI S100.
   2. ASTM A570 or A446 with a minimum yield strength of 33 ksi for 18 gauge and 20 gauge, 50 ksi for 14 gauge and 16 gauge.
   3. Framing members shall have the section properties as listed on the Drawings.

F. High-Strength Threaded Fasteners: Heavy hexagonal structural bolts, heavy hexagon nuts, and hardened washers, as follows:
   1. Quenched and tempered medium carbon steel bolts, nuts and washers, complying with ASTM A325 or:
   2. Quenched and tempered alloy steel bolts, nuts and washers, complying with ASTM A490.
   3. Provide two ASTM F436 washers for all bolts.
   4. Provide beveled washers at connections of sloped/tapered sections.
   5. Unless noted otherwise, high-strength fasteners shall be used for all non-stainless steel fasteners.

G. Cast-in-Place Anchor Rods:
   1. ASTM F1554, Grade 36 with weldability supplement S1, galvanized, unless shown otherwise.

2. Provide ASTM F436 washers at all nuts unless shown otherwise.
3. Provide anchor bolt sleeves as required or as shown for location adjustment.
4. Provide stainless steel anchors where shown on the Drawings or listed in another specific specification section.

H. Galvanizing:
1. Zinc coated hardware: ASTM A153.
2. Fabrications: ASTM A123.
3. Members designated as galvanized on the drawings or as directed by ENGINEER shall be galvanized after fabrication in accordance with ASTM A385. Weight of zinc coating shall not be less than 2.5 ounces per square foot of actual surface and have a coating thickness of 0.0042 inch. Coating weight will be subject to verification by ENGINEER. Thickness of coating will be measured by means of a magnetic thickness gauge.
4. Each fabricated assembly shall be totally immersed in the galvanizing bath. The galvanizing procedure shall be such as to avoid distortion of the assembly. Straightening of members after galvanizing will not be permitted. Assemblies shall be held in the galvanizing bath until the temperature of the assembly is equal to the temperature of the bath. All deviations shall require approval by ENGINEER.
5. Any galvanized surface which has the coating removed for any cause shall be touched up with a zinc-rich cold galvanizing compound so that the entire surface has a uniform coating of 2.5 ounces of zinc per square foot.
6. Galvanized work shall be subject to inspection by ENGINEER at any time to ensure strict compliance with this specification. Any areas found to show defects or signs of improper galvanizing application will be rejected. Repairs shall be made by CONTRACTOR without additional cost to OWNER.

I. Surface preparation and Finish:
1. Steel: Where not indicated to be galvanized, steel shall be primed in the shop. Comply with Section 09 91 03, Painting.

2.3 ALUMINUM STAIR TREAD

A. Extruded bearing bars positioned and locked by cross bars. Treads shall be manufactured with a defined visible abrasive nosing and end plates capable of welding or bolting to stair stringers.

B. Material:
1. All supports, cross members, etc. shall be aluminum
2. Bearing bars: Alloy 6061-T6 or Alloy 6063-T6, conforming to ASTM B221.
3. Fasteners and fittings: ASTM A320, Type 316
a. Where stainless steel bolts are in contact with dissimilar metals provide insulating sleeves and phenolic washers to electrically isolate the bolts and nuts.

C. Manufacturer:
1. Grating Pacific.
2. Borden Metal Products.
3. Ohio Grating.

2.4 ANCHOR BOLT SLEEVE

A. High Density Polyethylene Plastic:

1. Single unit construction with deformed sidewalls such that the concrete and grout lock in place.
2. The top of the sleeve shall be self-threading to provide adjustment of the threaded anchor blot projection.
3. Material requirements shall conform to the following:
   a. Plastic: High density polyethylene.
   b. Density: 0.956, ASTM D1505.
   c. Vicant Softening Point: 256°F, ASTM D1525
   d. Brittleness Temperature: -180°F, ASTM D746

B. Fabricated Steel Sleeve:
   1. Material: A36 steel.
   2. Dimensions, welding, and sizes as shown.

2.5 FABRICATIONS

A. Miscellaneous Framings and Supports:
   1. Fabricate units to the sizes, shapes, and profiles shown, or if not shown, of the required dimensions to receive the adjacent gratings, plates, tanks, doors, or other work to be retained by the framing.
   2. Except as otherwise shown, fabricate from structural shapes, plates, and bars of compatible material, all-welded construction, using mitered corners, welded brackets and splice plates, and a minimum number of joints for field connection. Cut, drill, and tap units to receive hardware and other items to be anchored to the work.
   3. Equip units with integrally welded anchors for casting into concrete or integrating into masonry. Furnish inserts for casting in, if units must be installed after concrete or grout is placed. Anchor spacing shall be 24" on-center, unless otherwise shown.
   4. Galvanize where shown.

B. Miscellaneous Fabricated Metals:
   1. The following additional items are listed as a guide. Some items on list may not be required, and list may not be all-inclusive. Submittal data for materials and products must be approved before they are incorporated in the work.
      a. Access Walkway
      b. Aluminum Stairways.
      c. Float Switch Supports
      d. Lifting Eyes.
      e. Pipe Supports.
      f. Steel Bases and Anchors.
      g. Weir Plates.

C. Stainless Steel Fabrication: Following welding fabrication all stainless steel assemblies shall be cleaned, descaled and passivated in accordance with ASTM A380.

D. Anchors, Fasteners, and Fittings: Provide zinc-coated carbon steel for steel fabrications, and stainless steel for aluminum and stainless steel fabrications, unless shown otherwise.

E. Pipe Sleeves
   1. Provide as follows:
      a. Hot-dip galvanized, Schedule 40 steel pipe sleeves where shown for piping passing through concrete or masonry.

b. Holes drilled with rotary drill may be provided in lieu of sleeves in existing walls.
c. Provide a center flange for water stoppage on sleeves in exterior or water-bearing walls.
d. Provide a rubber caulking sealant or a modular mechanical unit to form a watertight seal in the annular space between pipes and sleeves.

PART 3 - EXECUTION

3.1 FABRICATION

A. General:
1. Exposed Surfaces Finish: Smooth, sharp, well-defined lines.
2. Provide necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
3. Conceal fastenings where practical.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Fabricate materials as specified.
6. Weld connections, except where bolting is directed.
7. Methods of fabrication not otherwise specified or shown shall be adequate for stress and as approved.
8. Grind exposed edges of welds smooth on walkways, guardrails, handrails, stairways, channel door frames, steel column bases and where shown.
9. Round sharp edges to 1/8-inch minimum radius. Grind burrs, jagged edges, and surface defects smooth.

B. Aluminum:
1. Fabricate as shown, and in accordance with the Aluminum Association Standards and manufacturer's recommendations as approved.
2. Grind smooth sheared edges exposed in finished work.

3.2 WELDING

A. General
1. Meet codes for Arc and Gas Welding in Building Construction of the AWS and AISC for techniques of welding employed, appearance, quality of welds made, and the methods of correcting defective work.
2. Welding Surfaces: Free from loose scale, rust, grease, paint, and other foreign material, except mill scale which will withstand vigorous wire brushing may remain.
3. A light film of linseed oil may likewise be disregarded.
4. Do not weld when temperature of base metal is lower than zero degrees F.
5. Finished members shall be true to line and free from twists.
6. Prepare welds and adjacent areas such that there is:
   a. No undercutting or reverse ridges on the weld bead.
   b. No weld spatter on or adjacent to the weld or any other area to be painted.
   c. No sharp peaks or ridges along the weld bead.
7. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

B. Welding Operators: As specified in PART 1, Article 1.3 QUALITY ASSURANCE.

3.3 INSTALLATION

A. Set units accurately in location, alignment, and elevation, level, plumb, true, and square, measured from established lines and levels. Brace or anchor temporarily in formwork where units are to be built into concrete, masonry, or similar construction.

B. Anchor securely as shown or as required for the intended use, using concealed anchors wherever possible.

C. Fit exposed edges accurately together to form tight, hairline joints. Do not weld, cut, or abrade the surfaces of galvanized or anodized units which are intended for bolted or screwed connections.

D. Field Welding: Where field welding is necessary, grind joints smooth and touch-up the shop paint. Comply with the applicable provisions of AWS D1.1 for the procedures of manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding.

E. Field Coat all miscellaneous ferrous and steel metals per Specification Section 09 91 03 - Painting, System 300.

F. Where aluminum is in contact with dissimilar metals, or embedded in masonry or concrete, protect surfaces as specified in Section 09 91 03 - Painting, System 305.

++ END OF SECTION ++

SECTION 05 05 06

ANCHORS, INSERTS, AND DOWELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes all post-installed anchors and inserts required to anchor parts of the Work to supporting concrete or masonry construction, and plaster. This Section also includes adhesives for anchoring reinforcing dowels into existing concrete.

1.2 REFERENCES

A. American Society for Testing and Materials
   1. ASTM A36, Standard Specification for Carbon Structural Steel.
   2. ASTM A320, Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
   3. ASTM D746, Standard Test Method for Brittleness of Temperature of Plastics and Elastomers by Impact
   4. ASTM D1505, Standard Test Method for Density of Plastics by the Density-Gradient Technique
   5. ASTM D1525, Standard Test Method for Vicat Softening Temperature of Plastics

B. 2018 International Building Code (IBC)

C. American Concrete Institute (ACI)
   1. ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete
   2. ACI 355.4, Qualification of Post-installed Adhesive Anchors in Concrete

1.3 SYSTEM DESCRIPTION

A. Provide the size, type, and length of anchor shown on the drawings or, if not shown, as specified in the detailed sections of these specifications.

B. When the size, length or load carrying capacity of an anchor bolt, expansion anchor, toggle bolt, or concrete insert is not shown or specified, provide the size, length and capacity required to carry the design load times a minimum safety factor of 4.

C. For equipment anchors, if the design load is not specified by the manufacturer, provide anchors of diameter no less than the diameter of the hole minus 3/16 inch. When the design load is not specified by the manufacturer, provide structural calculations.

1.4 SUBMITTALS

A. Product Data: Submit for approval copies of material certification, manufacturer's specifications, load tables, dimension diagrams and installation instructions for the devices.

B. Installer's Qualifications: When installing adhesive anchors subject to sustained tension loading or when specifically noted in the Drawings, submit for approval copies of the installer's qualifications certified by the ACI/CRSI Adhesive Anchor Installer Certification program.

1.5 QUALITY ASSURANCE

A. Post-installed concrete anchors shall be ICC approved for seismic applications in cracked concrete and prequalified in accordance with ACI 355.2 or ACI 355.4.

PART 2 - PRODUCTS

2.1 ANCHOR BOLTS

A. Nonsubmerged Use in areas of wet use, washdown areas, or areas outside heated buildings:
   1. Stainless steel Type 316, unless otherwise shown.
   2. Diameter, Length and Bend Dimensions: As required by equipment or machinery manufacturer. Unless otherwise required, provide 3/4–inch minimum diameter by 12-inches long and other geometry as shown.
   3. Furnish A320 nuts and washers of same material for each bolt, unless otherwise shown.
   4. Provide sleeves as required or as shown for location adjustment.

B. Submerged Use:
   1. Submerged use is defined as any connection 1 foot 6 inches below the normal water surface elevation in a water holding basin.
   2. As specified for nonsubmerged use, for equipment, machinery or other connections except as follows:
      a. Coating of anchor bolt threads is not required.
      b. Where threads are covered with fusion bonded coating, provide nut of proper size to fit and provide connection of equal strength to embedded bolt.

C. For anchoring fabricated metalwork, structural steel, or other components where connections will be protected or dry:
   1. Galvanized Steel, 36 ksi, minimum.
   2. Minimum Size: ¾-inch diameter by 12-inch long, unless otherwise shown.
   3. At base plates with grout pads, furnish two nuts and two washers per bolt of same material as bolt, unless otherwise shown.

2.2 ANCHOR BOLT SLEEVE

A. High Density Polyethylene Plastic:
   1. Single unit construction with deformed sidewalls such that the concrete and grout lock in place.
   2. The top of the sleeve shall be self-threading to provide adjustment of the threaded anchor blot projection.
   3. Material requirements shall conform to the following:
      a. Plastic: High density polyethylene.

b. Density: 0.956, ASTM D1505.
c. Vicant Softening Point: 256°F, ASTM D1525
d. Brittleness Temperature: -180°F, ASTM D746

B. Fabricated Steel Sleeve:
1. Material: A36 steel.
2. Dimensions, welding, and sizes as shown.

2.3 STAINLESS STEEL FASTENERS LUBRICANT (ANTISEIZING)

A. Provide for stainless steel nuts and machined bolts, anchor bolts, concrete anchors, and all other threaded fasteners.

B. Lubricant shall contain substantial amounts of molybdenum disulfide, graphite, mica, talc, or copper as manufactured by:
1. Loc Tite Co., Permatex.
2. Or equal

2.4 CONCRETE INSERTS

A. For vertical support of grating or floor plate, provide cast-in metal fabrications as shown.

B. Except as permitted below, or as otherwise shown, provide malleable iron inserts for hanging piping and conduit from concrete ceilings and soffits. Comply with Federal Specification WW-H-171-E (Type 18). Provide those recommended by the manufacturer for the required loading.

C. Obtain inserts in sufficient time so as not to delay concrete or masonry work.

D. Product and Manufacturer: Provide inserts of one of the following:
1. Figure 282, as manufactured by Anvil/Grinnell.
2. Sharktooth Insert, as manufactured by Hohmann and Barnard, Incorporated.
3. Or equal.

2.5 ADHESIVE (EPOXY) ANCHORS AND DOWELS

A. Provide adhesive anchors where specifically shown and where adhesive anchors are allowed. Unless otherwise shown, adhesive anchors are allowed for anchoring:
1. Supports for pipe, conduit, and electrical boxes, devices, and panels, on floors and walls
2. Handrails, guardrails, sunshades, stairs,
3. Fixtures and equipment on floors and walls, and
4. Single pipes and conduits <2 inch in diameter to ceilings and soffits.

B. Adhesive shall be epoxy resin. Vinylester resin anchors are NOT allowed.

C. Product and Manufacturer: Provide one of the following:
1. Installation to Concrete:
a. HIT-HY 200 as manufactured by Hilti, Inc.
b. SET-3G as manufactured by Simpson Strong-Tie, Inc.
c. Or approved equal meeting ACI 355.4.

2. Installation to solid-grouted Masonry:
   a. HIT-HY 270 as manufactured by Hilti, Inc.
   b. SET as manufactured by Simpson Strong-Tie, Inc.
   c. Or approved equal.

2.6 EXPANSION ANCHORS

A. Provide expansion anchors only where specifically shown and where expansion anchors are allowed. Unless otherwise shown, and except as noted below, expansion anchors are allowed for anchoring:
   1. Supports for pipe, conduit, and electrical boxes, devices, and panels, to floors and walls.
   2. Handrails, guardrails, and sunshades.
   3. Fixtures and equipment which have no moving parts, to floors and walls.

B. Expansion anchors are NOT allowed in any submerged or chemical containment areas.

C. Leveling nuts shall not be used with expansion anchors. If leveling nuts are required, provide adhesive anchors, unless otherwise shown.

D. Wedge anchors: Provide one of the following:
   1. Installation to Concrete:
      a. Hilti Kwik Bolt TZ by Hilti, Inc.
      b. Strong-Bolt 2 by Simpson Strong-Tie, Inc.
      c. Or approved equal meeting ACI 355.2.
   2. Installation to solid-grouted Masonry:
      a. Hilti Kwik Bolt-3 by Hilti, Inc.
      b. Wedge-All by Simpson Strong-Tie, Inc.
      c. Or approved equal.

E. Drop-in anchors, only where specific shown on the drawings: Provide one of the following:
   1. HDI by Hilti, Inc.
   2. Drop-In by Simpson Strong-Tie, Inc.
   3. Or equal.

2.7 SCREW ANCHORS

A. Provide screw anchors only where specifically shown. Provide ICC approved screw anchors suited for seismic and cracked concrete applications.

B. Installation to Concrete or Masonry:
   1. KH-EZ by Hilti, Inc.
   2. Titen HD by Simpson Strong-Tie, Inc.
   3. Or approved equal.

2.8 TOGGLE BOLTS

A. Provide toggle bolts only where specifically shown, to fasten single pipes and conduits <1 inch and equipment weighing less than 50 lbs (4-bolts required) to hollow walls.

B. Provide spring-wing toggle bolts, with two-piece wings, carbon steel bolts with zinc coating in accordance with Federal Specification FF-S-325.

C. Product and Manufacturer: Provide toggle bolts of one of the following:
   1. The Rawlplug Company, Incorporated.
   2. Haydon Bolts, Incorporated.
   3. Or equal.

2.9 OTHERS

A. Powder actuated fasteners and other types of anchors not specified herein shall not be used, unless approved by ENGINEER.

2.10 ACCESSORIES

A. Provide Belleville washers, or approved equal, at anchorage connections used to transfer anchorage loads at sheet metal equipment housings.

PART 3 - EXECUTION

3.1 INSTALLATION OF ANCHORS

A. Obtain anchor bolts in sufficient time so as not to delay concrete or masonry work.

B. Adhesives shall be stored and installed at the service temperature ranges recommended by the manufacturer.

C. Locate and accurately set the anchor bolts using templates or other devices as necessary.

D. Protect threads and shank from damage during installation of equipment and structural steel.

E. Post-installed anchors are NOT acceptable substitutes for cast-in-place anchor bolts.

F. Assure that embedded items are protected from damage and are not filled in with concrete.

G. Unless otherwise shown, the minimum diameter of anchor bolts for structural steel is ¾ inch, and for other applications, 3/8 inch.

H. Unless otherwise shown, provide the following minimum embedment, where "d" is the nominal anchor diameter:
   1. Cast-in-place anchors: 12d.
   2. Adhesive anchors: 12d.
   3. Expansion anchors: 8d.

I. Unless otherwise shown, provide a minimum edge distance equal to six times the bolt diameter for adhesive anchors, eight times the bolt diameter for expansion anchors and a bolt spacing equal to twelve times the bolt diameter.

J. Concrete shall have a minimum age of 21 days at the time of post-installed anchor installation.
   1. Concrete temperature at the time of adhesive anchor installation shall be at least 50°F.

K. Existing reinforcing bars in the concrete structure may conflict with specific anchor locations. Unless noted on the Drawings that the bars can be cut, the CONTRACTOR shall review the existing structural drawings and shall undertake to locate the position of the reinforcing bars at the locations of the concrete anchors by ferroscan, ground penetrating rebar (GPR), x-ray, chipping or other means.

L. Drilling equipment used and installation of post-installed anchors shall be in accordance with the manufacturer's printed instructions.

M. For the adhesive and expansion anchors, CONTRACTOR shall comply with the manufacturer's printed installation instructions on the drilled hole diameter and depth.

N. CONTRACTOR shall properly clean out the hole utilizing a wire brush and compressed air in accordance with the manufacturer's printed installation instructions to remove all loose material from the hole, prior to installing adhesive or expansion anchors. Drilled and cleaned anchor holes shall be protected from contamination until the anchor is installed. A drilled anchor hole shall be re-cleaned assuming the hole was just drilled, if in the opinion of ENGINEER or Inspector that the hole has become contaminated after initial cleaning.

O. Unless otherwise indicated by the manufacturer, adhesive shall be dispensed through a tube or cartridge extension, beginning at the maximum depth of the hole and withdrawn as adhesive is injected, followed by insertion and rotating the anchor to the specified depth. Where necessary, spaces around anchors at the surface shall be sealed at horizontal to vertically overhead locations to prevent loss of the adhesive during curing.

P. Anchors to be installed in the adhesive shall be clean, oil-free, and free of loose rust, paint, or other coatings.

Q. Installed anchors shall be securely fixed in-place to prevent displacement. Unless shown otherwise on the Drawings, anchors shall be installed perpendicular to the concrete surface.

R. Reinforcing adhesive dowel bars or all-threaded adhesive bars shall not be bent after being adhesively embedded in hardened, sound concrete.

S. In lieu of the use of stacked standard washers, if threads of an anchor bolt protrude beyond the attachment, the installers shall use a fabricated filler plate of equal or greater size of the washer. Hole on the filler plate shall be 1/16 inch (or 2 to 3 mm) greater than the bolt size. Coat as appropriate in accordance with the material and installation location requirements.

3.2 FIELD QUALITY CONTROL

A. Anchors shall be installed by qualified personnel in accordance with the manufacturer's printed installation instructions. Installation of adhesive anchors shall be performed by personnel trained to install adhesive anchors.

B. Installation of adhesive anchors horizontally or upwardly inclined to support sustained tension loads shall be performed by personnel certified by the ACI/CRSI Adhesive Anchor Installer Certification program.

C. CONTRACTOR shall employ a special inspector to perform field inspection services in accordance with Chapter 17 of the IBC for all post-installed anchors.
   1. The special inspector must be periodically on the jobsite during post-installed anchor installation.
   2. Adhesive anchors installed to resist sustained tension loads shall be continuously inspected during installation by an inspector specially approved for that purpose by the building official.

D. CONTRACTOR shall employ a testing laboratory to perform field quality testing of installed adhesive anchors. A minimum of 10% of randomly selected adhesive anchors and reinforcing dowel bars greater than 3/8 inch diameter are to be tension tested to the least of 50 percent of expected adhesive ultimate bond strength or 80 percent of steel yield strength of the anchor rod. Maintain the proof load at the required load level for a minimum of 10 seconds.
   1. Tension testing shall be performed in accordance with ASTM E488.
   2. The independent testing laboratory shall submit an anchorage testing plan for approval to ensure the testing requirements are fulfilled.
   3. If failure of more than 5 percent of the tested anchors or reinforcing dowel bars occurs, CONTRACTOR will be required to pay for the costs involved in testing the remaining 90%.
      a. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure.

E. CONTRACTOR shall correct improper workmanship, remove and replace, or correct as instructed by the ENGINEER, all anchors or bars found unacceptable or deficient, at no additional cost to the OWNER.

F. The independent testing and inspection agency shall complete a report on each area. The report should summarize the observations made by the inspector and be submitted to ENGINEER.

G. Provide access for the testing agency to places where Work is being produced so that required inspection and testing can be accomplished.

++ END OF SECTION ++

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SECTION 06 10 03

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Lumber, plywood, and other wood products for building framing and sheathing and miscellaneous supports. Items include wood blocking, framing, sheathing, furring, nailers, sub-flooring, rough hardware, and light wood construction.

1.2 REFERENCES

A. American Forest and Paper Association (AFPA):
   1. National Design Specification for Wood Construction (NDS)

B. The Engineered Wood Association (APA):
   1. E30 – APA Engineered Wood Construction Guide

C. American Society of Mechanical Engineers (ASME):
   1. B18.2.1A Square and Hex Bolts and Screws
   2. B18.2.2 Square and Hex Nuts
   3. B18.6.1 Wood Screws
   4. B18.6.4 Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws

D. American Society for Testing And Materials (ASTM):
   1. A47 Ferritic Malleable Iron Castings
   2. A48 Gray Iron Castings
   3. A653 Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process
   4. C954 Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 inch to 0.112-inch in thickness
   5. C1002 Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases
   6. D143 Small Clear Specimens of Timber, Method of Testing
   7. D1760 Pressure Treatment of Timber Products
   8. D2559 Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions
   9. D3498 Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems
   10. E84 Test Method for Surface Burning Characteristics of Building Materials
   11. F844 Washers, Steel, Plan (Flat) Unhardened for General Use
   12. F1667 Nails, Spikes, and Staples

E. American Wood Preservers Association(AWPA):
   1. AWPA Book of Standards

F. Federal Specifications (Fed. Spec.):
   1. MM-L-736CLumber; Hardwood H. Commercial Item Description (CID):

2. TT-W-571 Wood Preservation Treating Practices
3. A-A-55615 Shield, Expansion (Wood Screw and Lag Bolt Self Threading Anchors)

G. International Code Council (ICC):
1. International Building Code (IBC)

H. Military Specification (Mil. Spec.):
1. MIL-L-19140E Lumber and Plywood, Fire-Retardant Treated

1.3 SUBMITTALS

A. Product Data: Provide product data for fasteners, connectors, adhesives, fire-retardant treatment, and preservative treatment.

B. Certification: Submit certificates of compliance for preservative treated lumber, fire retardant treated lumber and lumber grades.

1.4 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection: Store lumber indoors at the site on raised platforms. If outdoor storage is temporarily incorporated, set the material on raised platforms and cover with suitable weatherproof protective coverings, such as tarpaulins or heavy polyethylene film. Batten down covers with sufficient weights, ties or anchors to prevent blowoffs.

PART 2 - PRODUCTS

2.1 LUMBER:

A. Product Standards: Unless otherwise indicated, provide materials conforming to the requirements of the National Design Specification for Stress Grade Lumber as recommended by the National Forest Products Association.

B. Maximum Moisture Content: 19%.

C. Grading: Provide visually graded dimension lumber, timbers and decking of the following minimum grades unless otherwise shown or specified.

	Minimum Grade
Studs, Plates & Sills:	
Douglas Fir-Larch 2x4	No. 2
Douglas Fir-Larch 2x6 and larger	No. 1
Joists, Rafters & Ledgers, 2x and 4x:	
Douglas Fir-Larch	No. 1
Beams & Stringers, and Posts & Timbers:	
Douglas Fir-Larch	No. 1
Decking:	
Douglas Fir-Larch	Select Dex
Redwood	Deck Common

D. Preservative Treatment:

1. Do not treat Heart Redwood and Western Red Cedar.
2. Treat wood members and plywood exposed to weather or in contact with plaster, masonry or concrete, including framing of open roofed structures; sills, sole plates, furring, and sleepers that are less than 24 inch from ground; nailers, edge strips, blocking, crickets, curbs, cant, vent strips and other members used in connection with roofing and flashing materials.
3. Treat other members specified as preservative treated (PT).
4. Provide pressure-treated lumber complying with the requirements established in the latest AWPA P5 and TT-W-571. Use water-borne preservative with 0.25% retainage. Brand all lumber accordingly.

E. Fire Retardant Treatment: Pressure-impregnate all wood designated to be fire-retardant treated with a flameproofing complying with the requirements of AWPA Type A and with UL requirements for flame spread of 25 or less with no evidence of significant progressive combustion when tested in accordance with ASTM E 84. Provide each piece of wood bearing the UL FRS Label or the UL label indicating complete compliance with the fire hazard classification.

2.2 PLYWOOD AND STRUCTURAL-USE PANELS

A. Product Standards: Provide material conforming to the requirements of The Engineered Wood Association (APA), with the appropriate DFPA grade mark.

B. Temporary Protection: APA rated Exposure 1 or Exterior; panel grade DD or better, 23/32" thick.

2.3 FASTENERS:

A. Nails:
1. Size and type best suited for purpose unless noted otherwise.
2. Use zinc-coated or stainless steel nails, for nailing wood work exposed to weather and on roof blocking.
3. Wood-wood: Common nails (ASTM F1667, Type I, Style 10) unless otherwise noted.

B. Screws: ANSI B18.6.1 (Wood screws) or ASTM C1002 (Drywall Screws).

C. Framing and Timber Connectors:
1. Provide connectors as manufactured by Simpson Strong-Tie Co., Inc. (Simpson) or approved equal. Designations on the drawings are those of Simpson.
2. Use the number and type of fastener recommended by the connector manufacturer for full load value, unless otherwise shown.

D. Anchor Bolts, Bolts, Nuts, & Washers:
1. Anchor Bolts - F1554, galvanized where exposed to weather.
   a. Provide 3-inch square by 0.229-inch minimum thickness washers at all anchor bolts.
2. Common Bolts - A307.
   a. Provide standard cut washers where nut and bolt head contacts wood.
3. Square-headed bolts, or "L" anchors with bend of 5 times bolt diameter.
4. Embed a minimum of 12 times the bolt diameter, unless otherwise shown.
5. Size: 5/8-inch diameter unless otherwise shown.

E. Wedge Anchors and other post-installed anchoring devices.
   1. As required by Section 05 05 06, Anchors, Inserts, and Dowels.
   2. Post-installed anchors shall not replace cast-in-place anchors.

PART 3 - EXECUTION

3.1 INSTALLATION-GENERAL

A. Conform to applicable requirements of the following:
   1. AFPA National Design Specification for Wood Construction for timber connectors.
   2. AITC Timber Construction Manual for heavy timber construction.
   3. IBC, International Building Code for nailing and framing unless specified otherwise.
   4. APA for installation of plywood or structural use panels.
   5. ASTM F 499 for wood underlayment.
   6. TPI for metal plate connected wood trusses.

B. Fasteners:
   1. Nails. Nail in accordance with IBC Table 2304.9.1, unless otherwise shown.
   2. Bolts:
      a. Fit bolt heads and nuts bearing on wood with washers.
      b. Countersink bolt heads flush with the surface of nailers.
      c. Embed in concrete and solid masonry.
      d. Use toggle bolts to hollow masonry or sheet metal.
      e. Use bolts to steel over 11 gage in thickness. Secure wood nailers to vertical structural steel members with bolts, placed one at ends of nailer and 24 inch intervals between end bolts.
   3. Screws
      a. Use to join wood to steel less than 11 gage thick.
      b. May be used instead of nails to join wood to wood, at same spacing as nails.
      c. Provide minimum 1 inch penetration into anchorage member.
   4. Powder actuated drive pins may be used where practical to anchor to solid masonry, concrete, or steel.
   5. Do not anchor to wood plugs or nailing blocks in masonry or concrete. Use metal inserts or similar fastening.

C. Set sills or plates level in full bed of mortar on masonry or concrete walls.
   1. Space anchor bolts within 9 inch of ends and 4 feet on center unless shown otherwise. Stagger bolts from side to side on plates over 6 inch in width.
   2. Use shims of slate, tile or similar approved material to level wood members resting on concrete or masonry. Do not use wood shims or wedges.
   3. Closely fit, and set to required lines.

3.2 BLOCKING NAILERS, AND FURRING:

A. Use longest lengths practicable.

B. Blocking: Furnish blocking required for the attachment of ADA appurtenances, copings, roof ventilators, ducts and other sheet metal work and wood grounds for other work and as shown and required.

C. Layers of Blocking or Plates:
   1. Stagger end joints between upper and lower pieces.
   2. Nail at ends and 16 inch on center.
   3. Stagger nails from side to side of wood member over 4 inch in width.

D. Furring: Unless otherwise shown, use 1-inch x 3-inch continuous wood strips installed plumb on walls, using wood shims where necessary so face of furring forms a true, even plane. Space furring 16 inch on center, butt joints over bearings and rigidly secure in place. Anchor furring on 16 inch centers.

E. Preservative Coating: Liberally coat all field-cut edges and surfaces of treated lumber with a concentrated solution of preservative.

F. Use fire retardant treated wood blocking where shown at openings and where shown or specified.

3.3 ROOF FRAMING:

A. Set rafters with crown edge up.

B. Form a true plane at tops of rafters.

C. Connect rafters to wall plate with framing connectors.

D. Frame openings in roof with headers and trimmer rafters. Double headers carrying more than 2 rafters unless shown otherwise.

3.4 DECKING

A. Install decking with joints staggered, and over rafters.

B. Nail decking to rafters with 2-16d nails at each rafter and 8d toe-nails at 12 inch on center.

C. Provide a bead of joint sealant as specified in Section 07 92 03, Joint Sealants, under each tongue and groove at outside wall supports, to seal airtight.

D. Provide temporary waterproof covering to protect exposed decking prior to application of finished roofing.

++ END OF SECTION ++

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SECTION 07 21 03

INSULATING PANELS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Shop Drawings:
   1. Manufacturer's specifications and installation instructions for insulating panels. Include data substantiating that the materials comply with specified requirements.
   2. Copies of written guarantee for R-value and lamination.

1.2 DELIVERY, HANDLING, AND STORAGE

A. Package and protect during shipment.

B. Inspect for damage, dampness, and wet storage stains upon delivery to the Work site.

C. Remove and replace damaged or permanently stained materials that cannot be restored to like-new condition.

D. Carefully handle to avoid damage to surfaces, edges, and ends.

E. Do not open packages until ready for use.

F. Store materials in dry, weathertight, ventilated areas until immediately prior to installation.

PART 2 - PRODUCTS

2.1 INSULATING PANELS

A. Insulating panels shall be pressure laminated composites of oriented strand board (OSB) and expanded polystyrene (EPS) foam insulation.
   1. OSB panels shall be APA Exposure 1 rated, with minimum physical properties as required by APA PRP-108. OSB panels shall be 7/16-inch thick.
   2. EPS foam insulation shall have a minimum density of 0.95 lbs/cubic foot.
   3. OSB shall be laminated to EPS foam insulation using manufacturer approved adhesive. Adhesive shall be one part polyurethane with an in-use temperature range of -40 degrees F to +250 degrees F.

B. Insulating panels shall consist of a single layer of OSB laminated to one side of 4-inch nominal thickness of EPS foam insulation, suitable for installation over a nominal 2-inch tongue and groove wooden roof deck.

C. Insulating panel assembly shall have a minimum R-value of R-15.

D. Size 48-inches by 96-inches.

E. Product and Manufacturer:
   1. The Murus Company; NB-2100 EPS Insulating Panel
   2. Premier Building Systems; Insul-Lam
   3. Or Equal.

2.2 MISCELLANEOUS MATERIALS

A. Manufacturer shall supply appropriate fasteners and keysplines for connecting insulating panels to each other and to roof deck. Fasteners to connect insulating panels to roof deck shall be screws with a minimum diameter of 3/16 inch , long enough to provide at least 1-inch penetration into the roof deck and shall be coated with a corrosion-resistant coating.

PART 3 - EXECUTION

3.1 SEQUENCING

A. Proceed with and complete the Work only when materials, equipment and tradesmen required for the installation of the roofing material (underlayment, at a minimum) over the insulating panels are at the site and are ready to follow with this Work immediately (same day) behind the insulating panel Work.

B. Do not install any more insulating panels each day than can be covered with roofing underlayment by the end of that working day.

3.2 INSPECTION

A. CONTRACTOR and his installer shall examine the substrate and the conditions under which the insulation Work is to be performed, and notify ENGINEER, in writing, of any unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.3 INSTALLATION

A. Install insulating panels as shown on the Drawings and in accordance with all manufacturer's written instructions.

++ END OF SECTION ++

SECTION 07 21 06
BUILDING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install all building insulation.
   2. Extent of each type of building insulation is shown.
   3. Types of products required include the following:
      a. Glass fiber batt insulation.
      b. Extruded polystyrene plastic insulation.
      c. Mineral fiber insulation.
      d. Loose granular perlite insulation.
      e. Mineral fiber insulation
      f. Fire-stop sealants and other fire-stop system components.
      g. Miscellaneous materials and accessories.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the building insulations.
   2. Notify other contractors in advance of the installation of the building insulations to provide other contractors with sufficient time for the installation of items included in their contracts that must be installed before the building insulations.

1.2 QUALITY ASSURANCE

A. Manufacturer/Installer Qualifications:
   1. Engage single installers for each type of building insulation who are skilled, trained and have a record of successful experience in the application of each product and who have a successful record of performing work in accordance with the recommendations and requirements of the manufacturer or who can submit evidence in writing of being acceptable to the manufacturer for production of guaranteed construction and who agree to employ only tradesmen with specific skill and successful experience in each type of Work.
   2. Submit names and qualifications to ENGINEER along with the following information on a minimum of three successful projects:
      a. Names and telephone numbers of OWNERS, architects or ENGINEERs responsible for projects.
      b. Approximate contract cost of the building insulation system installed.
      c. Amount of area installed.

B. Source Quality Control:
   1. Obtain building insulations, requiring a hydrochlorofluorocarbon blowing agent, from manufacturers who manufacture specified insulation using a blowing agent acceptable for use until the year 2020 complying with the requirements of the Copenhagen Amendments to the Montreal Protocol in all ways.

2. Provide a manufacturer who will provide complete technical services including preparation and review of Shop Drawings, installation methods and proposed detailing for the Work.

C. Performance Criteria:
   1. Thermal Conductivity: The thicknesses shown are for the thermal conductivity, k-value at 75 F, specified for each material.
   2. Provide adjusted thicknesses, based on thicknesses shown or specified for building insulations, as required to comply with required thermal resistances for use of material having a different thermal conductivity.

D. Requirements of Regulatory Agencies: Comply with fire-resistance and flammability ratings as shown and specified; and comply with code interpretations by governing authorities.

E. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. ASTM C 165, Measuring Compressive Properties of Thermal Insulations, Test Method for.
   2. ASTM C 177, Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus, Standard Test Methods for.
   3. ASTM C 203, Breaking Load and Flexural Properties of Block-Type Thermal Insulation, Test Method for.
   4. ASTM C 236, Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box, Standard Test Method for.
   5. ASTM C 272, Water Absorption of Core Materials for Structural Sandwich Constructions, Standard Test Method for.
   6. ASTM C 303, Dimensions and Density of Preformed Block-Type Thermal Insulation, Standard Test Method for.
   7. ASTM C 518, Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of Heat Flow Meter Apparatus, Standard Test Method for.
   8. ASTM C 520, Density of Granular Loose Fill Insulations, Standard Test Method for.
   9. ASTM C 531, Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Monolithic Surfacings, and Polymer Concrete, Standard Test Method for.
   10. ASTM C 549, Perlite Loose Fill Insulation, Standard Specification for.
   11. ASTM C 553, Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications, Specifiction for.
   12. ASTM C 578, Rigid, Cellular Polystyrene Thermal Insulation, Standard Specification for.
   13. ASTM C 612, Mineral Fiber Block and Board Thermal Insulation, Specification for.
   14. ASTM C 665, Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing, Standard Specification for.
   15. ASTM C 764, Mineral Fiber Loose-Fill Thermal Insulation, Specification for.
   16. ASTM D 696, Coefficient of Linear Thermal Expansion of Plastics between -30 Degrees C and 30 Degrees C, Standard Test Method for.
   17. ASTM D 1621, Compressive Properties of Rigid Cellular Plastics, Standard Test Method for.
   18. ASTM D 1622, Apparent Density of Rigid Cellular Plastics, Standard Test Method for.
   19. ASTM D 2126, Response of Rigid Cellular Plastics to Thermal and Humid Aging, Standard Test Method for.

20. ASTM D 2842, Water Absorption of Rigid Cellular Plastics, Standard Test Method for.
21. ASTM E 84, Surface Burning Characteristics of Building Materials, Standard Test Method for.
22. ASTM E 96, Water Vapor Transmission of Materials in Sheet Form, Standard Test Method for.
23. ASTM E 119, Standard Methods of Fire Tests of Building Construction and Materials.
24. Underwriters Laboratories, Incorporated, UL 1479, Fire Tests of Through-Penetration Firestops.

F. Codes: Comply with the applicable requirements of the 2006 International Building Code for types of building insulation work specified.

1.3 SUBMITTALS

A. Samples: Submit for approval the following:
   1. 12-inch by 12-inch samples of each required type of building insulation.
   2. Samples will be reviewed by ENGINEER for color and texture only. Compliance with all other requirements is the responsibility of CONTRACTOR.

B. Shop Drawings: Submit for approval the following:
   1. Copies of material specifications, installation instructions and general recommendations from the building insulation manufacturers, for each type of building insulation product. Include manufacturer's data substantiating that the materials comply with specified requirements.
   2. Complete selection of fire stop manufacturer's recommended systems for each condition and kind of penetration encountered in the Work. Coordinate with equipment manufacturers for required number and kind of penetrations through fire-rated construction. Provide a schedule of penetrations and the fire stop system to be included for each condition and kind of penetration encountered.
   3. Drawings showing extent of the Work and all details required for the Work referencing system components provided as samples to ENGINEER.
   4. Indicate by copy of transmittal form that installer has received copy of manufacturer's installation instructions.

C. Test Reports: Submit for approval the following:
   1. Copies of test reports verifying compliance with physical properties and environmental features specified herein.
   2. Copies of testing agencies background and experience in preforming similar tests to those specified.

D. Certificates: Submit for approval copies of certificates stating that the manufacturer of the foam-type rigid board insulation has used an environmentally safe blowing agent complying with specified requirements.

1.4 PRODUCT DELIVERY STORAGE AND HANDLING

A. Delivery of Materials:
   1. Deliver building insulation products in manufacturer's original, unopened, factory-sealed containers, bearing manufacturer's name and labels, accurately representing container contents as shown on approved Shop Drawings.
   2. Damaged materials shall be permanently removed from Site by CONTRACTOR.

3. Do not deliver insulation materials to the Site before the time of installation.
4. Deliver materials in sufficient quantities to allow uninterrupted continuity of the Work.

B. Storage of Materials:
1. Store materials in original, undamaged containers with manufacturer's labels and seals intact.
2. Store all materials in a dry, enclosed area, off the ground and away form all possible contact with water, ice or snow.
3. Prevent damage to materials during storage, primarily by minimizing the amount of time they are stored on-Site before being incorporated into construction systems. Store only sufficient quantity of building insulation materials on-Site as necessary for the continuous advancement of the Work without causing delay.

C. Handling of Materials:
1. Handle materials carefully in order to avoid damage and breakage or compressing of boards to less than their specified thickness, or other damage.
2. Do not open containers, or expose materials to detrimental conditions or physical damage. Materials which are so exposed shall be removed from the Site and shall not be incorporated into the Work. If incorporated into the Work they shall be removed at no additional expense to OWNER.
3. Handle materials in a manner which prevents inclusion of foreign materials.
4. Do not open packages or containers until all necessary preparatory Work is complete and installation will begin immediately.

1.5 JOB CONDITIONS

A. Protection:
1. Do not allow building insulation materials to become wet or soiled, or covered with ice or snow. Provide continuous protection of materials against damage, wetting and moisture absorption primarily by storing materials under cover and above ground and away from all other construction traffic.
2. Protect foam plastic building insulation from exposure to sunlight.
3. Do not allow building insulations to come into contact with welding operations or other fire or ignition sources.
4. Do not overload the building structure or damage in-place construction system with the weight of stored materials or use of equipment.
5. Protect materials against damage by construction activities.

B. Scheduling:
1. Proceed with building insulation Work only when preceding Work is ready to receive the Work of this Section.
2. Proceed with the building insulation and associated Work only after curbs, blocking, substrate board, nailer strips, vents, drains and other projections through the substrates have been installed, and when the substrate construction and framing of openings is complete.
3. Proceed with and complete the Work only when materials, equipment and tradesmen required for the installation of the building insulation and backfilling operations are at the Site and are ready to follow with the Work in a manner which will not leave the Work vulnerable to damage or deterioration.

4. Do not advance the installation of building insulation materials beyond that which is necessary for proper sequencing of the Work. Do not advance Work when there is no proper and secure protection from damaging weather and construction activities.

C. Environmental Conditions:
   1. Complete the installation and concealment of building insulation materials as rapidly as possible in order to avoid damage from adjacent construction operations and adverse weather conditions.
   2. Install building insulations only when weather and temperature conditions comply with building insulations manufacturers' written recommendations.
   3. Install building insulations only when damaging environmental condition are not forecasted for the time when exposed systems materials components would be exposed to potential damage.
   4. Protect Work from precipitation, frost and direct sun.
   5. Do not apply pressure sensitive tape when temperature is below 35 F or above 110 F.
   6. Record decisions, conditions and agreements to proceed with the Work when weather conditions might be unfavorable. State the reasons for proceeding, along with the names of persons involved, and any changes or revisions, if required, to allow the Work to proceed.

1.6 SUBSTITUTIONS

A. Do not change products, system components, or manufacturers after Shop Drawing approval by ENGINEER.

B. Clearly identify, in a manner which is highlighted to ENGINEER, all proposed substitutions, modifications, variations and unspecified features. Provide complete comparative data with specified products at time of Shop Drawing submission.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Glass Fiber Insulations: Provide the following types:
   1. General: Provide insulations formed from glass fibers and resinous binders fabricated into flexible blankets, semi-rigid and rigid sheets complying with ASTM C665, ASTM C553, and ASTM C612.
   2. Unfaced Batt Insulation: Provide unfaced thermal batt insulation complying with ASTM C665, Type I.
      a. Physical Properties.
         1) R-value, ASTM C518: Reference Drawings. If not specified on the Drawings, provide the maximum R-value corresponding to the framing member thickness.
         2) Density, provide standard density unless high-desnity is required to achieve the specified R-value.
         3) Flame Spread, ASTM E 84: 25 maximum for insulation.
         4) Smoke Developed, ASTM E 84: 50 maximum for insulation.
      b. Thickness: Match the framing thickness shown on the Drawings.
      c. Width: 16-inches, or as required based on framing member spacing.
      d. Product and Manufacturer: Provide one of the following:

1) Thermal Batt Insulation by Owens-Corning Fiberglas Corporation.
2) Thermal Batt Insulation by CertainTeed.
3) Thermal Batt Insulation by Johns Manville.
4) Or equal.

3. Flame-Resistant Vapor Barrier Faced Batt Insulation: Provide thermal batt insulation, faced on one side with a foil-reinforced-kraft laminate vapor barrier complying with ASTM C665, Type III, Class A.
   a. Physical Properties:
      1) R-value, ASTM C518: Reference Drawings. If not specified on the Drawings, provide the maximum R-value corresponding to the framing member thickness.
      2) Water Vapor Transmission, ASTM E96: <0.06 perm/inch.
      3) Flame Spread, ASTM E84: 25.
      4) Smoke Developed, ASTM E84: 50.
   b. Thickness: Match the framing thickness shown on the Drawings.
   c. Width: 16-inches, or as required based on framing member spacing.
   d. Product and Manufacturer: Provide one of the following:
      1) FSK-25 Faced Thermal Batt Insulation by Owens-Corning Fiberglas Corporation.
      2) FSK-25 Faced Thermal Batt Insulation by Johns Manville.
      3) FSK-25 Faced Thermal Batt Insulation by CertainTeed.
      4) Or equal.

B. Foam Plastic Insulations: Provide the following types:
   1. General: Rigid, closed-cell, thermally stabilized, extruded, hydrochloroflurocarbon blown, foam board insulation consisting of 100 percent virgin extruded polystyrene modified resin complying with ASTM C 578.
   2. Provide a blowing agent with lowest available ozone depletion potential, such as HCFC-142b, or better. HCFC-141b will not be approved by ENGINEER.
   3. Perimeter Foundation Insulations: Provide very high-load-resisting, rigid foam board insulation complying with ASTM C 578, Type V.
      a. Physical Properties: Provide the following:
         1) Thermal Conductivity (k), ASTM C 177 and ASTM C 518: 0.20 Btu/in./hr./sf/°F.
         2) Compressive Strength (psi at 5% deformation) ASTM D 1621: 100 psi minimum.
         3) Flexural Strength, ASTM C 203: 100 psi minimum.
         4) Coefficient of Thermal Expansion, ASTM D 696: 3.5×10^{-5} inches/in./ °F.
         5) Water Vapor Absorption, ASTM C 272: Less than 0.1% by volume maximum.
         6) Water Vapor Permeance, ASTM E 96: 0.3-0.8 perms/inch maximum.
         7) Flame Spread, ASTM E 84: 5.
         8) Smoke Developed, ASTM E 84: 165 maximum.
      b. Thickness: 1 layer each 2-inches.
      c. Width: 24-inches.
      d. Length: 96-inches.
      e. Product and Manufacturer: Provide one of the following:
         1) STYROFOAM 100 HIGH LOAD by The Dow Chemical Company.
         2) Foamular 1000 by Owens-Corning Fiberglas Corporation.
         3) Or equal.
   4. Cavity Wall Rigid Insulation Board: Provide the following:

a. Rigid, rectangular boards of extruded polystyrene complying with ASTM C 578, Type X and IV.
b. Physical Properties: Provide the following:
1) Minimum Compressive Strength, (at 10 percent deformation), ASTM D 1621: 25 psi.
2) Flame Spread, ASTM E 84: 10 maximum.
3) Smoke Development, ASTM E 84: 165 maximum.
4) Vapor Transmission, ASTM E 96: 1.1 perms/inch.
5) Thermal Resistance, ASTM C 177: 5.0/inch.
6) Maximum Water Absorption, ASTM C 272: 0.10% by volume.
c. Size: 1 layer of 16-inches by 96-inches by 2-inches thick.
d. Product and Manufacturer: Provide one of the following:
1) CAVITYMATE Plus by The Dow Chemical Company.
2) Foamular 250 Square Edge by Owens-Corning Fiberglas Corporation.
3) Or equal.

C. Mineral Fiber Insulation: Provide the following types:
1. General: Provide insulations formed from inorganic mineral fiber extrusions spun at 2500 F complying with ASTM C 665 and ASTM C 764.
2. Loose Mineral Fiber Insulation: Provide non-asbestos rock, slag or glass processed into fiber and formed into loose resilient wool mass or granular nodules complying with ASTM C 764, Type 1 (for blowing) Type 2 (for pouring).
a. Physical Properties:
1) Thermal Conductivity (k), ASTM C 764: 0.46 Btu/in./ hr/sf/°F.
2) Ignition Loss: Less than 1% (99% pure mineral fiber).
3) Density, ASTM C 64: 1.5 pcf.
b. Product and Manufacturer: Provide one of the following:
1) Industrial Mineral Wool Fiber by Rock Wool Industries, Incorporated.
2) FBX Insulating Wool by Fibrex Incorporated.
3) Or equal.
3. Sound Attenuation Fire Blanket Insulation: Provide insulation containing non-asbestos, non-combustible compounds of spun mineral fiber felt formed into flexible, resilient blankets complying with ASTM C 665, Type I.
a. Physical Properties:
1) Thermal Conductivity (k), ASTM C 518: 0.27 Btu/in./ hr/sf/°F.
2) Density, Manufacturer's Certified Test: 2.5 pcf.
b. Thickness: 2-inches.
c. Width: 16-inches.
d. Product and Manufacturer: Provide one of the following:
1) Thermafiber SAFB Batts by USG Interiors, Incorporated.
2) Sound Control Fire Blankets by Fibrex Incorporated.
3) Or equal.
4. Safing Insulation: Provide unfaced semi-rigid non-asbestos, non-combustible blankets composed of compounds of spun mineral fiber felt, complying with ASTM C 665, Type I.
a. Physical Properties:
1) Thermal Conductivity (k), ASTM C 518: 0.25 Btu/in./ hr/sf/°F.
2) Density, Manufacturer's Certified Test: 4 pcf.
3) Flame Spread, ASTM E 84: 15 maximum.
4) Smoke Developed, ASTM E 84: 5 maximum.

5) Fire Resistance Rating, ASTM E 119: 3 hours.
b. Thickness: 4-inches.
c. Width: 24-inches.
d. Product and Manufacturer: Provide one of the following:
1) Thermafiber Safing Insulation by USG Interiors, Incorporated.
2) FBX Safing Insulation by Fibrex Incorporated.
3) Or equal.

D. Fire-Stop Sealants and Other Fire-Stop System Components: Provide the following:
1. Complete selection of fire stop manufacturer's recommended silicone rubber fire stop systems. Provide complete systems complying with UL 1479 with a two or three hour fire rating. Provide equal fire protection as provided by fire-rating of construction penetrated.
2. Provide multiple component systems coordinated to meet actual conditions encountered in the Work and as recommended by the fire stop manufacturer. In addition to providing fire-resistance, the fire stop systems shall also be gas and watertight.
3. Product and Manufacturer: Provide one of the following:
a. 3M Fire Stop Systems by 3M Incorporated.
b. Or equal.

E. Miscellaneous Materials and Accessories: Provide the following:
1. Adhesive for Bonding Insulation: The type recommended by the insulation manufacturer, and complying with fire-resistance requirements.
2. Mechanical Anchors: Type and size shown or, if not shown, as recommended by the insulation manufacturer for the type of application shown and condition of substrate.
3. Wire Arch Insulation Supports: Manufacturer's standard 11-gage galvanized spring-steel clip wire arches, for self-anchoring into wood joists; length as needed for joist spacing.
4. Wire Mesh Insulation Support: 2-inch by 24-gage galvanized steel wire hexagonal woven mesh.
5. Safing Impaling Clips: Provide galvanized steel impaling clips complying with requirements of governing code authorities and as recommended by the insulation manufacturer for full system responsibility.
6. Protection Board: Fiberboard sheathing or heavy duty asphaltic panels as recommended by the insulation manufacturer.
7. Adhesive Tapes: Complete selection of insulation manufacturer's recommended taping materials.
8. Bitumen: Asphalt, ASTM D 449.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR and his installer shall examine the substrate and the conditions under which the building insulation Work is to be performed, and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 SUBSTRATE PREPARATION

A. Verify that surfaces to receive building insulation are clean of all debris, dirt and other contamination before installation begins in any area.

3.3 INSTALLATION

A. General:
   1. Comply with manufacturer's instructions for the particular conditions of installation in each case. If printed instructions are not available or do not apply to Site conditions, submit to ENGINEER specific recommendations from manufacturer for approval before proceeding with the Work.
   2. Extend all insulations full thickness over entire surface to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation.
   3. Apply the number of layers of insulation specified, each of the required thickness, or the required thickness to provide the thermal value indicated, unless otherwise shown or required, to make up the total thickness.

B. Unit-Type Building Insulation:
   1. Apply insulation units of the type shown to the substrate by the method indicated. If not otherwise indicated and except for units resting on horizontal surfaces, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
   2. Seal joints between closed-cell (non-breathing) insulation units by applying mastic or sealant, of the type recommended by the manufacturer, to the edge of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with mastic or sealant.
   3. Exercise extreme care to avoid damage and soiling of faces on insulation units which will remain exposed-to-view. Align joints accurately, with adjoining surfaces set flush.
   4. Set vapor barrier faced units with vapor barrier to warm side of construction, (usually toward inside), except as otherwise shown. Do not obstruct ventilation spaces, except for firestopping.
   5. Tape joints and ruptures in vapor barriers, using adhesive tape of type recommended by insulation manufacturer, and seal each continuous area of insulation to surrounding construction so as to ensure vapor-tight installation of the units.
   6. Set reflective foil-faced units accurately with air space in front of foil as shown. Provide not less than 0.75 inch air space wherever possible.
   7. Support underfloor blanket insulation with vapor barrier up (if any). In wood frame construction, support by continuous wire mesh stapled to bottom of joists, or on wire arches impaled into joist walls, at 12 inch spacing near bottom of joists; or provide type of blanket insulation which has permeable kraft paper face with nailing flanges.

C. Board-Type Perimeter Insulation:
   1. Install perimeter insulation after concrete footings have been poured and before on-grade concrete slab work begins.
   2. Remove projections which interfere with placement.
   3. Apply a single 2 foot-0 inch-wide continuous band of insulation of the required thickness and number of layers at all slab-on-grade buildings whether or not shown. Stagger joints between layers of insulation and butt insulation tightly together.

4. Protect top surface of horizontal insulation from damage during concrete work by application of protection course material recommended by the insulation manufacturer.
5. On vertical surfaces, set units in adhesive applied in accordance with manufacturer's instructions. Use type adhesive recommended by manufacturer of board-type perimeter insulation.
6. Tape bottom edge of insulation before temporarily attaching insulation to wall with mastic.
7. Tape all joints in vertical wall insulation.
8. Protect insulation on vertical surfaces from damage during backfilling by application of protection course material recommended by the insulation manufacturer. Set in adhesive in accordance with the recommendations of the manufacturers of the insulation and the protection course material.

D. Batt-Type Insulation:
1. Install batt insulation above ceilings and between studs and rafters as shown. Extend insulation full width, length and height in all areas shown.
2. Fit tightly around obstructions to form a uniform insulated barrier.

3.4 PROTECTION

A. All components of the Work shall be protected from detrimental weather conditions and until construction operations including, but not limited to, backfilling, framing and sheathing, aluminum siding and concrete unit masonry Work, is completed and acceptable to ENGINEER.

B. Work which cannot for reasons acceptable to ENGINEER be covered with complete construction system before onset of weather detrimental to the Work, shall be completely covered and protected in such a manner as to deflect precipation from the installation without damaging adjacent Work.

C. Protect building insulations from all damage and abuse from all other contractors and installers involved on the Site until final acceptance by OWNER.

3.5 FIELD QUALITY CONTROL

A. Submit results of all testing to ENGINEER along with recommendations for remedial Work. Do not delay job progress. Coordinate the submission of tests and remedial Work in a manner which does not impact the acceptability of substrate and which permits expeditious completion of finishing Work.

3.6 ADJUSTMENT AND CLEANING

A. System components which are dislodged, damaged, expanded, broken, penetrated, or crushed by subsequent installation operations or damaged by detrimental weather shall be immediately replaced with undamaged material in compliance with the Specifications and properly protected as specified.

B. Only the original installer shall repair or replace deteriorated or defective Work.

3.7 INSPECTION AND ACCEPTANCE

A. Do not allow construction traffic which is not associated with the installation of building insulation in the area of Work. Protect the area from access by other installers and contractors until the Work of this Section has been incorporated into finished construction systems.

B. Building insulations which have become wet, damaged, or deteriorated shall be promptly removed from the Site and replaced with materials meeting the requirements of this Specification.

++ END OF SECTION ++

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SECTION 07 22 03

ROOF INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies requirements for building insulation for roofs and associated accessories to result in complete assemblies.

1.2 SUBMITTALS

A. Shop Drawings:
   1. Manufacturer's specifications and installation instructions for type of insulation required. Include data substantiating that the materials comply with specified requirements.
   2. Complete layout of all roof insulation showing sizes, placement and number of courses.
   3. Manufacturer's specifications and installation instructions showing the sizes and layout of the mechanical fasteners.

1.3 DELIVERY, HANDLING, AND STORAGE

A. Package and protect during shipment.

B. Inspect for damage, dampness, and wet storage stains upon delivery to the Work site.

C. Remove and replace damaged or permanently stained materials that cannot be restored to like-new condition.

D. Carefully handle to avoid damage to surfaces, edges, and ends.

E. Do not open packages until ready for use.

F. Store materials in dry, weathertight, ventilated areas until immediately prior to installation.

1.4 COORDINATION WITH OTHER ROOFING SYSTEM COMPONENTS

A. Roof insulation shall be part of a coordinated, complete roof system which includes the roofing system and all other roofing system components.

B. Roof insulation manufacturer shall certify that the roof insulation provided is completely compatible with the roofing system specified and all other roofing system components.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE RIGID ROOF INSULATION

A. Composed of extruded polystyrene (XPS) and water-resistant binders formed into rigid, non-combustible boards specifically designed for roofing applications with installation directly on structural steel decks beneath a sheet membrane or a standing seam metal roof.

B. Size: 48-inches by 96-inches.

C. Thickness:
   1. Base Layer: Thickness as shown in the Drawings.
   2. Tapered Top Layer: Varies to provide drainage.

D. Provide the following physical properties:
   1. Thermal Resistance, R-Value, ASTM C518: 5.0 hr*ft^2*^{o}F/BTU/in.
   2. Water Vapor Permeance, ASTM E96: 1.5 maximum perm.
   3. Compressive Strength, ASTM D1621: 25 psi.

E. Provide tapered and non-tapered boards as required to produce slope to drain per plans.

F. Provide custom pre-cut factory-formed corners, crickets, hips and valleys.

G. Product and Manufacturer: Provide one of the following:
   1. STYROFOAM Brand DECKMATE Plus, by Dow Building Solutions.
   2. THERMAPINK 25 by Owens-Corning Fiberglass Corporation.
   3. Or equal.

2.2 ROOF INSULATION COVER BOARD

A. Fiberglass-mat faced roof cover boards.

B. Provide the following physical properties:
   1. Size: 48-inches by 96-inches, 1/2-inch thick
   2. Weight: 1.95 psf
   3. Water Adsorption, ASTM C1177: < 10%
   4. Compressive Strength, ASTM C472: 900 psi

C. Product and Manufacturer: Provide one of the following:
   1. DensDeck Prime by Georgia-Pacific
   2. SecurRock by USG
   3. Or approved equal

2.3 MISCELLANEOUS MATERIALS:

A. Mechanical Fasteners: Screw-type 6-gauge minimum self-drilling galvanized steel with sufficient length and quantity to securely anchor system into place and to withstand all super-imposed loads. Provide 1 ½-inch diameter disc washers.

B. Joint Tape: 6-inch wide glass fiber tape.

PART 3 - EXECUTION

3.1 SEQUENCING

A. Proceed with and complete the Work only when materials, equipment and tradesmen required for the installation of the roofing membrane over the roof insulation are at the site and are ready to follow with this Work immediately (same day) behind the roof insulation Work.

B. Do not install any more roof insulation each day than can be covered with complete elastic sheet roofing system by the end of that working day.

3.2 INSPECTION

A. CONTRACTOR and his installer shall examine the substrate and the conditions under which the insulation Work is to be performed, and notify ENGINEER, in writing, of any unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.3 INSTALLATION

A. General:
   1. Tapered glass fiber board roof insulation system shall be designed and totally precut at the factory.
   2. Comply with manufacturer's instructions for the particular conditions of installation in each case. If printed instructions are not available or do not apply to the project conditions, consult the manufacturer's technical representative for specific recommendations before proceeding with the Work.
   3. Where skylight or other roof openings are required, provide crickets shaped from tapered glass fiber board to direct roof drainage around opening and to roof drain.
   4. Extend roof insulations full thickness, as shown and specified, over entire surface to be insulated.
   5. Cut and fit roof insulation Work tightly around obstructions, and fill voids with insulation. Keep back 1/4-inch for all vertical flashings.

B. Laying Roof Insulation Units:
   1. Apply rigid glass fiber board roof insulation to the thickness shown in the Drawings. Provide tapered rigid board roof insulation at crickets and sloped areas shown to provide 1/4-inch per foot positive slope to drains.
   2. Mechanically fasten insulation boards to substrate at the UL required spacing.
   3. Stagger end joints and stagger joints between courses where two or more courses are used.
   4. Lay insulation boards with edge in moderate contact without forcing.

3.4 PERFORMANCE

A. Roof insulation Work shall withstand the uplift forces of wind, as defined by the Roofing System Guarantee. Refer to the roofing system specification. Failures of the roof insulation Work, or within the insulation, shall be considered failures of materials or workmanship under the Roofing System Guarantee.

++ END OF SECTION ++

SECTION 07 53 03

ELASTOMERIC SHEET ROOFING

PART 1 - GENERAL

1.1 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Manufacturer's specifications and installation instructions for type of roofing required. Include data substantiating that the materials comply with specified requirements.
   2. Copies of written Roofing System Guarantee
   3. Complete layout of all roofing showing sizes, placement and number of seams.

1.2 DELIVERY, HANDLING, AND STORAGE

A. Package and protect during shipment.

B. Inspect for damage, dampness, and wet storage stains upon delivery to the Work site.

C. Remove and replace damaged or permanently stained materials that cannot be restored to like-new condition.

D. Carefully handle to avoid damage to surfaces, edges, and ends.

E. Do not open packages until ready for use.

F. Store materials in dry, weathertight, ventilated areas until immediately prior to installation.

1.3 QUALIFICATIONS

A. Manufacturer's Qualifications:
   1. Minimum of 5 years of experience in the production of similar material
   2. Satisfactory operation in at least 5 installations
   3. Elastic sheet roofing shall be the produce of one manufacturer.

B. Installer Qualifications:
   1. Minimum of 5 years of experience in installation of similar roofing materials
   2. Trained and certified by manufacturer for installation of proposed roofing system
      a. Submit proof of acceptability of installer by manufacturer to ENGINEER prior to the start of the Work.

1.4 COORDINATION WITH OTHER ROOFING SYSTEM COMPONENTS

A. Elastomeric sheet roofing shall be part of a coordinated, complete roof system which includes all the roofing system components.

B. Elastomeric sheet roofing manufacturer shall certify that all roof system materials are completely compatible with the elastomeric roof sheeting specified and all other roofing system components.

1.5 GUARANTEE

A. Upon completion of the Work, submit a statement to ENGINEER, signed by CONTRACTOR and-roofing installer, stating that the Work complies with the requirements of the Contract Documents and the installation methods comply with the manufacturer's written instructions and were proper and adequate for the condition of installation and use.

B. Provide 30-year Roofing System Guarantee which guarantees the performance of the elastomeric sheet roofing, along with all of the associated roofing system components, for a period of 30-years.

PART 2 - PRODUCTS

2.1 LOOSE LAID ROOFING SYSTEMS: PROVIDE THE FOLLOWING:

A. Ethylene Propylene Diene Monomer (EPDM) Synthetic Rubber Sheeting: Provide white synthetic rubber sheeting. Comply with the following:
   1. Thickness:
      a. 0.090-inches for base flashings.
      b. 0.090-inches for loosely applied system.
   2. Hardness Durometer A, ASTM D 2240: 60 ±10 points.
   3. Tensile Strength, ASTM D 412: 1305 psi, minimum.
   4. Elongation at Break, ASTM D 412: 350 percent minimum at 75°F.
   5. Brittleness Temperature, ASTM D 746: -75°F.
   6. Tear Resistance, ASTM D 624: 175 pounds per linear inch minimum.
   7. Flame Resistance, ASTM D 542: No flame.
   8. Resistance to Heat Aging, Change in Original Properties after 70 hours at 212°F, ASTM D 573: Hardness, +10 points maximum; Elongation, -40 percent maximum; Tensile Strength, -15 percent maximum.
   9. Resistance to Oil Aging, Change in Volume after 70 hours Immersion in ASTM No. 33 oil at 212°F, ASTM D 471: +80 percent.
   10. Resistance to Ozone, Condition after Exposure to 100 ppm Ozone in Air for 168 hours at 104°F, ASTM D 1149: No cracks.
   11. Resistance to Permanent Set, Compression Set after 22 hours at 158°F, ASTM D 395: +10 percent maximum.
   12. Resistance to Water, Change in Weight after 7 days Immersion at 158°F, ASTM D 471: 4 percent.
   13. Resistance to UV weathering, Xenon Arc, 4000 hours exposure at 176°F, ASTM G 26: No cracks, no crazing.

B. Product and Manufacturer: Provide one of the following:
   a. Sure-White: Design A by Carlisle SynTec Systems Division of Carlisle, Corporation.
   b. Or equal.

2.2 ROOF SYSTEM ACCESSORY COMPONENTS: PROVIDE THE FOLLOWING:

A. Roof Protection Pavers:
   1. 1-1/2-inches thick by 11-3/4-inches wide by 16-1/2-inches long
   2. Interlocking extruded 5000 psi precast concrete pavers weighing 12 psf maximum.
   3. Provide water absorption less than 5 percent by weight.
   4. Density: 145 pounds per cubic foot.
   5. Pavers shall exhibit integral bidirectional drainage capabilities, with 25 percent bearing area minimum and not requiring the use of separate pedestals or other point supports.
   6. Complete selection of manufacturer's recommended 20-gage aluminum alloy mechanical clips and anchor materials.
   7. Provide one paver for every 10 square feet of roof area.
   8. Product and Manufacturer: Provide one of the following:
      a. Ballast Pavers by Westile Incorporated.
      b. Or equal.

B. One-Way Breather Vents:
   1. Provide one-way breather vents as recommended by the manufacturer for single-ply roofing installation.
   2. Coordinate adhesives and sealants for full system responsibility.
   3. Provide black body with gray top for single-ply installation.
   4. Product and Manufacturer: Provide one of the following:
      a. FP-10 One-Way Roof Vent by Johns Manville.
      b. Or equal.

C. Miscellaneous Materials: Provide the following:
   1. Splice Cleaner: Cleaning solution, for EPDM synthetic rubber sheeting, containing toluene, heptane, carbon black and isopropanol.
   2. Bonding Adhesive: Polyhloroprene synthetic rubber adhesive.
   3. In-Seam Sealant; Silicone.
   4. Splicing Cement: Butyl adhesive.
   5. Lap Sealant: EPDM elastomeric sealant.\
   6. Deck Primer: As recommended by sheet manufacturer.
   7. Asphalt: ASTM D 312, Type 11 (flat). Softening Point: 160°F-175°F.
   8. Protection Board, EPDM Underlayment or Puncture Relief Mat: As recommended by the roofing manufacturer for use beneath walkway protection concrete pavers.
   9. Rubber Fastening Strips: As required by roofing manufacturer for fully guaranteed construction.
   10. Other miscellaneous and accessory materials as required for guaranteed construction.

PART 3 - EXECUTION

3.1 WEATHER CONDITIONS

A. Proceed with and complete the Work only when weather conditions are within those recommended by the elastomeric sheet roofing system manufacturer.

3.2 INSPECTION

A. CONTRACTOR and his installer shall examine the substrate and the conditions under which the elastomeric sheet roofing Work is to be performed, and notify ENGINEER, in writing, of any unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.3 INSTALLATION

A. Follow all installation instructions and recommendations contained in the roofing manufacturer's written installation and product manuals.

B. Seal joints in vapor barrier and seal to other surfaces at edges and at penetrations in vapor barrier. Seal over punctures and tears in vapor barrier with tape or adhesively applied strips of vapor barrier material in a manner which maintains permeable rating of entire system.

C. Cut sheets to the maximum size possible in order to minimize seams and to accommodate contours of the deck. Do not seam within four feet of roof drains.

D. Clean all splices and lap areas using manufacturer's recommended splice cleaner.

E. Lap sheets and bond joints using the seaming system recommended by the manufacturer.

F. Cover top edges of each sheet at seams with uniform fillet of special sealant.

G. Install one-way breather vents, as recommended by the roofing manufacturer, one per 1000 square feet.

++ END OF SECTION ++

SECTION 07 62 03

METAL FLASHING, GUTTERS, DOWNSPOUTS AND OTHER ROOFING SPECIALTIES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Shop Drawings: Provide documentation showing the gutter, gutter guard, scupper, conductor head, and downspout profiles, dimensions and material properties. Show joints, types and location of fasteners, and special shapes.

1.2 DELIVERY, HANDLING, AND STORAGE

A. Package and protect during shipment.

B. Inspect for damage, dampness, and wet storage stains upon delivery to the Work site.

C. Remove and replace damaged or permanently stained materials that cannot be restored to like-new condition.

D. Carefully handle to avoid damage to surfaces, edges, and ends.

E. Do not open packages until ready for use.

F. Store materials in dry, weathertight, ventilated areas until immediately prior to installation.

PART 2 - PRODUCTS

2.1 METAL

A. Galvanized Sheet Steel: ASTM A653, G90, commercial quality copper bearing steel, thickness 24 gauge, unless otherwise shown.

2.2 DOWNSPOUTS, GUTTERS, SCUPPERS, AND CONDUCTOR HEADS

A. Same as galvanized metal flashing.

2.3 ANCILLARY MATERIALS

A. Solder: ASTM B32, alloy composition Sn 50.

B. Soldering Flux: ASTM B32, Type RA.

C. Sealer Tape: Polyisobutylene sealer tape as specified in Section 07 92 03, Joint Sealants.

D. Isolation Paint: As specified in Section 09 91 03, Painting System No. 27.

E. Isolation Tape: Butyl or polyisobutylene, internally reinforced, or 20-mil thick minimum polyester.

F. Plastic Roof Cement: ASTM D4586, Type II.

G. Fasteners:
   1. For Galvanized Steelwork: Steel, galvanized per ASTM A153 or stainless steel fasteners.
   2. Nails: Roofing nailhead, 10-gauge spiral or ring shank, lengths as required to penetrate wood at least 3/4-inch.

H. Gutter Guard (Cover): Provide low profile perforated metal gutter guards compatible with the gutter style supplied. Gutter guards shall be riveted or screwed to the lip of the gutter.

2.4 FABRICATION OF FLASHING

A. Field measure prior to fabrication.

B. Fabricate in accordance with SMACNA Architectural Sheet Metal Manual.

C. Accurately form flashings to shapes shown and detailed, with angles and lines in true alignment.

D. Form angles true to line and surfaces free of waves and buckles.

E. Form bends to 1/16-inch inside radius.

F. Hem exposed edges.

G. Reinforcements and Supports: Provide same material as flashing unless other material is shown. Steel, where shown or required, shall be galvanized or stainless.

H. Rigid Joints and Seams: Make mechanically strong. Solder galvanized and stainless steel metal joints. Do not use solder to transmit stress.

I. At exposed ends of counterflashing furnish weathertight closures.

J. Neutralize soldering flux.

K. Solvent clean sheet metal. Surfaces to be in contact with roofing or otherwise concealed shall be coated with isolation paint.

2.5 FABRICATION OF DOWNSPOUTS AND GUTTERS

A. Fabricate in accordance with SMACNA Architectural Sheet Metal Manual.

B. Form downspouts and gutters in maximum lengths as practicable to sizes and shapes indicated on Drawings or to field-fit the locations shown on the drawings.

C. Telescope end joints 1-1/2 inches and lock longitudinal joints of downspouts.

D. Furnish elbows at bottom where downspouts empty onto splash blocks.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Flashing:
   1. Coordinate flashing Work with roofing Work for weathertight and watertight assembly.
   2. Isolate metal from wood and concrete and from dissimilar metal with isolation tape or two coats of isolation paint.
   3. Use only stainless steel fasteners to connect isolated dissimilar metals.
   4. Set flanges of flashings and roof accessories on continuous sealer tape or in plastic roof cement on top of deck. Nail flanges through sealer tape and at 3-inch maximum spacing. Touch up isolation paint on flanges.
   5. Joints, Fastenings, Reinforcements, and Supports: Sized and located as required to preclude distortion or displacement due to thermal expansion and contraction.
   6. Provide continuous holddown clips at counterflashing and edge drips.
   7. Conceal fastenings wherever possible.
   8. Set flashing and sheet metal to straight, true lines with exposed faces aligned in proper plane without bulges or waves.

B. Downspouts and Gutters: Anchor downspouts to wall with straps of same material as downspouts. Install gutters, scuppers, and conductor heads as indicated on Drawings.

3.2 FINISH

A. Exposed Surfaces of Flashing and Sheet Metalwork: Free of dents, scratches, abrasions, or other visible defects, and clean and ready for painting where applicable.

++ END OF SECTION ++

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SECTION 07 92 03

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Product Data: Surface preparation and installation instructions. Indicate where each product is proposed to be used. Provide sealant certified to NSF/ANSI Standard 61 where sealant is in direct contact with potable water.

B. Samples: Material proposed for use showing color range available.

C. Quality Control Submittals:
   1. Applicator Qualification: Documentation showing minimum of 5 years' experience installing sealants in projects of similar scope.
   2. Certificates of Compliance: Proposed materials meet Specification requirements.

1.2 ENVIRONMENTAL REQUIREMENTS

A. Ambient Temperature: Between 40 and 80 degrees F (4 and 27 degrees C) when sealant is applied. Consult manufacturer when sealant cannot be applied within these temperature ranges.

PART 2 - PRODUCTS

2.1 SEALANT MATERIALS

A. Sealant Characteristics:
   1. Uniform, homogeneous.
   2. Free from lumps, skins, and coarse particles when mixed.
   3. Nonstaining, nonbleeding.
   4. Hardness of 15 minimum and 50 maximum, measured by ASTM C661 method.
   5. Immersible may be substituted for nonimmersible.

B. Sealant Color: To match adjacent surfaces or as selected by ENGINEER.

C. One-Part Polyurethane, Immersible:
   1. Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS or P, Class 25.
   2. Capable of being continuously immersed in water.
   3. Designed to be used where the maximum depth of sealant will not exceed 1/2 inch.
   4. Provide sealant certified to NSF/ANSI Standard 61 where sealant is in direct contact with potable water.
   5. Manufacturers and Products for Nonsag:
      a. Sika Construction: Sikaflex-1a.
      b. Tremco: Vulkem 116.
      c. Or approved equal.

6. Manufacturers and Products for Self-Leveling:
    a. Sika Construction: Sikaflex-1C SL.
    b. Tremco: Vulkem 45 SSL.
    c. Or approved equal.

D. Two-Part Polyurethane, Immersible:
1. Polyurethane elastomeric, two-part, self leveling (or gun grade), non-staining, which cures at ambient temperature and conforms to ASTM C920.
2. Designed to be used where the maximum depth of sealant will exceed 1/2 inch or where chemical curing is required.
3. Manufacturers and Products:
    a. Sika Construction: Sikaflex-2C.
    b. Tremco: Dymeric 240FC.
    c. Or approved equal.

E. Waterproof Expandable Sealant
1. One-component, polyurethane foam that expands and cures slowly to a semi-rigid, closed cell foam upon reaction with moisture, such as ambient humidity
2. Manufacturers and Products:
    a. Sika Chemical Corp.; Boom
    b. Or approved equal

2.2 BACKUP MATERIAL

A. Nongassing, extruded, closed-cell round polyethylene foam rod, compatible with sealant used, and as recommended by sealant manufacturer.

B. Size: As shown or as recommended by sealant material manufacturer. Provide for joints greater than 1/2-inch deep. Backup material should be sized to maintain 2:1 width to depth ratio to the greatest extent possible.

C. Manufacturers and Products:
1. Dow Corning; Ethafoam SB.
2. Sonneborn; Sonofoam.
3. Or approved equal.

2.3 ANCILLARY MATERIALS

A. Bond Breaker: Pressure sensitive tape as recommended by sealant manufacturer to suit application. Provide bond breaker tape in the bottom of joints to prevent 3-sided joint sealant adhesion when backup material is not used.

B. Joint Cleaner: Noncorrosive and nonstaining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Primer: Nonstaining type recommended by sealant manufacturer to suit application

PART 3 - EXECUTION

3.1 GENERAL

A. Use of more than one material for the same joint is not allowed unless approved by the sealant manufacturer.

B. Install joint sealants in accordance with ASTM C1193.

C. Horizontal and Sloping Joints of 1 Percent Maximum Slope: Use self-leveling (Grade P) joint sealant.

D. Steeper Sloped Joints, Vertical Joints, and Overhead Joints: Use nonsag (Grade NS) joint sealant.

3.2 PREPARATION

A. Verify that joint dimensions, and physical and environmental conditions, are acceptable to receive sealant.

B. Surfaces to be sealed shall be clean, dry, sound, and free of dust, loose mortar, oil, and other foreign materials.
   1. Mask adjacent surfaces where necessary to maintain neat edge.
   2. Starting of work will be construed as acceptance of subsurfaces.
   3. Apply primer to dry surfaces as recommended by sealant manufacturer.

C. Verify that joint shaping materials and release tapes are compatible with sealant.

D. Examine joint dimensions and size materials to achieve required width/depth ratios.

E. Carefully follow manufacturer's instructions for mixing multi-component products.

3.3 INSTALLATION

A. Use joint filler to achieve required joint depths, to allow sealants to perform intended function.
   1. Install backup material as recommended by sealant manufacturer.
   2. Where possible, provide full length sections without splices; minimize number of splices.
   3. Tape sealant may be used as joint filler if approved by sealant manufacturer.

B. Use bond breaker where recommended by sealant manufacturer and in the bottom of joints to prevent 3-sided joint sealant adhesion.

C. Seal joints around window, door and louver frames, expansion joints, and elsewhere as indicated.

D. Joint Sealant Materials: Follow manufacturer's recommendation and instructions, filling joint completely from back to top, without voids.

E. Joints: Tool slightly concave after sealant is installed.

1. When tooling white or light color sealant, use a water wet tool.
2. Finish joints free of air pockets, foreign embedded matter, ridges, and sags.

F. Tape Sealant: Compress to 50 percent of expanded thickness and install in accordance with manufacturer's instructions.

3.4 CLEANING

A. Clean surfaces next to the sealed joints of smears or other soiling resultant of sealing application.

B. Replace damaged surfaces resulting from joint sealing or cleaning activities.

++ END OF SECTION ++

SECTION 08 13 03

METAL DOORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Provide and install metal doors.

1.2 SUBMITTALS

A. Shop Drawings: Applicable information for each type of door and frame, including:
   1. Frame conditions, complete anchorage details, dimensions, glazing, fire ratings, etc.
   2. Reference door numbers used on Drawings and in Door Schedule on shop drawings.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Identify each door with number used on Drawings and in Door Schedule.

B. Store doors upright, in protected dry area and provide for air circulation around each door. Store doors at least 4-inches off of the floor to prevent water damage and wear of door bottom on floor. Do not cover doors in plastic tarps or other storage provisions which promote water damage and rust. If door packaging becomes wet, remove it immediately.

PART 2 - PRODUCTS

2.1 HOLLOW STEEL DOORS

A. General:
   1. Doors and Frames shall conform to SDI 100, except as modified herein.
   2. Doors and Frame cutouts, anchors and reinforcement shall conform to SDI 107 and ANSI A115 to receive hardware as specified elsewhere.

B. Materials:
   1. Doors, frames and frame components shall be manufactured from commercial quality carbon steel conforming to ASTM designation A366, with an A60 zinc-iron alloy coating conforming to ASTM designation A653.

C. Hollow Metal Doors:
   1. Flush Panel Doors: 16-gauge, Grade III, Model 1, with honeycomb or polyurethane core.
   2. Trim for doors with glass cutouts shall be 18-gauge galvanized steel. If the trim is installed using screws, screws shall be only visible from the non-secure side of the door. Trim shall be flush or shall protrude no more than 1/16” from the door face, and shall be the same on both sides of the door.
   3. All doors shall have flush end closure at top of doors to eliminate moisture penetration. Door tops shall no have holes or openings.

4. All doors shall include a self-adjusting, concealed door sweep installed in the bottom channel. The bottom seal shall not include springs.
5. Glass Lites
    a. Provide door with a narrow lite (N) located along the lock edge of the door with exposed glass dimensions of approximately 4" x 25" where indicated in the door schedule.
    b. Provide door with a half glass (G) where indicated in the door schedule.
    c. Glazing:
        1) All glass shall be ¼" thick fully tempered safety glass, manufactured by a horizontal process.
        2) The tempered glass shall meet, at the time of installation, quality and strength requirements of ASTM C-1036 and ASTM C-1048 and the safety criteria of CPSC 16 CFR 1201 and ANSI Z97.1-1984.
        3) Glass shall be appropriate for service in environmental conditions from -10 degrees Fahrenheit air temperature to 130 degrees Fahrenheit air temperature.
        4) Glass shall be labeled as follows: Each pane of safety glass shall be identified by a label specifying the labeler, whether the manufacturer or installer, the type and thickness of glass, and the safety glazing standard with which it complies. Label shall be acid etched, sand blasted, ceramic fired or an embossed mark or otherwise written so that it cannot be removed without destroying the glass.
6. Louvers
    a. Provide door with a louver and louver type as shown in the door schedule.
        1) Louvers are of the insert type designed to be mounted into a cutout in the door and an overlapping frame. Insert type louvers shall be securely fastened to the door to provide security.
        2) Frames for louvers, 20-Gauge minimum.
        3) Blades for louvers, 24-Gauge minimum.
        4) Provide bird or insect screen.
        5) Provide prime painted, except when the louver is used in a factory prefinished door, in which case the louver will be finished painted with a color to match the door.
        6) Provide zinc coated louvers in exterior doors.
7. Door swing shall be as shown on Drawings.

D. Metal Frames:
1. Products of hollow metal door manufacturer, constructed to coordinate with hollow metal door.
2. Frames for Doors 14-Gauge: Welded type, of cross-section shown.
3. Finished size, shape, and profile of frame members as shown.
4. Concealed fasteners or welding are preferred to through-the-face fasteners.
5. Identification: Stamp opening number, as shown on Drawings and in Door Schedule, on center hinge reinforcement of each frame.

E. Finish:
1. Doors and frames shall be cleaned and phosphate treated.
2. Doors and frames shall be galvanized with A60 or G60 zinc coating in accordance with ASTM A525 (Wipe Coat galvanized coating is not acceptable).

3. Doors and frames shall be finished with a baked-on rust-inhibiting primer in accordance with ANSI A250.3. Doors shall be field finished in accordance with Section 09 91 03, Painting.

F. Manufacturers and Models:
   1. Steelcraft L series with F series frame
   2. Curries 727 series with M type frame
   3. Or equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean and prepare rough opening to accept metal frame. Identify and report any deficiencies in rough opening to ENGINEER prior to installing metal frame.

3.2 INSTALLATION

A. Metal Frames:
   1. Set all frames in accordance with SDI 105.
   2. Set welded frames in position prior to beginning partition work.
   3. Brace frames until permanent anchors are set.
   4. Set anchors for frames as work progresses.
   5. Install anchors at hinge and strike levels.
   6. Use temporary setting spreaders at all locations.
   7. Use intermediate spreaders to assure proper door clearances and header braces for grouted frames.
   8. Install frames in prepared openings in concrete and masonry walls using countersunk bolts and expansion shields.

B. Hollow Metal Doors:
   1. Install hollow metal doors in frames using hardware specified in Section 08 71 03, Door Hardware.
   2. Clearances at edge of doors
      a. Between door and frame at head and jambs: 1/8 inch.
      b. At meeting edges pairs of doors and at mullions: 1/8 inch.
      c. At transom panels, without transom bars: 1/8 inch.
      d. At sills without thresholds: 5/8 inch maximum above finish floor.
      e. At sills with thresholds: 1/8 inch above threshold.

3.3 ADJUSTMENT AND CLEANING

A. Remove dirt and excess sealants, mortar or glazing compounds from exposed surfaces.

B. Adjust moving parts for smooth operation. Use shims if necessary to allow for proper closing.

C. Fill all dents, holes, etc. with metal filler and sand smooth and flush with adjacent surfaces - Reprime/paint to match finish.

++ END OF SECTION ++

SECTION 08 35 00

ACCESS HATCHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Provide all materials, equipment, and accessories to furnish and install the following access hatches:
   1. Roof hatches
   2. Flush floor hatches

1.2 QUALITY ASSURANCE

A. Warranty: Provide a 1-yr warranty on all hatches from date of installation. Warranty shall cover defects in workmanship, design, and materials. If any component should fail during the warranty period, it shall be corrected and the unit restored to service at no expense to the OWNER.

1.3 DESIGN REQUIREMENTS

A. In locations designated as "Standard", hatches shall be designed for a live load of 300 pounds per square foot.

B. In locations designated as "Traffic Rated", hatches shall be designed for H-20 load rating, as defined by AASHTO.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Detailed drawings showing component and assembly dimensions, location of connections, weights of all equipment, installation details, and accessory details.

B. Product Data:
   1. Descriptive literature, specifications, and engineering data.
   2. Materials of construction for all components and accessories.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All equipment and accessories shall be properly protected during shipment such that no damage or deterioration shall occur between shipment and installation.
   1. Finished surfaces shall be protected by wooden blanks.
   2. Finished ferrous metal surfaces not painted shall be protected from corrosion.
   3. Each box and package shall be clearly marked with the contents and total weight.

B. Manufacturer shall provide any special storage and handling instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.
   1. Aluminum hatches:
      a. The Bilco Co.
      b. Nystrom
      c. Or Equal.

2.2 MATERIALS

A. Unless otherwise noted, all access hatches shall be constructed of aluminum.

B. Aluminum hatches shall be provided with aluminum frames and stainless-steel hardware.

C. Steel hatches and frames shall be galvanized and provided with galvanized or cadmium-plated hardware.

2.3 FLUSH FLOOR HATCHES

A. General
   1. Doors shall be pre-assembled from the manufacturer.
   2. Covers shall open 90 degrees and be equipped with a hold open arm which automatically locks the cover in the open position.
   3. Covers shall be fitted with the required number and size of compression spring operators. Springs shall have an electrocoated acrylic finish. Spring tubes shall be constructed of a reinforced nylon 6/6-based engineered composite material.
   4. A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the cover and the latch release shall be protected by a flush, gasketed, removable screw plug.
   5. Hardware:
      a. Hinges shall pivot so that the cover does not protrude into the channel frame.
      b. A Type 316 stainless steel snap lock with fixed handle shall be mounted to the underside of the cover.
      c. The hatch shall be supplied with manufacturer's recessed padlock hasp option.
   6. Entire door and all hardware components shall be highly corrosion resistant.
   7. Doors shall be sealed with an EPDM gasket for odor control purposes.
   8. Hatch frames shall be supplied with concrete anchor straps.

B. **H-101**: Double leaf flush floor hatch for walking areas (over 42-inch by 42-inch)
   1. Furnish and install where indicated on drawings flush floor access hatch. The hatch shall be double leaf.
   2. Service: Floor hatch for use in H20 rated traffic areas.
   3. Features:
      a. Material:
         1) Cover: ¼-in aluminum diamond pattern plate
         2) Frame: ¼-in extruded aluminum
      b. Hinges:
         1) Heavy duty Type 316 Stainless Steel

2.4 ROOF HATCHES

A. General
   1. All roof hatches shall be preassembled from the manufacturer.
   2. Entire hatch shall be weathertight with fully welded corner joints on cover and curb.
   3. Cover:
      a. Material: 11 gauge aluminum with a 3-inch beaded flange with formed reinforcing members.
      b. Cover shall be reinforced to support a minimum live load of 40 psf with a maximum deflection of 1/150th of the span or 20 psf wind uplift.
      c. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed on the top surface of the curb.
      d. Cover insulation shall be fiberglass of 1-inch thickness, fully covered and protected by an 18 gauge aluminum liner.
   4. Curb:
      a. Material: 11 gauge aluminum
      b. The curb shall be 12 inches in height.
      c. The curb shall be formed with a 3-1/2-inch flange with 7/16-inch holes provided for securing to the roof deck.
      d. The curb shall be equipped with an integral metal capflashing of 11 gauge aluminum, fully welded at the corners.
      e. Curb insulation shall be rigid, high-density fiberboard of 1-inch thickness on outside of curb.
   5. Lifting Mechanisms:
      a. Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide smooth, easy, and controlled cover operation.
      b. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly.
      c. The lower tube shall interlock with a flanged support shoe welded to the curb assembly.
   6. Winch Operated Rigging:
      a. Manufacturer shall provide winch operated rigging to allow the roof hatches to be manually opened from ground floor level.
      b. Rigging shall include all winches, cables and pulleys per roof hatch.
      c. Contractor shall install rigging and provide all necessary hardware and stand-off brackets to allow the winches to be readily accessible without interference of adjacent mechanical, structural or electrical items.
      d. Layout of rigging shall be approved by ENGINEER prior to installation.
   7. Hardware:
      a. Heavy pintle hinges shall be provided.
      b. Cover shall be equipped with a spring latch with interior and exterior turn handles.
      c. Roof hatch shall be equipped with interior and exterior padlock hasps.
      d. The latch strike shall be a stamped component bolted to the curb assembly.
      e. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1-inch diameter red vinyl grip handle to permit easy release for closing.
      f. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be zinc plated and chromate sealed. Springs shall have an electrocoated acrylic finish for corrosion resistance.

g. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

8. Factory finish shall be mill finish aluminum.

B. **H-201**: Single leaf roof hatch for small equipment access
   1. Furnish and install where indicated on plans a roof hatch.
   2. Dimensions: As shown on drawings.
   3. The roof hatch shall be single leaf.
   4. Furnish winch operated rigging for each roof hatch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install in accordance with the manufacturer's recommendations and approved shop drawings. Install level and square with other construction, without warp or rack.

B. Unless otherwise shown, hatches shall be cast integrally with concrete decks, and shall not be grouted in later.

C. Coordinate precise location with equipment to be accessed thereby.

D. Aluminum surfaces shall be protected with two heavy coats of asphaltic or zinc chromate paint, where they are in contact with concrete or masonry.

+ + END OF SECTION + +

SECTION 08 71 03

DOOR HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Provide all materials, equipment, and accessories to furnish and install door hardware.

1.2 SUBMITTALS

A. Shop Drawings:
   1. Product Data: Manufacturers' literature for each item of finish hardware required herein, clearly marked.
   2. Finish Hardware Schedule: Furnish complete and detailed schedule, show product items, numbers, and finishes for all hardware for each separate opening.
   3. Special Tools: Provide listing and description of usage.

1.3 QUALITY ASSURANCE

A. Qualifications of Supplier: A recognized supplier of architectural finish hardware, with warehousing facilities, who has been furnishing hardware in the vicinity of the Project for not less than 5 years, and who is, or who employs, an architectural hardware consultant.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Provide secure storage for all finish hardware until installation is made.

B. Before delivery, clearly identify and tag each item of hardware with respect to specified description and location of installation.

1.5 SPECIAL TOOLS

A. Provide two sets of special tools for installation and maintenance of hardware.

PART 2 - PRODUCTS

2.1 DOOR HARDWARE

A. Provide all door hardware from a single manufacturer in order to have consistency in appearance, function and maintenance procedures.

B. Fasteners:
   1. All fasteners shall be type 304 stainless steel.

C. Butt Hinges:
   1. Conforming to ANSI A156.1-88.

2. Quantity per Door Leaf (Minimum):

DOOR HEIGHT	MINIMUM NUMBER OF HINGES PER LEAF
Up to 5’-0”	2 ea
5’-0” to 7’-7”	3 ea
7’-7” to 10’-0”	4 ea
10’-0” to 12’-6”	5 ea
Over 12’-6”	One for every 30” of door height, rounding up

3. Hinge Size: Except as otherwise specified or as required to comply with UL and NFPA, provide hinges of the following sizes:
   a. Up to 36" wide: 4½" heavy weight.
   b. Over 36” to 48" wide: 5" heavy weight.
   c. Over 48" wide: 6" heavy weight.
4. Types of Hinges: Full-mortise type, ball-bearing hinges swaged for mortise applications, inner leaf beveled, square cornered.
5. Width: Minimum for clearance of trim and 180-degree swing.
6. Exterior Hinges: Non-removable pin.
7. Joint Tolerance: 0.012-inch maximum, gauged in CLOSED position.
8. Material: type 304 stainless steel.
   a. Finish: Satin stainless steel No. 630.
9. Hinge Manufacturers and Models:
   a. Stanley FBB191-32D
   b. McKinney TB2314
   c. Or Equal.

D. Locks and Latch Sets:
1. Tactile Warning: Knurl knob backs and lever handles for touch identification; ANSI A117.1, Section 4.29.3.
2. Materials: Type 304 stainless steel.
   a. Finish: Satin stainless steel No. 630.
3. Lock and Latch Set Manufacturers and Models:
   a. Sargent; 8245-J.
   b. Schlage; L9456P-03.
   c. Or Equal.

E. Coordinator:
1. Provide coordinator at all double doors.
2. Coordinator Manufacturers and Models:
   a. Ives COR7G.
   b. Or Equal.

F. Closers:
1. Provide closers on all exterior doors or as indicated in the door schedule which comply with ANSI A156.4.
2. Size closers in accordance with manufacturer’s standards. Mount regular arm closers on pull side of doors. Mount parallel arm closers on push side of doors. On pair of doors provide closer on active leaf only, unless noted otherwise.
3. Closer Manufacturers and Models:
   a. LCN 4110 Series
   b. Sargent 351 Series
   c. Or Equal.

G. Thresholds:
   1. Provide threshold at each door as indicated in the door schedule or shown on the drawings: One-piece full width of opening; extend beyond jamb where indicated.
   2. Provide with stainless steel machine screws in threaded expansion anchors at concrete.
   3. Coordinate thresholds with the door shoes.
   4. Finish: Mill finish aluminum, unless indicated otherwise.
   5. Threshold Manufacturers and Models:
      a. Pemko 274X4AFG
      b. Reese Enterprises, Inc. S407A
      c. Or approve equal

H. Door Shoes:
   1. Provide door shoes at each door indicated to have a threshold. Provide vinyl or neoprene seal with a depth coordinated with the threshold. Provide an integral drip cap at exterior doors. Attach door shoes to doors in accordance with the manufacturer's installation instructions.
   2. Finish: Mill finish aluminum, unless indicated otherwise.
   3. Door Shoe Manufacturers and Models:
      a. Pemko 216 at exterior doors and 217 at interior doors
      b. Reese Enterprises, Inc. DB595 at exterior doors and DB594 at interior doors
      c. Or approved equal

I. Weatherproofing:
   1. Provide complete weatherstrip system including rubber or vinyl at jambs and head at exterior doors and interior doors required to be sealed or airtight.
   2. Provide astragal seal for 2-leaf doors.
   3. All other weatherstripping necessary to provide a weather-sealed door system which does not allow air or moisture movement through the gap between the door and frame.

J. Rain Drip:
   1. Provide overhead rain drip guard attached to the top of the door frame at all exterior doors. Attach to the door frame in accordance with the manufacturer's installation instructions.
   2. Finish: Clear anodized aluminum, unless indicated otherwise.
   3. Drip Cap Manufacturers and Models:
      a. Pemko 346
      b. Reese Enterprises, Inc. R201
      c. Or approved equal

K. Stops and Holders:
   1. Provide stops and holders for all doors with closers in accordance with ANSI A156.16.
   2. Finish: Satin chromium-plated No. 626.
   3. Stop/Holder Manufacturers and Models:
      a. Ives WS445
      b. Hager Companies 256
      c. Or Equal.

2.2 KEYING

A. Coordinate Keying System with OWNER. Provide master-keying and local-keying to match OWNER's keying system.

B. Provide removable construction core system for use during construction.

PART 3 - EXECUTION

3.1 INSTALLATION

A. In accordance with manufacturer's written instructions.

B. Make Work neat and secure, develop full strength of components, and provide proper function.

C. Prevent marring, scratching, or otherwise damaging adjacent finishes during hardware installation.

D. Latchbolts: Install to engage in strikes automatically, whether activated by closers or manually. In no case shall additional manual pressure be required to engage latchbolt in strike.

E. Wall Mounted Hardware: Install over solid structural backing or solid blocking in hollow walls.

F. Thresholds:
   1. Cope ends neatly to profile of jamb.
   2. Set in sealant and seal ends to jambs.

G. Hardware: Adjust for easy, noise-free operation.

H. Replace damaged hardware items.

3.2 MOUNTING DIMENSIONS

A. Standard Door Hardware Locations: As recommended and published by the Door and Hardware Institute, except as noted or detailed otherwise.

B. Door Silencers: Install 3 inches from top and bottom of jamb and 1 inch above strike at single doors, and 3 inches from edges of doors in head for pairs of doors.

3.3 MANUFACTURER'S SERVICES

A. Deliver permanent lock cores to the site.

B. Remove temporary construction cores and insert permanent cores.

C. Inspect each lock set to ensure permanent cores are operating satisfactorily.

D. Deliver to OWNER change and control keys for the permanent system.

E. Return temporary construction cores to the manufacturer.

3.4 PROTECTION

A. Cover and protect exposed surfaces of hardware during installation and until Substantial Completion.

B. Fit, dismantle, and reinstall finish hardware as required for finish painting work.

C. Protect and prevent staining of hardware during construction in accordance with manufacturer's recommendations.

D. Remove protective measures and permanent lock cylinders installed prior to final cleaning.

++ END OF SECTION ++

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SECTION 09 29 03

GYPSUM WALLBOARD

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Furnish all materials, labor, equipment and incidentals required to install gypsum wallboard.

1.2 QUALITY ASSURANCE

A. General: Regardless of the minimum specifications herein, utilize materials and applications recommended by the manufacturer.

B. Applicator's Qualifications: Use only workers regularly employed in this type of work who can show experience in the application of similar materials and the specific systems specified.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Control joint pattern proposed for gypsum wallboard.
   2. Control joint pattern proposed for gypsum soffit.
   3. Manufacturer's list of items and materials proposed for use, with descriptive literature for each system used.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:
   1. Deliver materials to the project site with manufacturer's labels intact and legible.
   2. Deliver fire rated materials bearing testing agency label and required fire classification numbers.

B. Storage and Handling of Materials:
   1. Store materials inside under cover, stack flat, off floor.
   2. Stack gypsum wallboard so that long lengths are not over short lengths.
   3. Avoid overloading floor system.
   4. Store adhesives and finishing compounds in dry areas, and protect against freezing at all times.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Temperature:
   1. In areas receiving gypsum wallboard installation, maintain temperature range between 55 and 70 degrees F for 24 hours before, during, and after gypsum wallboard and joint treatment application.
   2. In areas receiving veneer plaster, where outside air temperature is less than 50 degrees F, maintain interior temperature range between 50 degrees F and 80

degrees F for a period of 1 week before, during, and 1 week after application of veneer plaster, base, and joint treatment.

B. Ventilation:
   1. Provide ventilation during and following adhesives and joint treatment applications.
   2. Use temporary air circulators in enclosed areas lacking natural ventilation.
   3. Keep air circulation at a minimum level during veneer plastering to avoid excessive drying.
   4. Under slow drying conditions, allow additional drying time between coats of joint treatment.
   5. Protect installed materials from drafts of ambient air during hot, dry weather.

PART 2 - PRODUCTS

2.1 GYPSUM WALLBOARD

A. Regular Board: ASTM C36, Type X, 5/8 inch thick with tapered edges.

B. Mold and Moisture Resistant Board: ASTM C1396, 1/2 inch thick with tapered edges.

2.2 FASTENERS FOR GYPSUM WALLBOARD

A. Screws: ASTM C1002, self-drilling, self-tapping, bugle head, for use with power-driven tool.
   1. Type S, 1-inch long for gypsum wallboard to sheet metal.
   2. 1¾-inch long for gypsum wallboard to wood framing.

B. Nails: ASTM C514, F547, F1667
   1. Reference IBC section 2508 for nail sizes in wood framing.

2.3 JOINT TREATMENT

A. Joint Tape for General Interior Applications: ASTM C475, perforated paper tape.

B. Joint Compound for General Interior Applications: ASTM C475, all-purpose, ready-mixed compound.

2.4 ANCILLARY MATERIALS

A. Adhesives: As recommended by gypsum wallboard manufacturer for intended use.

2.5 TRIM ACCESSORIES

A. Zinc-Coated Metal, ASTM C1047:
   1. Corner Bead: 1-1/4 inch by 1-1/4 inch:
      a. United States Gypsum; Dur-A-Bead.
      b. Award Metals; standard corner beads.
      c. Clark Dietrich: standard corner beads.
   2. Edge Trim:
      a. United States Gypsum; L-Trim and J-Trim.

b. Award Metals; L-Bead and J-Bead.
c. Clark Dietrich: L-Trim and J-Trim.

3. Metal Control Joint:
   a. United States Gypsum: No. 093.
   b. Phillips: 093 control joint.
   c. Clark Dietrich: No. 093.

B. Vinyl Wall Base, ASTM F1861:
1. Profile: Standard Cove
2. Gauge: 1/8-inch
3. Height: 4-inch
4. Provide factory corners and all inside and outside corners.
5. Adhesive: As recommended by manufacturer of wall base.
6. Manufacturer:
   a. Roppe Corporation
   b. Johnsonite
   c. Or approved equal

2.6 LIGHT-GAUGE METAL FRAMING ACCESSORIES

A. Z Furring: Galvanized 20-gauge, 1-1/2 inch depth.

2.7 NONSTRUCTURAL FRAMING MEMBERS

A. ASTM C645, 20-gauge galvanized C-studs with 1-5/8 inch flanges, and ancillary items for interior wall framing, shaft walls, and ceiling framing.

B. Dry wall studs, tracks, shaft wall studs, Z-furring channels, and accessories.
1. Cemco.
2. Clark Dietrich
3. United Metal Products.

2.8 SPRAY TEXTURE

A. Interior Walls and Ceilings:
1. United States Gypsum; Texture I sand finish.
2. Gold Bond; Wall Spray texture finish.

2.9 FIBERGLASS-MAT FACED GYPSUM BACKING BOARD

A. Fiberglass-Mat Faced Gypsum Backing Board: ASTM C1178:

B. Water-resistant treated core with glass mat moisture protectant coating and embedded glass mats, both sides, and face side surfaced with heat-cured copolymer water- and vapor-retarding coating.

C. Thickness: ½-inch

D. Fasteners:

1. Screws: 1-1/4 inch, type S, Hi-Lo for wood or 22- to 25-gauge steel framing. 1 ¼-inch, Type S-12, for 14- to 20-guage steel framing. 1-15/16 inch, type S-12, Pilot Point for steel joists.
2. Nails: 1-1/4 inch galvanized roofing nail with 7/16-inch diameter head for wood framing.

E. Joint Reinforcement: 2 inches wide, glass fiber, open weave tape, as recommended by manufacturer.

F. Joint Compound: Chemically curing, polyindurate type material, as recommended by manufacturer.

G. Manufacturer and Product: G-P Gypsum Corp., DENS-SHIELD TILE BACKER.

2.10 ACCESS PANELS

A. Architectural grade prime coated flush steel panel and frame with concealed hinges and screwdriver-operated locking device.

B. Provide frame type and anchors to suit opening conditions.

C. Sizes Not Indicated on Drawings:
1. Smallest standard size that will permit ready access and removal of working parts required for maintenance.
2. Not less than 8 inches square.

D. Manufacturers:
1. Milcor.
2. Acudor.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect surfaces to receive gypsum wallboard and related materials before beginning work and report to ENGINEER any defects in such work which will adversely affect the quality of work specified herein.

3.2 PREPARATION

A. General: Provide, install, and maintain necessary scaffolding, staging, trestles, planking, and temporary heating, lighting, and ventilation as necessary for the duration of the gypsum wallboard work.

B. Protection: Protect work of other trades.

C. Coordination:
1. Coordinate work with that of other trades. Check specifications and drawings of other trades to determine parts of work requiring coordination.
2. Cut and repair gypsum wallboard systems for installation of omitted work.

D. Surface Preparation: Repair defective surfaces prior to starting work. Prepare as specified for application of specific materials.

3.3 ERECTION OF LIGHT-GAUGE METAL FRAMING

A. Layout: Align partitions as shown on the Drawings.

B. Tracks:
   1. Attach metal runner tracks to floor slabs with suitable fasteners located 2 inches from each end and spaced not more than 24 inches OC.
   2. Where partitions terminate at suspended or framed ceilings, attach top tracks to suspended ceiling with toggle or molly bolts spaced 24 inches OC.
   3. Where partitions terminate at underside of concrete or metal decking, attach deflection channels to substrate with suitable fasteners located 2 inches from each end and spaced not more than 24 inches OC. Locate partition top racks within deflection channels with a minimum top clearance of 1 inch. Do not attach track to channel.

C. Studs:
   1. ASTM C754.
   2. Following manufacturer's printed instructions, position studs vertically, engaging floor and ceiling tracks and spaced as noted on Drawings.
   3. Splice: When necessary, use 8-inch nested lap and one positive attachment per stud flange.
   4. Place indirect contact with doorframe jambs, abutting partitions, and partition corners. Provide for anchorage of doorframes to studs.
   5. Anchor all studs for shelf-walls and those adjacent to window and doorframes, partition intersections, and corners to ceiling and floor runner flanges. Securely anchor studs to jamb and head anchor clips of door or borrowed-light frames by bolt or screw attachment.
   6. Over metal door and borrowed-light frames, place horizontally a cut-to-length section of runner, with a web-flanged bend at each end, and secure with one positive attachment per flange. Position a cut-to-length stud (extending to ceiling runner) at vertical panel joints over doorframe header.
   7. Locate studs at abutting construction, partition intersections, and partition corners.
   8. Spacing: At 16 inches OC, unless otherwise required by manufacturer.
   9. At Doorframes and Cased Openings:
      a. Full height double studs, No. 20 gauge minimum, secured to jamb anchors by bolts, screws, or welds.
      b. Header Track: Secure to frame head anchors and double studs.
      c. Provide double channel stiffeners through studs above frame and extend at least one stud space beyond each jamb.
   10. Windows: Similar framing to door openings with stiffeners both above and below.
   11. Wall Mounting Accessories: Provide channels, horizontal studding, No. 16 gauge sheet 8 inches by 2 inches greater than stud spacing, or other members within walls as required to provide secure and adequate support.

D. Furring:
   1. Space furring channels the same as studs or as shown on the Drawings.
   2. Around columns and beams construct furring as shown using metal studs and furring channels securely tied together and anchored in-place.

3. Attach resilient furring channels to wood framing with screws.

3.4 APPLICATION OF GYPSUM WALLBOARD

A. Inspection and Preparation:
   1. Check framing for accurate spacing and alignment.
   2. Verify that spacing of installed framing does not exceed maximum allowable for thickness of gypsum wallboard to be used.
   3. Verify that frames are set for thickness of gypsum wallboard to be used.
   4. Do not proceed with installation of gypsum wallboard until deficiencies are corrected and surfaces to receive gypsum wallboard are acceptable.
   5. Protrusions from framing, twisted framing members, or unaligned members must be repaired before installation of gypsum wallboard is started.

B. General:
   1. Meet requirements of ASTM C840 and GA-216.
   2. Joints: Use gypsum wallboard of maximum lengths to minimize end joints. Stagger end joints when they occur. Locate end joints as far as possible from center of wall or ceiling. Abut gypsum wallboard without forcing. Neatly fit ends and edges of gypsum wallboard. Do not place butt ends against tapered edges.
   3. Support ends and edges of gypsum wallboard panels on framing or furring members except for face layer of double layer and where ends are back blocked and floated.
   4. Use metal edge trim where gypsum wallboard abuts another material and where shown or noted on Drawings.
   5. Use gypsum fiberglass-mat faced gypsum backing board in toilet and shower walls, behind ceramic tile, and elsewhere as indicated on Drawings.
   6. Follow manufacturer's recommendation of good practice.

C. Over Framing:
   1. Apply gypsum wallboard first to ceiling and then to walls for single layer horizontal application.
   2. Use vertical application for fire-rated walls.
   3. Fasten gypsum wallboard securely to framing using double nailing, screw, or adhesive method.

3.5 JOINT SYSTEM

A. Interior Gypsum Wallboard: Conform to ASTM C840.

B. Required: On exposed gypsum wallboard, under ceramic tile and wall covering, and behind casework.

C. Prefill: Fill V-grooves formed by abutting rounded edges of gypsum wallboard with prefill joint compound. Fill V-joint flush and remove excess compound beyond groove. Leave clear depression to receive tape. Permit prefill joint compound to harden prior to application of tape.

D. Taping and Finishing Joins:
   1. Taping or Embedding Coat: Apply compound in thin, uniform layer to joints and angles to be reinforced. Apply reinforcing tape immediately. Center tape over joint and seat tape into compound. Leave approximately 1/64-inch to 1/32-inch compound

under tape to provide bond. Apply skim coat immediately following tape embedment but not to function as fill or second coat. Fold tape and embed in angles to provide true angle. Dry embedding coat prior to application of fill coat.
2. Filling Coat: Apply joint compound over embedding coat. Fill taper flush with surface. Apply fill coat to cover tape. Feather out fill coat beyond tape and previous joint compound line. For joints with no taper, feather out at least 4 inches on either side of tape. Do not apply fill coat on interior angles. Allow fill coat to dry prior to application of finish coat.
3. Finishing coat: Spread joint compound evenly over and beyond fill coat on joints. Feather to smooth uniform finish. Apply finish coat to tapes angles to cover tape and taping compound. Sand final application of compound to provide surface ready for decoration.
4. Filling and Finishing Depressions:
    a. Apply joint compound as first coat to fastener depressions. Apply at least two additional coats of compound after first coat is dry. Leave filled and finished depressions level with plane of surface.

E. Finishing Beads and Trim:
1. First Fill Coat: Apply joint compound to bead and trim. Feather out from ground to plane of the surface. Dry compound prior to application of second fill coat.
2. Second Fill Coat: Apply joint compound in same manner as first fill coat. Extend beyond first coat onto face of gypsum wallboard. Dry compound prior to application of finish coat.
3. Finish Coat: Apply joint compound to bead and trim. Extend beyond second fill coat. Feather finish coat from ground to plane of surface. Sand finish coat to provide flat surface ready for decoration.

3.6 FINAL FINISHES

A. Levels of Finish: Conform to GA-214.

B. Level 5:
1. Taping, filling, and finishing coats plus two separate coats applied over joints, angles, fastener heads, and trim accessories.
2. A thin, smooth, uniform skim coat of joint compound, or product specially formulated for this purpose, over entire surface.
3. Sand between coats and after last coat.
4. Use on surfaces indicated to receive wall coverings. Use on surfaces not indicated otherwise, those indicated to receive gloss, semi-gloss, and nontextured flat paints, and where indicated.
5. Produce surfaces free of tool marks and ridges, ready for decoration.

3.7 SPRAY TEXTURE

A. Application:
1. Apply on gypsum wallboard and ceiling surfaces, except behind ceramic tile and wall covering, following manufacturer’s printed direction for a medium texture.
2. Before texture application, finish gypsum wallboard as specified for Level 3.
3. When surfaces are prepared and dry, apply sealer and allow to dry. Mix texture finish material as directed by manufacturer.
4. Use spray equipment of a size and type to assure acceptable results.

5. Apply by spray only at a coverage rate not to exceed 8 square feet per pound and in accordance with directions printed on container. Apply material to blend uniformly and cover fully without starved spots or other evidence of thin application. Provide uniform texture without application patterns.

3.8 ADJUST AND CLEAN

A. Clean: Remove droppings or texture overspray from walls, windows, and floor, leaving room clean for following trades.

3.9 INSTALLATION OF FIBERGLASS-MAT FACED GYPSUM BACKING BOARD

A. Follow manufacturer's printed instructions for erection, cutting, attachments, and joint treatment.

B. Verify that framing is installed at maximum 16 inches OC, and that necessary blocking to support all fixtures and accessories has been installed. Where backing plates or straps are used, space out from framing to ensure a smooth finish application. Do not proceed until defects are corrected.

C. Precut boards to required sized and make necessary cutouts. Fasten with appropriate fasteners. Space fasteners 6 inches OC maximum, or as directed by manufacturer. Fit ends closely but not forced together. Maintain ¼-inch spacing between edge of board and fixture. Apply 2-inch glass fiber tape over joints and corners embedded with tile setting mortar.

3.10 ACCESS PANELS

A. Install in accordance with manufacturer's printed instructions.

++ END OF SECTION ++

SECTION 09 90 05

BUILDING PAINTING AND COATING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The work to be done consists of furnishing all labor, materials, tools, equipment, scaffolding, and all other necessary equipment and supplies for doing all the work involved in applying paint to buildings and miscellaneous structures (except pavement markings and street signs), as shown on the plans and as specified in these specifications, and as directed by the Engineer.

1.2 MEASUREMENT AND PAYMENT

A. Cleaning and painting shall be paid for on a Lump Sum price, unless otherwise specified in the Special Provisions. The Lump Sum price paid for shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in the cleaning and painting of the work, as shown on the plans and as specified in these specifications and Special Provisions, and as directed by the Engineer.

B. Where no separate payment is specified, costs for all work and materials specified herein shall be included in bid items requiring painting.

1.3 STORAGE OF MATERIALS

A. Paints shall be stored in a protected area with temperatures between forty degrees and one hundred degrees Fahrenheit (40°F-100°F). Materials shall not be used if storage conditions or minimum shelf life have been exceeded

1.4 SUBMITTALS

A. Before ordering materials, the Contractor shall submit two (2) samples of each material, including color charts, to be used for approval of the Engineer.

B. The Contractor shall provide the City with Manufacturer's warranty on the product, and a certificate of compliance with the applicable ASTM or Federal Standards, where containers do not show such information.

PART 2 - PRODUCTS

2.1 PAINT FOR BUILDINGS AND APPURTENANCES

A. Paint for buildings and miscellaneous appurtenances shall be products of Dunn-Edwards, or comparable quality products of Glidden-Durkee, Sherwin Williams, Sinclair, Kelly-Moore, or approved equal. (The products listed below are Dunn- Edwards.)

B. Exterior

1. Stucco, Fiber Cement Siding, Concrete, Masonry:
   a. Patching - Custom Patch
   b. Primer - W 709 Eff-Stop
   c. Second and Third Coats - W 701 Evershield
2. Wood:
   a. Patching - Custom Patch
   b. Primer - 42-1 Compo
   c. Second and Third Coats - W 701 Evershield
3. Metal doors, gutters, flashing, rails, and metal trims:
   a. Primer - QD 43-7 Galv-Alum
   b. Second and Third Coats - QD 2 Aristolite
4. Other ferrous, galvanized, and aluminum surfaces:
   a. Primer - Van Prime W 711
   b. Second and Third Coats - W 701 Evershield

C. Interior
1. Stucco, concrete, and masonry:
   a. Crack Filler - Eternaflex Neoprene Sealing Compound
   b. Primer - W 101 Vinyl
   c. Second and Third Coats - W 450 Decoglo
2. Gypsum Drywall:
   a. Crack Filler - Eternaflex Neoprene Sealing Compound
   b. Primer - W 101 Vinylastic
   c. Second and Third Coats - W 450 Decoglo
3. Wood (Painted Finish):
   a. Crack Filler - Eternaflex Neoprene Sealing Compound
   b. Primer - W 707 Unikote
   c. Second and Third Coats - W 450 Decoglo
4. Wood (Varnish Finish):
   a. First Coat - V 108 Stain
   b. Second Coat - V 106A Sanding Sealer
   c. Third Coat - V 198 Flat Varnish, or V 199 Pale Satin Varnish, or V 197 Pale Gloss Varnish
5. Wood (Lacquer Finish):
   a. First Coat - LW 120 Deco
   b. Second Coat - ELQ 101 Sanding Sealer
   c. Third and Fourth Coats - ELQ 104 Semi-Gloss Lacquer

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. All surfaces to be painted shall be cleaned free of loose dirt and dust. All loose, chalking or scaling paint shall be removed by sanding, wire brushing, or scraping. Holes, cracks, and damaged spots shall be patched, filled, finish flush to adjoining surfaces.

B. All surfaces shall be sterilized before repainting to remove mildew. These surfaces shall be cleaned by high pressure water washing with the following solution:
1. Tri-sodium Phosphate ("TSP") = 2/3 cup
2. Household Bleach ("Clorox") = 1 quart

3. Powdered Detergent = 1/3 cup
4. Add warm water to make one (1) Gallon

C. Rinse surface applied with solution and allow to dry completely.

D. All sterilizing solution wash water and rinse water shall be contained for disposal into the sanitary sewer system and must not be allowed to enter City storm drains.

E. Wood surfaces shall be uniformly abraded by hand or power sanding and shall be roughened sufficiently to ensure a good bond with the base surface.

F. Metal surfaces shall be uniformly abraded by hand or power sanding or by sandblasting. Power impact tools shall remove stratified rust. Loose mill scale, loose rust, and loose paint shall be removed by power wire brushing, power grinding, or sandblasting. Remove all dust and loose matter from the surface by vacuuming. Blast cleaning shall conform to Section 59-2.03, "Blast Cleaning," of the State Specifications. Newly cleaned surfaces shall be prime-coated the same day. All blast material removed shall be properly collected and disposed as solid waste.

G. New concrete surfaces shall cure at least thirty (30) calendar days and have a moisture content below eight percent (8%) prior to coating. Concrete surface shall be cleaned by abrasive "brush-off" blast or etched with ten percent (10%) hydrochloric acid. Acid solution shall be applied at the rate of one and one-half (1-1/2) pints per Square Yard to obtain a total wetting of the substrate, and thoroughly worked into the surface by stiff bristled brushes until the bubbling reaction has subsided. Thoroughly wash and scrub etched surfaces by high-pressure water hosing to remove all salts and loose particles. Wash water shall be collected, then neutralized to a pH value between 5 and 9, and then disposed of, in the sanitary sewer system. Wash water shall not be allowed to flow into the City storm drain system.

H. Previously painted concrete surfaces or old unpainted concrete surfaces shall be stiff-brush cleaned and sterilized with a solution as described in Paragraph 28-3.01 B. Rinse surface and allow to dry completely. Sterilizing solution and rinse shall be contained for disposal into the sanitary sewer system and must not be allowed to enter the City storm drain system.

I. Remove all hardware and accessories not to be painted, or provide surface protection. Following completion of painting of each area, reinstall all removed items, by workers skilled in the trades involved.

J. All stucco and concrete blocks shall be water-blasted to remove dust and dirt.

K. Fill hairline cracks, small holes, and imperfections on plaster surfaces with patching plaster. Smooth off to match adjacent surfaces. Wash and neutralize high-alkali surfaces where they occur.

3.2 APPLICATION

A. Paint shall be applied only on thoroughly dry surfaces during periods of favorable weather. Painting will not be permitted in rainy, damp, misty, or frosty weather, or then the temperature is below thirty-five degrees Fahrenheit (35°F) or when the

relative humidity exceeds eighty five percent (85%) at the job site. Exterior blast cleaning or spray painting of solvent-borne paint will not be permitted when the wind velocity is more than fifteen miles per hour (15 mph).

B. Paint shall be applied by brush, spray, roller, or any combination of these methods.

C. No coating shall be applied during rain or fog, during periods of high humidity, when condensation of the cleaned surface could occur, or when conditions are present that could create the adherence of dust, debris, or insects to freshly painted surfaces.

D. Surfaces shall be primed the same day that the blast cleaning is done.

E. Each application of paint shall be thoroughly cured and subject to inspection with holiday detector. Any skips, holidays, thin areas or other deficiencies shall be corrected before the succeeding application. The surface of the paint being covered shall be free from moisture, dust, grease, or deleterious material, which would prevent the bond of succeeding applications.

F. Each coating shall be checked for the desired dry film thickness where thickness is indicated. Use a "Mikrotest" on ferro-magnetic substrates, and an "Elcometer" on non-ferrous metallic substrates. Work that does not meet the required dry film thickness, or which is uneven or blotchy, shall be recoated at the Contractor's expense, as directed by the Engineer.

G. First finish coat shall be of a different shade from second finish coat in order to evaluate and observe application of the second finish coat. The Contractor shall leave two (2) gallons of unopened finish coats of each color for touch-up.

3.3 CLEANUP

A. The Contractor shall remove all dropped and splattered paint and other stains and blemishes resulting from his operations. If such stains or blemishes cannot be satisfactorily removed from surfaces painted by the Contractor, or from existing finished surfaces, such surfaces shall be repainted or refinished at Contractor's expense in such manner that it shall match satisfactorily with the adjacent existing surfaces, and in a manner satisfactory to the Engineer.

B. The Contractor shall dispose of all latex paint wash water into the sanitary sewer. Oil based paint waste shall be properly disposed of as hazardous waste.

++ END OF SECTION ++

SECTION 09 91 03

PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Provide and install coatings on all exposed surfaces as indicated herein, in other Specification Sections, and on the Drawings.

1.2 QUALITY ASSURANCE

A. Experience: Both Coatings Manufacturer and Coatings Installer shall have a minimum 5 years' experience in production and application, respectively, of specified products. Coatings Installer shall be approved and endorsed, in writing, by Coatings Manufacturer.

B. Regulations: Meet federal, state, and local requirements which apply to the work, including, but not limited to those regulations limiting the emission of volatile organic compounds.

C. Coatings Manufacturer Recommendations: Coatings Installer shall follow all recommendations of the Coatings Manufacturer regarding storage, handling, surface preparation, application of coatings, recoat times, environmental conditions during storage, preparation and application of coatings, and all other Coatings Manufacturer recommendations.

D. Warranty: Both Coatings Manufacturer and Coatings Installer shall provide a 1-year complete replacement warranty for all coatings. Manufacturer shall provide 5-year warranty for long-term performance of coatings in addition to 1-year warranty.

1.3 SUBMITTALS

A. Shop Drawings: Coatings Manufacturer shall submit for approval the following:
   1. Copies of Manufacturer's technical information and application instructions for each material proposed for use. Specify exactly which product is being proposed for each coating type (as specified below). This may be accomplished through a reference table along with information on the various products, or by a separate, tabbed section with information on products being submitted for each system in a separate tab of a binder. Submittal of general Manufacturer's literature without detailing which product is proposed for each paint system will be unacceptable.
   2. Copies of Manufacturer's complete color charts for each coating system.
   3. Letter from the Coatings Manufacturer approving and endorsing Coatings Installer.
   4. Letter from Coatings Manufacturer stating that volatile organic compounds (VOCs) meet all Federal, State and Local requirements.
   5. Furnish copies of the final, approved submittal to the Coatings Installer so that it is clear which product is to be used for which each system.

B. Reference Samples:

1. Provide reference samples of paint colors and textures as required by the ENGINEER. Reference samples will show the color and texture of the final paint to be applied and shall be approved by the ENGINEER prior to painting. Reference samples should be applied to similar substrates to the final surfaces to be painted. If ENGINEER chooses to forego reference samples, CONTRACTOR must receive the allowance to forego reference samples before painting begins or all painted surfaces will be re-painted at the ENGINEER's discretion and at no additional cost to the OWNER.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect all pre-coated items from coating damage during shipping.

B. Store products in accordance with Manufacturer's directions.

C. Store products in a neat, orderly fashion. Protect products from damage. Protect storage area from damage from stored products.

PART 2 - PRODUCTS

2.1 PRODUCT AND MANUFACTURER:

A. Provide coating types as listed in the following table. The systems referenced in the table are those provided by TNEMEC and Sherwin-Williams. If manufacturers other than TNEMEC or Sherwin Williams are desired, the CONTRACTOR shall submit equivalent paint systems.

COATING TYPE	DESCRIPTION	Sherwin Williams Series	TNEMEC SERIES
Industrial Acrylic	Single component, high density acrylic finish for interior, exterior surfaces	Pro Industrial High Performance Acrylic	Series 1029
Polyamidoamine Epoxy	Polyamidoamine Epoxy designed for use on steel or other ferrous metals not in contact with potable water but submerged or immersed in wastewater or non-potable water.		Series V69, Hi-Build Epoxoline II
	Polyamidoamine Epoxy designed for use on steel or other ferrous metals in contact with potable water.	Macropoxy 5500	Series V140 Pota-Pox Plus

B. All coatings used shall comply with Federal, State and local VOC limits based on application location.

2.2 COLOR

A. Color Pigments: Pure, nonfading, lead-free applicable types to suit the substrates and service indicated.

B. Provide colors as described in the drawings or specifications, or as selected by ENGINEER from standard color palette. For piping system colors, reference pipe schedule.

C. Where existing colors are to be matched or satisfactory color is not available from standard color palette, provide custom-mixed colors.

D. Provide samples of each color on the substrate to be coated for approval by the ENGINEER prior to beginning coating application.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Coatings Installer shall prepare all surfaces to be painted in strict accordance with Coatings Manufacturer's recommendations.

B. Coatings Manufacturer representative shall observe Coatings Installer's methods of preparing surfaces and approve of the work prior to Coatings Installer beginning coating installation. If, after a period of time, Coatings Manufacturer is satisfied with Coatings Installers methods, Coatings Manufacturer can allow Coatings Installer to proceed without inspection following surface preparation. Coatings Manufacturer and installer will still both be held equally accountable for any coatings failure.

C. Wood surface preparation
   1. Coatings Installer shall clean and prepare all wood surfaces in accordance with the Coating Manufacturer's recommendations. Patching may be required where approved by the Engineer. All joints in wood members including trim, siding, soffits, and joints between wood and dissimilar materials shall be filled with joint sealant prior to coating.

3.2 PROTECTION

A. Protect all adjacent surfaces from overspray, dripping or other transfer of coatings not intended for those surfaces. Use masking, tape, drop cloths, plastic and other protective materials as appropriate.
   1. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, stainless steel surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted.
   2. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors, fan housings, etc. to prevent coatings from falling inside.
   3. Correct all damages by cleaning, repairing or replacing, and repainting, as acceptable to ENGINEER.

B. Completely remove all masking, tape, drop cloths, plastic and other protective materials within 48 hours of completion of application of finish coat. Take special care to remove masking and plastic which cover tank vent openings, HVAC registers, vents, motor vents, and other areas where airflow is critical to proper operation.

3.3 APPLICATION

A. Paint all exposed surfaces not specifically excluded in 3.3.C, below. Provide and install Coatings in accordance with the following Table, unless otherwise specified in other Sections:

COATING SYSTEM NO.	SURFACE TO BE COATED	PRIMER COATING	NO OF PRIMER COATS	PRIME COAT THICKNESS (EACH COAT)	FINISH COATING	NO OF FINISH COATS	FINISH COAT THICKNESS (EACH COAT)
300	Exposed Ferrous Pipe Systems and Exposed Steel Items	Polyamidoamine Epoxy	2	4-6 MDFT	Polyurethane	2	2-3 MDFT
301	Exposed, Non-metallic Pipe Systems	Exterior Latex Primer/Sealer	1	3-5 MDFT	Industrial Acrylic (Semigloss)	2	3-5 MDFT
304	Buried Ferrous and Steel Items	Polyamidoamine Epoxy	1	8-10 MDFT	Polyamidoamine Epoxy	1	8-10 MDFT

* Where in contact with potable water, coating shall be NSF-61 certified.

B. Items Delivered with Factory Applied Primer:
   1. For items delivered with a factory applied primer and requiring painting under this Section, the factory applied primer may be used in lieu of field applied primer only under the following conditions:
      a. The ENGINEER approves the use of the factory applied primer in lieu of field applied primer.
      b. The factory applied primer is certified by the Coatings Manufacturer as compatible with the field applied finish coat.
      c. The Coatings Manufacturer's recommended recoat time for the factory applied primer has not been exceeded.
   2. If all of the above conditions are not met, the Coatings Installer shall re-prepare all surfaces to be painted in strict accordance with Coatings Manufacturer's recommendations and primer applied, in accordance with this Section.

C. Table Definitions:
   1. SF/Gal: Square foot of coverage per gallon of coating used.
   2. MDFT: mil dry film thickness
   3. mil: 1/1000 of an inch paint thickness
   4. Ferrous Pipe: Includes Ductile Iron, Cast Iron, Steel, and Galvanized Steel piping
   5. Steel Items: Includes steel and galvanized steel items such as structural steel, doors, window frames, overhead coiling doors, bollard posts, steel gates, steel fences, and all other steel and galvanized steel items.
   6. Non-Metallic Pipe: Polyvinyl Chloride, Chlorinated Polyvinyl Chloride, Fiberglass Reinforced Plastic, High Density Polyethylene
   7. Exposed: Located above grade, exposed to the atmosphere not submerged. Includes surfaces inside and outside of buildings.
   8. Submerged: In an area which normally is under water or other liquid or is intermittently under water or other liquid.

9. Buried: Located below grade, surrounded by backfill.

D. Surfaces Not Requiring Painting:
   1. Unless otherwise stated or shown below or in other sections, the following areas or items will not require painting or coating:
      a. Concrete surfaces.
      b. Reinforcing steel.
      c. Copper, bronze, brass, Monel, aluminum, chromium plate, and stainless-steel surfaces, except where:
         1) Required for electrical insulation between dissimilar metals.
         2) Aluminum and stainless steel are embedded in concrete or masonry, or aluminum is in contact with concrete or masonry.
         3) Color coding of equipment and piping is required.
      d. Existing piping, fittings and pipe supports.
      e. Pipe unions or portions of piping systems where painting would make disassembly difficult or impossible.
      f. Prefinished electrical, mechanical and architectural items such as motor control centers, switchboards, switchgear, panelboards, transformers, disconnect switches, HVAC equipment enclosures, ductwork, acoustical tile, cabinets, louvers, and wall panels.
      g. Electrical conduits.
      h. Cathodic protection anodes.
      i. Insulated piping and insulated piping with jacket will require prime coat only.
      j. Fiberglass reinforced plastic (FRP) surfaces with an integral ultra-violet resistant colored gel coat do not require painting, provided the color is as selected.
      k. Glass, plexiglass or other transparent or translucent material intended to allow passage of light.
      l. Civil/site materials such as asphalt, gravel, rock, chain-link fence, and plantings.

3.4 RECOAT TIMES:

A. Coatings Installer shall observe all requirements of the Coatings Manufacturer regarding recoat times.

3.5 PAINT LOG

A. Coatings Installer shall keep a paint log
   1. Specific details of the contents and format paint log shall be determined by the Coatings Installer and approved by the ENGINEER.
   2. At a minimum, paint log shall record, on a daily basis for any day when coating work is performed:
      a. Weather conditions, including 3-day forecast
      b. Which surfaces were prepared for coating
      c. Approval of surface preparation by the Coatings Manufacturer representative
      d. Which surfaces or systems were coated that day
      e. Who the installer was (specific names of persons on crew)
      f. Which coating type was used
      g. Which coat was installed
      h. What the application rate or MDFT was (as approved by ENGINEER)

3. Paint log shall be kept on-site. Paint log shall be signed on a daily basis, for any day when coating work is performed, by the supervisor of the coatings installer field crew and by the ENGINEER.
4. Any painted surface which was not recorded in the paint log shall be stripped, re-prepared, and recoated at the ENGINEER’s discretion.

3.6 WARRANTY INSPECTION

A. Warranty inspection shall be conducted during the eleventh month following completion of the Work. All defective Work shall be repaired by the CONTRACTOR in accordance with this Specification and to the satisfaction of the ENGINEER and at the CONTRACTOR'S expense.

B. Any location where paint has peeled, bubbled, or cracked and any location where rusting is evident shall be considered to be a failure of the system. The CONTRACTOR shall make repair at all points where failures are observed by removing the deteriorated paint, cleaning the surface, and recoating or repainting with the same system. If the area of failure exceeds 25 percent of the total coated or painted surface, the entire coating or paint system may be required to be removed and repainted in accordance with this specification as determined by the ENGINEER.

C. All costs for CONTRACTOR'S inspection, Manufacturer's inspection and all costs for repair shall be borne by the CONTRACTOR.

++ END OF SECTION ++

SECTION 10 05 03

IDENTIFICATION DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Furnish and install signs, placards, and labels for safety equipment, hazards, and equipment and piping identification.

1.2 SUBMITTALS

A. Shop Drawings:
   1. Provide manufacturer's literature showing available letter sizes and styles, standard and custom colors, and standard mounting details.
   2. Provide drawings showing layouts, actual letter sizes and styles, colors, and project-specific mounting details.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHER LOCATION SIGNS

A. Material:
   1. Subsurface silkscreened graphics on a transparent acrylic sheet, 0.08" thick with Helvetica Medium alphabet and matching arrows type face.
   2. Provide 2" high upper case letters and 1" high lower case letters.

B. Fire Extinguisher Identification Sign:
   1. Provide 15"x 15" with 1" radiused corners, unframed.
   2. Provide one for each surface mounted fire extinguisher.
   3. Background color shall be red with white lettering.
   4. Signs shall incorporate a white directional arrow as located by ENGINEER.

C. Product and Manufacturer: Provide one of the following:
   1. ASI/SPE MH (Four Corners) Plaque by ASI Sign Systems, Incorporated.
   2. Or equal.

2.2 EXIT SIGNS

A. Material: Plastic, 1/8-inch minimum thickness.

B. Lettering: 6 inches high, 3/4-inch stroke, white letters on red background.

2.3 IDENTIFICATION LABELS

A. Pipe Labels and Flow Direction Arrows:
   1. Label, Lettering Color, Size and Placement: In accordance with ANSI A13.1, and as listed below.

2. Label Colors:

Fluid Service	Background Color	Letter Color
Fire quenching fluids	Safety red	White
Toxic and corrosive fluids	Safety orange	Black
Flammable fluids	Safety yellow	Black
Combustible fluids	Safety brown	White
Potable, cooling, boiler feed, and other water	Safety green	White
Compressed air	Safety blue	White

3. Label Size:

Outside Diameter of Pipe Covering, inches	Length of Color Field, inches	Size of Letters, inches
3/4 to 1-1/4	8	½
1-1/2 to 2	8	3/4
2-1/2 to 6	12	1-1/4
8 to 10	24	2-1/2
Over 10	32	3-1/2

4. Label Placement:
   a. Labels shall be positioned on the pipes so they can be easily read. Proper label placement is on the lower side of the pipe if the employee has to look up to the pipe, on the upper side of the pipe if the employee has to look down towards the pipe, or directly facing the employee if on the same level as the pipe. Labels should be located near valves, branches, where a change in direction occurs, on entry/re-entry points through walls or floors, and on straight segments with spacing between labels that allows for easy identification.
5. Material: Manufacture from or encase in outdoor grade plastic or vinyl that will resist damage or fading from washdown, sunlight, mildly corrosive atmosphere, dirt, grease, and abrasion.
6. Message: Matching "Description" per Piping Schedule.
7. Labels:
   a. Snap-Around Type: Size for finished outside diameter of pipe and insulation.
   b. For 6 Inches and Over Diameter Pipe: May furnish strap-on type fastened without use of tools with plastic or stainless steel straps.
   c. Firmly grip pipe so labels remain fixed in vertical pipe runs.
8. Manufacturers and Products:
   a. T & B/Westline, Rariton, NJ, Model WSS Snap-Around.
   b. Seton Name Plate Corp., New Haven, CT, Setmark Series.
   c. Or equal.

B. Valve and Equipment Labels:
1. Applies to valves and equipment with assigned tag numbers wherever specified.
2. Lettering: Black bold face, 3/4-inch minimum high.
3. Background: OSHA safety yellow.
4. Materials: Either of the following:
   a. Aluminum or stainless steel base with a baked-on finish that is suitable for use on wet, oily, exposed, abrasive, and corrosive areas.
   b. Fiberglass with fiberglass-encased lettering.
5. Furnish 1-inch margin on each end of label for mounting. On fiberglass labels furnish grommets at each end for mounting.
6. Size:
   a. As appropriate for lettering provided.
   b. Provide same-size labels for equipment series which are adjacent.
7. Message: Equipment names and tag numbers as used in Sections where equipment is specified and/or on Drawings.
8. Manufacturers and Products:
   a. T & B/Westline Co., Rariton, NJ; Type KQ.

b. Seton Name Plate Corp., New Haven, CT; Style EB.
c. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF SIGNS

A. Install Fire Extinguisher location signs at all fire extinguisher locations, approximately 12" above fire extinguisher mounting bracket.

B. Install Exit Signs mounted to each door which leads to the outside of the building, on the panic bar side of the door, mounted to the door approximately 5'-6" above finished floor.

C. Install all other signs at locations as shown on the drawings. Signs should be installed approximately 5'-6" off of finished floor, attached to doors where appropriate. Where two signs are indicated in the same location, signs should be mounted side-by-side, where possible.

D. Install all signs plumb and level. They shall be attached with four stainless steel screws or anchor bolts as required for substrate. Provide theft/tamper-resistant fasteners on all signs.

3.2 INSTALLATION OF PIPE IDENTIFICATION LABELS

A. Provide pipe identification label with flow arrows on all exposed piping systems as follows:
   1. At all connections to equipment, valves, tees or wall penetrations.
   2. At intervals along piping not greater than 18 feet on center with at least one label applied to each exposed horizontal and vertical run of pipe.

B. Install pipe identification labels after all painting has been completed.

3.3 INSTALLATION OF EQUIPMENT IDENTIFICATION LABELS

A. Install equipment identification labels on all equipment and valves which have been given a tag number in the Drawings or Specifications. Provide identification label which includes equipment name and tag number.

B. Where no damage will be caused to equipment, mount equipment identification label directly to equipment. Otherwise, mount equipment identification labels to concrete equipment base or wall space. Install equipment identification label such that it is clear which piece of equipment is being labeled.

C. Anchor to equipment or base for easy removal and replacement with ordinary hand tools.

++ END OF SECTION ++

SECTION 10 42 03

SAFETY EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. The following safety equipment is to be provided and installed by CONTRACTOR so that it may be integrated into OWNER's safety program for operation of the facility into which it is installed.
   2. The following safety equipment does not represent a complete package of safety equipment required to operate the facility. Refer to OWNER's safety program for all required safety equipment and procedures.

1.2 SUBMITTALS

A. Shop Drawings: Provide manufacturer's product data for each item including sizes, ratings, UL listings, OSHA certifications or other certifications, and mounting/installation information.

B. Warranty: Provide manufacturer's 5-year warranty on all products provided.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect all equipment provided from all damage until such time as it is turned over to the OWNER.

B. Safety equipment provided under this specification shall not be used by the CONTRACTOR in the construction of the facility. Safety equipment shall be turned over to the OWNER in new condition.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS

A. Provide at all locations labeled "FEXT" on Drawings.

B. Provide Fire Extinguishers which Conform to NFPA-10 and as follows:
   1. Tri-class dry chemical extinguishing agent.
   2. Pressurized, red enameled steel shell cylinder.
   3. Activated by top squeeze handle.
   4. Agent propelled through hose or opening at top of unit.
   5. For use on A, B, and C class fires.
   6. Minimum UL Rating: 4A:60B:C, 10-pound capacity.

C. Mounting Hardware:
   1. Furnish heavy-duty brackets with clip-together strap for wall mounting.

2. Use all stainless steel fasteners for attaching brackets to wall.

D. Manufacturers:
   1. Walter Kidde
   2. Master Protection Enterprises
   3. Or Equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all safety equipment per manufacturers written instructions.

B. Install fire extinguishers where "FEXT" is called out on the drawings, 48" above finished floor or adjacent grade.

++ END OF SECTION ++

SECTION 23 05 03

HEATING, VENTILATION AND AIR CONDITIONING EQUIPMENT

PART 1 - GENERAL

1.1 SERVICE CONDITIONS:

A. All units will be designed using the following outdoor design conditions:

Summer	
Outdoor Dry-Bulb Temperature	103 °F
Outdoor Wet-Bulb Temperature	68 °F
Winter	
Outdoor Dry-Bulb Temperature	26 °F

B. All units will be designed using the following indoor design conditions:

Summer	
Pump/ Mechanical Room Indoor Dry-Bulb Temperature	79 °F
Electrical Dry-Bulb Temperature	79 °F
Winter	
Pump/ Mechanical Room Indoor Dry-Bulb Temperature	60 °F
Electrical Dry-Bulb Temperature	60 °F

1.2 SUBMITTALS:

A. Complete specifications, descriptive drawings, catalog cuts, and descriptive literature that include make, model, dimensions, weight of equipment, horsepower, and electrical schematics for products and control system components specified.

B. Complete performance data that indicates full compliance with the Specifications.

C. Recommended procedures for protection and handling of equipment and materials prior to installation.

D. Manufacturer's standard finish color selection for cabinet finishes.

E. Operation and maintenance manuals.
   1. List of recommended spare parts for equipment and materials specified.
   2. Manufacturer's Certificate of Conformance for the heat pumps.

F. Equipment shall conform to requirements of California Title 24.

1.3 QUALITY CONTROL

A. Furnish 2-year warranty for all equipment.

B. Furnish special warranty of 5 years for refrigeration section compressor(s).

PART 2 - PRODUCTS

2.1 ELECTRIC UNIT HEATERS

A. General:
1. Heaters shall be of the draw-through air flow design.
2. Heaters shall be UL listed and meet the requirements of the National Electrical Code.
3. All heaters drawing in excess of 48 amps shall be provided with factory-installed subdivided and fused circuits of 48 amps or less.

B. Cabinet:
1. 22-gauge die formed steel.
2. Individual adjustable louvers with 30 degrees downward stops.
3. Metal surfaces shall be phosphate coated and covered with manufacturer's polyester powder coat finish.
4. Mounting brackets shall be compatible ceiling or wall swivel mounting.
5. Unit shall not project into room more than 8-inches

C. Heating Element:
1. Electric heating bank consisting of 80/20 Nichrome wire and copper clad steel sheath.
2. Aluminum fins.
3. Automatic reset thermal overheat protection shall be of the linear capillary type wired for instantaneous de-energizing in case of thermal overload.
4. Heating bank shall have protective air inlet louvers.

D. Fan:
1. Aluminum, directly connected to fan motor.

E. Motors:
1. Totally enclosed, designed for continuous heavy-duty all-angle operation and equipped with built-in thermal overload protection.

F. Controls:
1. Low voltage (24 volt) transformers.
2. Single Pole Internal Thermostat
   a. Temp Range: 45 to 85 deg F

G. Space Heater Information:

SPACE HEATERS: EUH

Location	Mechanical Rooms
Unit Type	Space Heater
Minimum Heating Capacity	5.0 kW
Air Delivery Rate	270 CFM
Electrical Requirements	208V/1PH

Manufacturer/Model	1. Heating Unit: a. Berko HUHAA 520SA b. Or Equal 2. Thermostat: a. HUHTA-1 b. Or Equal

2.2 WALL MOUNTED AIR CONDITIONER

A. General:
1. Unit shall be UL listed and meet the requirements of the National Electrical Code.
2. Contractor shall verify dimensions and through-the-wall mounting requirements.
3. Unit shall have minimum of 3 cooling and 3 heating speeds, with mechanical controls.
4. Four-way adjustable louver for airflow supply direction
5. Provide manufacturer or prefabricated wall sleeve with exterior louvered openings, slide out chassis type.
6. Provide fabricated galvanized wall support for installation with stainless steel hardware.
7. Electrical: 115V/1Ph
8. Minimum Energy Efficiency Rating of 9.5.

2.3 WALL MOUNTED EXHAUST FAN

A. General: Provide steel wall-mounted exhaust propeller fan with thermostat control and thermostat bypass switch for on/off only control.

B. Performance:
1. Continuous operating temperature from -10° F to 130° Fahrenheit
2. Propeller shall be statically and dynamically balanced in accordance with AMCA Standard 204-05
3. The propeller and fan inlet shall be aligned and shall have precise running tolerances for maximum performance and operating efficiency
4. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing, fan performance, the model number and individual unit serial number

C. Propeller:
1. Propeller shall be constructed of cast aluminum tapered airfoil blades and cast aluminum hubs
2. Propeller shall be securely attached to motor shaft with a standard square key, set screw and tapered bushing

D. Motor:
1. Motor enclosure shall be Open type
2. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable.
3. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase
4. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.

5. Motor shall be speed controllable with factory mounted equipment set for 2 speeds as noted on schedule.

E. Damper:
   1. Aluminum gravity type balanced for minimal resistance to flow.

F. Coating:
   1. Coating shall be provided to protect from environmental conditions.

G. Accessories:
   1. OSHA Motor Side Guard
   2. Weather hood kit with bird screen, 45-degree angle, aluminum material, matching coating

H. Controls:
   1. Provide control dial for balancing located on interior side
   2. Provide thermostat controller compatible with exhaust fan, unless otherwise noted.
   3. Provide barometric pressure controller as noted in fan schedule.
   4. Provide adjustable speed controller for 2 speed fans as noted on schedule
   5. Provide Manual ON/OFF switch for continuous operation of fan as noted on schedule

I. Manufacturer:
   1. Loren Cook
   2. Greenheck
   3. Or Approved Equal

2.4 FIXED LOUVERS

A. Furnish heavy gauge fixed blade louvers where shown and with the dimensions and shapes shown on Drawings. Louvers shall be designed for intake and exhaust while providing maximum resistance to water penetration due to wind-driven rain.

B. Fixed Louver Construction:
   1. Louver shall be constructed from extruded aluminum, alloy 6063-T5.
   2. Louver shall be 4 inches thick.
   3. Frame and blades shall be 0.081" thick.
   4. Louver shall be shaped and dimensioned as shown on the drawings.
   5. Install aluminum louver screen on interior side of the louver.
   6. Finish: Kynar 500 fluorocarbon coating, dark brown color, or equal.

C. Fixed Louver Design:
   1. Free Area: Minimum 52% net free area. Provide AMCA test data to show a 4'x 4' unit with a minimum of 8.4-square feet free area.
   2. Pressure Loss: AMCA certified rating of no greater than 0.10-inch WC at 750 fpm.
   3. Provide louver supports designed to carry 25 psf wind load.
   4. Louvers to be designed for air flow in either direction.
   5. Louvers to provide protection from water penetration due to wind-driven rain. Provide test results, per AMCA standard 511, which show that the louver being provided has the following performance characteristics:
      a. 99% effectiveness at preventing water penetration of 0.01 oz of water per square foot of louver free area at 690 fpm free area velocity.

D. Manufacturers and Products:
   1. Greenheck ESJ-401
   2. Or equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment and systems in accordance with manufacturers' instructions.

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SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to perform the testing, adjusting and balancing of HVAC systems.

1.2 QUALITY ASSURANCE

A. Balancer's Qualifications:
   1. Submit biographical data on employee proposed to directly supervise the testing, adjusting and balancing Work.
   2. Submit proof of certification by NEBB (National Environmental Balancing Bureau), AABC (Associated Air Balance Council), or SMACNA (Sheet Metal and Air Conditioning Contractors' National Association), proof of registration in the State of Arizona and a record of at least five years experience in the testing and balancing contracting industry, engaged in heating, ventilating and air conditioning (HVAC) Work.

1.3 SUBMITTALS

A. Data Forms:
   1. Submit data forms on each item of testing equipment required. Include name of device, manufacturer's name, model number, latest date of calibration, and correction factors.
   2. All field data pertaining to each item of equipment being tested must be tabulated and submitted on the standard forms of NEBB, AABC, or SMACNA.
   3. Testing agency shall sign and date each form in the space provided and proof of certification shall accompany the final report.

B. Report Forms:
   1. Submit example copies of report forms for ENGINEER'S approval.
   2. Forms shall be 8-1/2 by 11-inch paper for loose-leaf binding, with blanks for listing of the required test ratings and for certification of report.
   3. Reports shall be on the organizations approved forms imprinted with the company's name.
   4. Certified report outlining procedure used to balance the system and the types of measuring devices used.

C. Test results shall be submitted on approved forms in a typed format.

D. Submit certified copies of required test reports to the ENGINEER for approval.

1.4 JOB CONDITIONS

A. Heating, ventilating and air conditioning equipment shall be completely installed and in continuous operation as required to accomplish the testing, adjusting and balancing Work specified.

B. Testing, adjusting and balancing shall be performed when outside conditions approximate design conditions indicated for heating and cooling functions.

1.5 OPERATING INSTRUCTIONS

A. Reports shall be certified by CONTRACTOR verifying that the methods used and the results achieved are as specified.

1.6 CORRECTIVE ADJUSTMENTS

A. Should corrective measures caused by faulty installation require retesting, adjusting and balancing, such Work shall be performed by CONTRACTOR, at no additional cost to the OWNER.

B. Inspections:
   1. Fan Belt Deflection: No less than 1/4-inch or more than a 1/2-inch.
   2. Finned Coils: Fins shall be combed out with a fin comb for appropriate fin spacing. Helical fins shall be straightened with blunt bladed instrument.

PART 2 - PRODUCTS

2.1 BALANCING INSTRUMENTATION

A. Provide all necessary instrumentation, tools, ladders, etc. to complete all air balancing, tests and adjustments.

B. Instrumentation shall be in accordance with NEBB, AABC, or SMACNA requirements and shall be calibrated to the accuracy standards stipulated by these organizations.

C. Flow-measuring hoods (manufactured, not fabricated) shall be acceptable for measurement of ceiling diffuser performance only.

D. Assume full responsibility for safe keeping of all instrumentation during the course of the Work.

PART 3 - EXECUTION

3.1 GENERAL

A. Testing, adjusting, and balancing of air systems shall be performed in compliance with the standard procedure manual published by the testing, adjusting, and balancing

organization affiliated with CONTRACTOR. Submit one copy of the standard procedure manual to the ENGINEER for record purposes only.

B. Sole responsibility for the protection and safeguarding of the Work and providing every protection against accidents, injury, and damage to persons and property belongs to CONTRACTOR.

C. Keep dust, dirt, and debris to an absolute minimum and reinstall all removed ceiling components to their original positions at the end of each day.

D. Full responsibility for removal and reinstallation of ceiling system and replacement of any component damaged belongs to CONTRACTOR.

E. Install additional access panels, at no additional cost to the OWNER, as required to gain access to equipment concealed above ceilings, behind walls, or any other concealed space.

F. Air systems shall be tested, adjusted, and balanced with clean filters.

3.2 INSPECTION

A. Pre-Startup Inspection:
   1. Verify proper equipment mounting and setting.
   2. Verify that control, interlock and power wiring is complete.
   3. Verify alignment of motors and drives.
   4. Verify proper piping connections and accessories.
   5. Verify that lubrication is completed.

B. First Run Observations:
   1. Verify direction of rotation.
   2. Verify setting of safety controls.
   3. Monitor heat build up in bearings.
   4. Check motor loads against manufacturer’s nameplate data.

C. Equipment Check:
   1. Verify proper overload heater sizes.
   2. Verify function of safety and operating controls.
   3. Verify proper operation of equipment.
   4. Report on inspection, observation and checking procedures.

3.3 AIR SYSTEMS

A. Preliminary:
   1. Identify and list size, type and manufacturer of all equipment to be tested, including air terminals.

B. Central Systems:

1. Test rpm for all equipment, including adjustment to each fan and air handling unit, and air conditioning unit to design requirements within the limits of mechanical equipment provided.
2. Adjust or change drive sheaves as required to adjust actual cfm to scheduled cfm.
3. Test and record motor voltages and running amperes, including motor manufacturer's nameplate data, and starter heater ratings for each unit as listed above.
4. Make Pitot tube traverse of main supply, exhaust and return ducts, determine cfm at all fans and units and adjust fans and units to within five percent of design requirements.
5. Test and record system suction and discharge static pressure.
6. Test and adjust system for design outside air, cfm.
7. Test and adjust system for design recirculated air, cfm.
8. Test and record heating apparatus outdoor entering air temperatures, dry bulb.
9. Test and record heating apparatus return air temperatures, dry bulb.
10. Test and record heating apparatus mixed air temperatures, dry bulb.
11. Test and record heating apparatus leaving air temperatures, dry bulb.
12. Test and record cooling apparatus outdoor entering air temperatures, dry bulb and wet bulb.
13. Test and record cooling apparatus return air temperatures, dry bulb and wet bulb.
14. Test and record cooling apparatus mixed air temperatures, dry bulb and wet bulb.
15. Test and record cooling apparatus leaving air temperatures, dry bulb and wet bulb.
16. Record all fan and air handling unit speeds.
17. Record air quantity delivered by each fan and air handling unit.

C. Distribution:
1. Adjust volume dampers, control dampers, splitter dampers, air extractors, etc. to proper design cfm in main ducts, branch ducts, and zones.

D. Air Terminals:
1. Identify each air terminal as to location and determine required flow reading.
2. Test and adjust each air terminal to within tolerance of design requirements as listed below:
   a. Diffusers and Supply Registers: 0 percent to +10 percent.
   b. Return Registers: 0 percent to -10 percent.
   c. Exhaust Registers: 0 percent to -10 percent.
3. Test procedure on air terminals shall include recording comparison of required cfm and observed cfm, adjustment of terminal, and recording of final cfm.
4. Adjust flow patterns from air terminal units to minimize drafts to extent design and equipment permits.

E. Verification:
1. Prepare summation of readings of observed cfm for each system, compared with required cfm, and verify that duct losses are within specified allowable range.
2. Verify design cfm at fans as described above.
3. If the air systems are not properly balanced, rebalance and recheck all data in the presence of ENGINEER and as approved by the ENGINEER.

3.4 AUTOMATIC CONTROL SYSTEM

A. In cooperation with the control manufacturer's representative, set and adjust automatically operated devices to achieve required sequence of operations.

B. Verify all controls for proper calibration and operation and list those controls requiring adjustment by control system installer.

3.5 MANUFACTURER'S SERVICES

A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of 2 visits, minimum 4 hours on-site for each visit, to the site. The first visit shall be for assistance in the installation of equipment. The second visit shall be for checking the completed installation and start-up of the system and instruction of Operations and Maintenance Personnel. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the equipment and controls conform to requirements. Representative shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. All costs, including travel, lodging, meals and incidentals, shall be considered as included in CONTRACTOR'S bid price.

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SECTION 26 00 10

ELECTRICAL GENERAL

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The following list of components and areas of work is a summary of the work required in the drawings and specifications. The list is not comprehensive of the total work required nor is it in any specific order. It is merely being provided as an aid to the bidder. Work not listed herein, but described in the plans or specifications, is also part of the overall scope of work.

1. Two pump stations including electrical systems, equipment, services, programming, and start-up.

2. Utility Metering Systems, Main Disconnect, Generator Breaker, Distribution Section, Transfer Switch, panelboard and transformer.

   a. Circuit breakers with electronic trip units for those breakers above a specified voltage and current trip level.

3. Pump control panels.

4. Standby Engine Generators.

5. Control panel(s).

6. Control System programming, configuration, and testing for automated control of the facility.

7. Communications system. Contractor to coordinate, configure, test, and place communications system(s) into operation.

8. Electric Gate Controls

9. Video Camera system

   a. Install system per manufacturer instructions with DVR within the communication panel.

   b. Setup, configure, and test system for operation per manufacturer instructions.

   c. Connect to existing site internet service, Coordinate with City for connection.

10. Instrumentation

a. Furnish NSF/ANSI 61 certified products that have undergone testing for any device, valve, instrument, or assembly that will come into contact with drinking water.

b. Mounting supports or other accessories as detailed and as recommended by the instrument manufacturer for the application.

c. Contractor shall calibrate, configure and test all instrumentation and document results.

11. Conduit – support systems, wire, and grounding system, for equipment interconnection, and operation.

12. All necessary process piping, shut off, sample and calibration valves, drains, pressure reducers and calibration equipment for connection of instrumentation.

13. Trenching, backfilling, compaction and resurfacing for all new underground conduit routes, concrete pads, and pull boxes.

14. Coordination and equipment for connection of power utility and telephone services per utility drawings and standards.

15. Site electrical devices, lights and receptacles.

16. Seismic Anchorage Design Calculations and conforming installation.

17. System startup, calibration, testing and documentation.

a. Complete factory and field testing per specification section [Factory and Field Testing] and as defined herein.

1) Complete start-up and configuration of all components

2) Complete testing documentation and submit for record.

b. The Contractor shall facilitate test as outlined herein such that hardware, software and application programming are tested completely and all applicable test documentation is completed.

c. The Contractor shall assume that a minimum of 80 hours will be required to assist in this task.

B. Demolition and waste of existing electrical equipment to be replaced.

C. Electro-mechanical equipment to be installed in this project may be specified in other divisions but will interface to equipment provided under Electrical Specifications. Obtain submittals for those devices, review, coordinate and provide all interfacing equipment, software, communications, I/O, and testing to integrate the equipment to the extent possible and as intended.

D. Install electrical and control portion of electro-mechanical equipment specified in other sections. Reference those specifications, pertinent details, and follow all manufacturer instructions to erect, install and commission equipment. Furnish all electrical equipment, interconnecting wire, and make connections to place equipment in operation.

E. All electrical equipment and materials, and methods - including installation, calibration, and testing - shall conform to the applicable codes and standards listed in this and other Sections. All electrical materials and work shall conform to published standards of the National Electric Code (NEC) current issue, Institute of Electrical and Electronic Engineers (IEEE), and Underwriters Laboratories Inc (UL).

1.02 RELATED SPECIFICATIONS

A. The following specification sections are part of the [Electrical Specifications].

Section	Description
26 01 10	Conduit and Boxes
26 01 20	Low Voltage Wire and Data Cable
26 32 13	Engine Generator
26 36 23	Automatic Transfer Switch
26 44 13	Low Voltage Switchboard
26 44 50	Grounding
26 44 70	Panelboard and Power Transformer
26 44 81	Variable Frequency Drive
26 66 00	Factory and Field Testing
26 79 05	Control Panels
26 79 10	PLC & OI Hardware
26 79 15	PLC & OI Applications Programming
26 89 40	Instrumentation

B. Owner, Engineer, Construction Manager, and City are used within Electrical Specifications and are interchangeable. They are all representatives of the Owner, in this case, the City of San Bruno.

1.03 QUALIFICATIONS AND REQURIED WORK SCOPE

A. Electrical Contractor

1. Management and installation of the entire electrical and control system (including stand-by generator) required for this project shall be by an Electrical Contractor meeting qualifications as defined herein.

a. Contractor shall be capable of looking at electrical equipment submittals, prior to installation, comparing hookup

requirements to the drawings, and noting any deficiencies.

2. Electrical Contractor shall select, furnish, and install all commodity electrical materials (conduit, wire, supports, fittings, ductbanks, etc) that are generally not "custom" or uniquely manufactured for this project. Custom electrical panels, controls, and instrumentation shall be furnished by Systems Integrator.

3. Shall be competent in and familiar with management and subcontracting of specialty electrical and instrumentation supply and engineering work as requires of a Systems Integrator as described herein.

4. Electrical Contractor must be competent in performance, supervision and coordination of work required and performed by equipment suppliers and Systems Integrator (Subcontractors).

5. The Electrical Contractor (EC) shall meet the following minimum qualifications:

    a. Has a current C10 Electrical Contractor's License issued by the State of California Department of Consumer Affairs.
    b. EC shall be regularly engaged in similar industrial power and controls electrical contracting for the Water and Wastewater Industry.
    c. EC shall have successfully performed work of similar or greater complexity (as measured in contract value on industrial power and controls projects) on at least three (3) previous projects.
    d. EC shall carry all insurances as defined and required by the special provisions and as required by law.
    e. EC shall be competent in methods and materials execution and selection associated in the type of electrical and instrumentation work specified in this Division.
        1) EC shall be familiar with and understand codes and requirements from NFPA70, NFPA110, and all other governing national or local codes as required for work scope as described in the drawings and specifications.
        2) EC shall know and understand common terms and abbreviations used in this Industry. Not all terms and abbreviations will be defined in the drawings and specifications.
    f. EC shall comply with State law which requires that all personnel installing electrical components are certified by the State of California as "Electrician" or "Electrician Trainee." Apprentices may install electrical components only under direct supervision of a certified Electrician.

B. System Integrator

1. Systems Integrator shall be a supplier to the Electrical Contractor and must be competent in performance, supervision and coordination of

work required in this contract.

2. This includes, but is not limited to, all work necessary to select, furnish, construct, supervise installation, configure, calibrate, test, and place into operation all transmitters, instruments, programmable controllers, control panels, motor controls, alarm equipment, communications, monitoring equipment, and accessories.

3. The System Integrator shall have on staff a Project Engineer with three years prior experience on similar sized projects. This Project Engineer shall coordinate the technical aspects of this project and prepare the submittals and drawings. The Project Engineer shall attend all coordination meetings when specifically requested by the Engineer.

4. The System Integrator (SI) shall meet the following minimum qualifications:

    a. SI shall be regularly engaged providing electrical and control systems for the Municipal Water and Wastewater Industry.
    b. SI shall have an Electrical Engineer on staff registered in the State of California as a Professional Engineer.
    c. SI shall be capable of labeling all electrical panels as manufactured or customized by the System Integrator with appropriate Underwriters Laboratories (UL) label prior to factory testing or shipment to project site.
    d. SI shall have successfully completed work of similar or greater complexity and on similar facilities on at least ten previous projects under the present company name.
    e. SI shall be actively engaged in the following disciplines for the last 5 consecutive years.
        1) Design and manufacturing of custom Control Panels, Motor Controls Centers, and associated devices and equipment as specified in this division.
        2) Programming and commissioning of SCADA, PLC and Operator Interface hardware.
        3) Instrumentation - selection, purchase, calibration, start-up and commissioning.
        4) Testing, calibration, start-up, and commissioning of control systems as applied to the Water and Wastewater industry.
    f. SI shall employ personnel on this project who have successfully completed ISA or equal training courses on general purpose instrumentation.
    g. SI shall have a permanent, fully staffed and equipped service facility within 200 miles of the project site for a minimum of 1 year prior to bid date with personnel and equipment required to maintain, repair and calibrate the instrumentation system.

5. The companies listed below have been determined to meet the minimum qualifications specified in this Section and are pre-qualified for performing work as System Integrators on the project. Other

System Integrators may submit a statement of qualifications, proving requirements above, and listing relevant project experience on similar completed projects. Include project references with phone numbers including the Owner, Engineer and Electrical Contractor. See submittals section of this specification section.

a.	Tesco Controls, Inc.	(916) 395-8800
b.	Primex Control Systems	(707) 449-0341
c.	Telstar, Inc.	(925) 671-2888
d.	Technical Systems, Inc (TSI)	(707) 678-4444

C. Application Programmer

1. The Applications Programmer will be furnished by System Integrator or by Contractor as a separate unique supplier.
2. Applications Programmer must be competent in performance, supervision, and coordination of work required in this contract in order to facilitate construction and not cause delays to the main construction contract.
3. This includes, but is not limited to, all work necessary to configure, test, troubleshoot, and place into operation SCADA system, Operator Interface, and programmable controller.
4. The Application Programmer work is limited to programming and configuration, and associated startup and testing services of the PLC, Operator Interface, SCADA,and communications devices. All other work is by Contractor.
5. The Application Programmer shall have on staff a PLC Programmer with no less than seven (7) years prior experience performing new installation PLC programming on water and wastewater projects.
6. The Application Programmer shall have on staff a SCADA Programmer with no less than five (5) years prior experience performing new installation SCADA configuration and programming on water and wastewater projects.
7. The PLC Programmer shall be the lead project manager for the Application Programmer and shall coordinate the project onsite installation and testing work and prepare the control descriptions and Drawings. The Project Engineer shall attend all coordination meetings when specifically requested by the Engineer.
8. The PLC Programmer and the SCADA programmer shall not be the same person and both shall be continuous staff of the Application Programmer. A minimum of 2 persons shall be required to perform Application Programming over the duration of the project.
9. The following company shall be retained by the Contractor as Application Programmer on this project. The Owner intends to use them due to their familiarity with the plant and proven capabilities on the type of work required on this and on similar projects. No other Application Programmers will be considered for this project.
   a. EDDCO Group (650) 637-2232

1.04 CONTRACT DOCUMENTS

A. The resolution of conflicting information within the contract electrical

documents shall put precedence on electrical drawings over that of electrical specifications.

B. The following specifications may incorporate specific equipment or materials that do not have equal equipment listed. These items are standards because of their familiarity, serviceability, and/or spare parts inventory. However, equal alternate equipment or materials (noted in the submittal cover letter) will be considered for use on this project if submitted. The Engineer may reject said equipment for the purpose of adherence to standards.

C. Contract drawings are diagrammatic and indicate general arrangement of systems and equipment.

1. Exact locations and layouts of electrical products shall be defined during submittal, assembly, or field fit during construction. Field measurements take precedence over dimensioned drawings. Drawing intent is to show initial size, capacity, approximate location, orientation, and general relationship of equipment in area shown but may not show exact detail or arrangement.

2. However, when materials, locations, sizes, or methods are specifically dimensioned, detailed or noted, the drawings shall take precedence over electrical specifications in the event of conflict. In no case, is NEC, UL, or other applicable governing standards to be overridden.

D. The Contractor shall examine the architectural, mechanical, structural, and electrical and instrumentation submittals and equipment furnished under other specifications divisions in order to determine conduit routing, stub-up locations, and final terminations for all conduits and cables. Conduits shall be stubbed up as near as possible to equipment electrical terminals. The exact locations and routing of cables and conduits shall be governed by structural conditions, physical interferences, and the physical location of wire terminations on equipment.

E. All equipment shall be installed and located so that it can be readily accessed for operation and maintenance. If accessibility appears to be compromised, the location of equipment or stub ups shall be modified to the extent possible.

F. Where conduits are shown on the Drawings, or stated to be furnished but not explicitly shown, as part of the scope of work; the Contractor shall provide all fittings, boxes, wiring, etc. as required for completion of the raceway system in compliance with the NEC and the applicable specifications in this Section.

G. No changes from the Drawings or specifications shall be made without written approval of the Engineer. Should there be a need to deviate from the Contract documents, submit written details and reasons for all changes to the Engineer for review.

H. When documents are changed, they shall be marked with erasable colored pencils using the following coloring scheme:

Additions - red
Deletions - green
Comments - blue
Dimensions - black

I. Prior to final acceptance of the work, the Contractor shall deliver to the Engineer one set of record full size drawings neatly marked accurately showing the information required above.

1.05 UTILITY COORDINATION AND FEES

A. All fees and charges of the Power Utility, Pacific Gas & Electric (PG&E), for design and final connection will be paid by others.

B. Coordinate all work with the Utility for the work shown on Contract Drawings.

1. Unless already completed, apply for electric service within 10 working days from Notice to Proceed.

2. Coordinate and meet with the Utility's Representative at the project site(s) within 30 days after award of contract.

3. Coordinate and obtain required inspections prior to backfill. Make corrections to installation as required.

4. Coordinate connection and date of service with Utility. Utility back-charges due to mis-coordination or installation problems will be Contractor responsibility to pay and correct.

C. Furnish and install electric service in accordance with the serving Utility's requirements.

1. The contract plans show the preliminary design for the Utility installation. Slight changes required by the Utility do not constitute extra work unless cost impacts in material and labor exceed $5000. In that event, the agreed excess amount will be allowed as a contract change.

2. The Contractor shall provide and install service entrance equipment, all material, conduits, wiring, pull ropes, pole risers, transformer pads, bollards, etc. as shown on Utility design drawings and standards for new power service. Utility standards are available upon request from the Utility or for download from the Utility's website.

3. The Utility will provide and install primary wire, transformer, meter, and connections.

D. Following award of Contract, schedule all service installations and connections with utilities. Construction or start-up delays as a consequence to lack of documented effort by the Contractor which delay the project completion due to lack of Utility services will not be considered valid and Contract liquidated

damages may be assessed.

1.06 PROJECT COORDINATION

A. Prior to submittal, the Electrical Contractor shall coordinate with equipment suppliers to verify sizes, mounting, connections, storage, and delivery of equipment. If there are any issues whereby the solution will be in conflict with plans and specifications, or that are undefined and need direction, they shall be brought to the attention of the Engineer or Construction Manager via the RFI process.

B. Where connections must be made to existing or new operational facilities, the Contractor shall schedule all the required work with Engineer, including the power shutdown period. Carry out each shutdown so as to cause the least disruption to the operation of the installation.

1. The Contractor shall limit all unscheduled shutdown periods to less than 15 minutes and only with prior approval of the Station operator.

2. Carry out shut downs of durations greater than 15 minutes only after the time and date schedule and sequence of work proposed to be accomplished during shutdown has been favorably reviewed by the Engineer. Submit shutdown plans at least 2 days in advance of when the scheduled shutdown is to occur.

3. Provide temporary power to all existing facilities utilizing a portable generator. The generator shall be utilized for all shutdowns that exceed 15 minutes and run continuously for the duration of the primary power shutdown. All cost for operating the generator including equipment, fuel and labor shall be provided.

4. The Engineer reserves the right to delay, change, or modify any scheduled shutdown at any time, at no additional cost to the Owner, when the risk of such a shutdown would jeopardize the operation of the water distribution system and/or water plant operation.

1.07 SUPERVISION

A. The Contractor shall schedule all activities, manage all technical aspects of the project, coordinate submittals and drawings, and attend all project meetings associated with this Section. The Contractor shall coordinate and confirm that the project schedule is being adhered to and all work is being completed within the scheduled time frames.

B. The Contractor shall supervise all work in this Section, including the electrical system general construction work, from the beginning to completion and final acceptance.

C. The Contractor shall coordinate, obtain, prepare, and/or complete the documentation required within this division. All documentation shall be complete and delivered prior to final acceptance.

1.08 INSPECTIONS

A. General

1. Contract work or materials shall be subject to inspection at any time by the Engineer. If equipment, material, or installation method does not conform to the Contract documents, or does not have a favorably reviewed submittal status and has been determined to be unsatisfactory by the Engineer, then the Contractor shall remove said material from the premises; and if said material has been installed, the entire expense of removing and replacing same, including any cutting and patching that may be necessary, shall be borne by the Contractor.

2. The Engineer may inspect and test the fabricated equipment at the factory before shipment to job site. See Electrical Specifications [Factory and Field Testing] for requirements.

3. Work shall not be closed in or covered over before inspection and approval by the Engineer. All costs associated with uncovering and making repairs where non-inspected work has been performed shall be borne by the Contractor.

4. The Contractor shall cooperate with the Engineer and provide assistance at all times for the inspection of the electrical system under this Contract. The Contractor shall remove covers, provide access, operate equipment, and perform other reasonable work which, in the opinion of the Engineer, will be necessary to determine the quality of the work.

B. Milestones requiring inspection and signoff.

1. Underground conduit and grounding system complete. Do not cover any portion of conduit prior to inspection. Conduits must be labeled with temporary tags per Electrical Specifications [Conduit and Boxes] and [Grounding].

2. Factory testing. Coordinate test date with Engineer 2 weeks prior to test scheduled date.

3. Installation of electrical equipment. Equipment is anchored in place, conduit connections are complete, no wire is yet pulled into conduit. Permanent conduit tags must be in place per Electrical Specifications [Conduit and Boxes] and [Grounding].

4. Wire termination complete. Do not energize equipment. All wire tags must be installed and wires terminated per Electrical Specifications [Low Voltage Wire and Data Cable]. Pre-energization testing to commence after inspection.

5. Punch list – final inspection. Schedule final walkthrough with Engineer one week prior to intended project completion date. All items on

punchlist must be complete prior to scheduling walk-through.

1.09 JOB CONDITIONS

A. Construction Power and Telephone Service

1. The Contractor shall coordinate, furnish and install, temporary utility services required during construction of the project, such as temporary electrical power and telephone service. Temporary services shall be installed in accordance with the applicable codes and regulations of the serving utilities.

2. Upon completion of the project, remove temporary services. All equipment and material shall be the property of the Contractor.

B. Equipment Storage

1. The Contractor shall provide adequate protection for all equipment and materials during shipment, storage and construction.

2. Equipment and materials shall be completely and sufficiently sealed and covered and set on a pallet above grade so that they are protected from weather, wind, dust, water, or construction operations.

3. Equipment shall not be stored outdoors. Where equipment is stored or installed in an area with susceptibility to moisture, such as unheated buildings, untested piping, etc., provide an acceptable means to prevent moisture damage, such as plastic cover and a uniformly distributed heat source to prevent condensation.

C. The project site is located where outside temperatures vary between 10 deg F. to 110 deg F. Humidity in this area will range from 10% to 100%.

1.10 AREA CLASSIFICATIONS

A. Area classifications are shown on the site electrical plans. The area enclosed by walls or the entire drawing area shall be classified as shown unless otherwise described in notes.

B. All electrical equipment, enclosures, conduit, and supports shall be formally rated for or, at minimum, meet the intent of the rating as interpreted by Engineer.

C. If no area classification rating is shown on the drawings, classification shall default to a NEMA 12 rating for indoors, and NEMA 4 rating for outdoors (non corrosive) and NEMA 4X for corrosive areas both indoors and outdoors.

1.11 SUBMITTAL REQUIREMENTS

A. General

1. Requirements described herein are specific to electrical submittals and are secondary to those described in other general specifications sections. Any additional requirements described here that are beyond those described in those sections shall be provided as described. Conflicts shall be resolved by giving priority to general specifications.

2. The Contractor shall ensure that the System Integrator and/or equipment suppliers provide the submittal documentation required in this section. Submittals shall be neat, orderly, complete (without un-needed parsing), and indexed.

    a. Like equipment shall be submitted complete in a single submittal. For instance, all general electrical materials shall be in a single submittal. All instrumentation, all control panels, or all MCCs and so on shall be submitted complete where possible.

    b. Submittals that are broken down without sufficient cause will be rejected for future inclusion into a combined submittal.

    c. Do not separate submittals by area.

    d. Do not separate submittals by specification division unless agreed to in advance.

    e. Submittals for work scope covered in this contract are expected to be as follows. This list is intended to be a guideline and not to be specific of all submittals required. Project circumstances or leadtimes or availability will each impact the order and division of submittals.

        1) General electrical materials – conduit, wire, labels, etc.
        2) Power Distribution and Motor Controls
        3) PLC and Control Panels
        4) Engine Generator
        5) Seismic Calculations
        6) Instrumentation
        7) PLC Programming
        8) Factory and Field Testing forms and procedures
        9) O&M Manuals

3. The Contractor shall coordinate submittals with the work so that project will not be delayed. This coordination shall include scheduling the different categories of submittals, so that one will not be delayed for lack of coordination with another. Time extensions will not be allowed due to failure to properly schedule submittals.

4. No material or equipment shall be delivered to the job site until the submittal for such items has been reviewed by the Engineer and marked "no exceptions noted" or "make corrections noted".

5. The equipment specifications have been prepared on the basis of the equipment first named in the Specifications. The Contractor shall note that the second named equipment, if given, is considered acceptable

and equal equipment, but in some cases additional design, options, or modifications may be required to meet Specifications or functional installation.

6. Exceptions to the Specifications or Drawings or equipment or procedures submitted as "equal" to specified equipment shall be clearly identified in a letter at the front of the submittal. Submittal data for "equal" equipment or procedures shall contain sufficient details so a proper evaluation may be made by the Engineer. The Contractor is responsible for verifying proper application/operation of substituted equipment.

7. The opinion of the Engineer will be the final determination whether a substitution request meets the design intent.

8. Deviations from the Contract documents shall **not** be incorporated into the work without prior written approval of the Engineer. A "Change Order" directive from the Engineer is required prior to incorporating any deviation from the Contract documents that has costs associated. The cost differential associated with this change order must be negotiated with the Owner to amend the Contract to reflect the costs or savings.

B. Electrical Equipment -- Submittal data shall be grouped by equipment type. Each submittal shall be as complete as possible covering the entire project and scope of supply. Drawings or equipment submitted individually that are not on the critical path will not be accepted for individual review. The electrical submittals shall include (as a minimum):

1. Table of Contents

2. Comment Letter: The Project Engineer of the System Integrator shall note all deviations from Contract Documents and the reason(s) for the deviation. They may use this forum to inform the Engineer or installing Contractor of important information related to the project. RFIs must be submitted separately. Re-submittals shall include written responses to every comment provided by the Engineer during the previous review.

3. Bill of Materials: The Contractor and System Integrator each shall provide Bill of Material for electrical components formatted as shown below. Generic names or part numbers as defined by a distributor or Integrator are not acceptable. Only the originating manufacturer's name and part number shall be listed. Provide separate bill of materials for each panel, MCC, instrument list, etc.

Bill of Material

Item #	Qty	Tag#	Description	Manufacturer	Part #

4. Shop Drawings:

   a. Equipment elevations with enclosure details drawn to scale or dimensioned with relative scale.
   b. Electrical One-line, Elementary, and wiring diagrams
   c. PLC I/O wiring diagrams

5. Catalog Data shall include the following: (features and options shall be highlighted, circled, or "arrowed.")

   a. Instrumentation data summary sheets (by Contractor)
   b. Manufacturer's technical information brochure
   c. Physical size and mounting details and illustrations
   d. Calibration Range
   e. Input/output signals
   f. Electric power, air, and/or water supply requirements.
   g. Options selected and available (Cross out items not included)
   h. Materials of construction of components

C. Shop Drawings - Shop drawings shall be numbered in sequence. Blank drawings or drawings that contain no specific project data will not be accepted for review.

All drawings shall be generated with a computer utilizing AutoCAD or similar drafting program. Drawings shall be no smaller than 11" x 17". The lettering shall be legible and no smaller than 0.75 inch in height.

Drawings shall be custom prepared for this project and shall have borders and a title block identifying the project, manufacturer, system or location, drawing number, drawing title, AutoCAD file name, project engineer, date, revisions, and type of drawing. Diagrams shall carry a uniform and coordinated set of wire colors, wire numbers, and terminal block numbers. The shop drawings shall include the following as a minimum:

1. Electrical one-line diagrams detailing all devices associated with the power distribution system. The following applicable information or data shall be shown on the one- or three- line diagram: location, size and amperage rating of bus; size and amperage rating of wire or cable; CPT wattage, breaker ratings, number of poles, and frame sizes; power fail and other protective devices; fuse size and type.

2. Detailed analog and digital I/O diagrams showing the wiring requirements for each instrument or device connection. Reference the Drawings for an example of each I/O card drawing requirements. If one is not included in the Drawings, then one may be obtained from the Engineer upon request.

3. Elementary (wiring) diagrams shall be provided for all relay logic, programmable logic controls, motor controls, power supplies, and other wiring. All elementary (wiring) diagrams shall be drawn in JIC EMP/EGP format and standards showing ladder rung numbers and coil

and contact cross referencing numbers.

4. Equipment exterior and interior scaled drawings of front, side, elevation, deadfront, front panel devices, and backpan components. Show fabrication methods and details; including material of construction, paint color, door latch and lock, and ventilation system. Show shipping split locations and offloading information. Submit base plan showing allowed conduit entrance areas and bolt hole locations.

5. Drawings shall show UL required information as needed to UL label the equipment in accordance with UL procedures for label applied.

6. Submit full size drawing of all nameplates and tags, as specified herein, to be used on project. Submittal to include the following:

   a. Dimensions of nameplate.
   b. Exact lettering and font for each nameplate.
   c. Color of nameplate.
   d. Color of lettering.
   e. Materials of construction.
   f. Method and materials for attachment.
   g. Drawing showing location of nameplates on each, panel and enclosure.

D. Seismic Anchor Design Calculations

1. All switchgear, motor controls centers, transformers, cabinets, raceways, supports, and electrical materials shall be so installed as to remain in a secure and captive position when subjected to a horizontal force in accordance with the current, applicable, and more stringent of California Building Code (CBC) or International Building Code (IBC) requirements. Method of securing shall constrain equipment against both vertical and horizontal forces and overturning forces.

2. Calculations as prepared by a structural engineer registered in the State of California shall be submitted in accordance with code requirements for earthquakes forces on all specified equipment. Calculations shall include wind loading forces for equipment installed outdoors.

1.12 OPERATING AND MAINTENANCE INFORMATION

A. Operational Training

1. At time of completion, the Contractor shall provide a period of not less than 6 hours training for instruction of operation and maintenance personnel in the use of systems. Instruct all personnel at one time in one session. Make necessary arrangements with manufacturer's representative. Provide product literature and application guides for user's reference during instruction.

B. Operations and Maintenance Manuals

1. Provide Operation and Maintenance manuals per specifications as described in "Submittal Requirements" in this section with the following additional requirements:

   a. A comprehensive index.

   b. A complete "Record" set of favorably reviewed electrical submittals as provided under subsection "Submittal Requirements" illustrating all components, piping, and electrical connections.

   c. A complete list of the equipment supplied, including serial numbers, ranges, catalog cuts, and pertinent data.

   d. Full specifications on each item.

   e. Detailed service, maintenance and operation instructions for each item supplied. Schematic diagrams of all electronic devices shall be included. A complete parts list with stock numbers shall be provided for the components that make up the assembly. All of these shall be originals, no copies.

   f. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

   g. PLC & OI applications programming and configurations (as applicable)

2. Submit electronic readable PDF file format of the proposed O&M manuals for review by the Engineer. Submittals shall be delivered timely to the Engineer to allow for review period, corrections, and re-submissions as necessary.

   a. General Contractor supervision must not be circumvented by sending submittals direct to Engineer.

   b. O&M Submittals shall be published 1st electronically and 2nd on hard copy paper stock.

   c. Electronic Submittals shall be transmitted with the hard copy submittals and be viewable using a PDF reader.

   d. Electronic submittals shall be assembled in accordance with the specifications for hard copy submittals with table of contents, bookmarks, tabs, subtabs, etc. utilizing the electronic bookmarks feature available in the PDF assembler.

   e. Electronic (PDF) submittals must follow all applicable requirements for hard copy submittals including indexing, item selection indication, bookmarks, etc.

3. Provide four (4) hard copy O&M manuals per specifications as described in SUBMITTALS REQUIREMENTS in this section.

a. Deliver approved hard-copy O&M manuals to the project site and Owner prior to pre-operational testing or equipment start-up.

C. At the end of the project hard copy and soft copy electronic PDF files, shall be updated to "as-built" conditions.

PART 2: PRODUCTS

2.01 QUALITY

A. All equipment and materials shall be new, in current production, and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product.

B. Products specified that have become obsolete (out of current manufacturing, or have been superseded by another product) shall be cross-referenced to a replacement product(s) and provided in lieu of the specified product(s) for no additional cost. Under no conditions, shall products be submitted or furnished that are known (on manufacturer's list of obsolescence) and expected to be removed from current production within 12 months after project submittal. Products found to have been furnished this way will be removed and replaced at Contractor's expense.

C. 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 braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for long, trouble free service. Light duty, fragile and competitive grade devices of questionable durability shall not be used.

D. Products that are specified and include a manufacturer, trade name or catalog number are intended to establish a standard of quality, performance, warranty and service. Products that are specified "or equal," do not prohibit the use of equal products of other manufacturers provided they are submitted, identified and promoted as equal, and favorably reviewed by the Engineer prior to procurement and installation.

E. Products submitted as "equal" to the named products will be reviewed for conformance with the specifications and in comparison with the first named product. If the equal product meets specifications, but does not have a feature or performance characteristic that is available with the first named product, and that feature or performance is required for this project, then the submitted equal product may be rejected on those grounds.

F. In the event that some claims of the manufacturer of submitted "equal"

product are called into question by the Engineer, the Contractor, may be required to prove those claims either prior to installation or during startup of product. If the product does not meet the claims made or specifications, the product may be rejected by the Engineer and a replacement product must be submitted by the Contractor in its place. All cost for the rejected product, installation, testing, and removal will be the responsibility of the Contractor.

G. Underwriters Laboratories (UL) listing is required for all substituted equipment when such a listing is available for the first named equipment. Extra parts, labor, panel space, power supplies, circuit breakers, and/or GFIC devices shall be provided as necessary for incorporation of specified non-UL components.

H. When required herein or requested by the Engineer, the Contractor shall submit equipment or material samples for test or evaluation. The samples shall be furnished with information as to their source and prepared in such quantities and sizes as may be required for proper examination and tests, with all freight and charges prepaid. All samples shall be submitted before shipment of the equipment or material to the job site and in ample time to permit the making of proper tests, analyses, examinations, rejections, and resubmissions before incorporated into the work.

2.02 NAMEPLATES & TAGS

A. Equipment exterior nameplates - Nameplate material shall be rigid laminated black plastic with beveled edges and white lettering; except for caution, warning, and danger nameplates the color shall be red with white lettering. The size of the nameplate shall be as shown on the drawings. No letters are allowed smaller than 3/16". All nameplates located outdoors shall be UV resistant. Securely fasten nameplates in place using two stainless steel screws, type 316L, if the nameplate is not an integral part of the device. Epoxy cement or glued on nameplates will not be acceptable. Engrave the nameplates with the inscriptions as approved by the Engineer in the submittal.

1. For each major piece of electrical equipment provide a manufacturer's nameplate showing the Contract specified name and number designation, and pertinent ratings such as voltage, # of phases, ratings, etc.

2. For each device with a specific identity (pushbutton, indicator, instrument, etc.) mounted on the exterior or deadfront of a piece of equipment provide a nameplate with the inscription as shown on the Drawings and described herein.

3. Where no inscription is indicated on the Drawings or described herein, furnish nameplates with an appropriate inscription providing the name and number of device.

4. Install Safety Signs in accordance with the latest OSHA requirements.

a. Entrances to electrical rooms and stations: Danger Sign

requirements, ELECTRICAL ROOM, HIGH VOLTAGE (define voltage, example 480 VAC) KEEP OUT, AUTHORIZED PERSONNEL ONLY.

b. Equipment enclosures, cable tray and wireway where 120 VAC or higher and 50 V DC and higher exist: Danger Sign requirements, HIGH VOLTAGE (define voltage, example 480 VAC) AUTHORIZED PERSONNEL ONLY.

c. Equipment such as motor control centers, control panels, etc., where more than one source may be present in an enclosure or cubicle: Danger Sign requirements, VOLTAGE (define voltage, example 120 VAC control voltage or 480 VAC power) FROM MULTIPLE SOURCES IN THIS ENCLOSURE.

d. Equipment such as switchboards, switchgear, panelboards and motor control centers: Warning Sign requirements, WARNING, SERVICE ENTRANCE DISCONNECT FOR 1 OF ___ (define quantity) SERVICES TO THIS BUILDING. OTHER SERVICE ENTRANCE DISCONNECTS ARE LOCATED AT (define locations).

5. Caution, warning and danger nameplates shall be red with white lettering

B. Equipment Interior Nameplates - Nameplate material shall be clear plastic with black machine printed lettering as produced by a KROY or similar machine; except caution, warning, and danger nameplates shall have red lettering. The size of the nameplate tape shall be no smaller than 1/2” in height with 3/8" lettering unless otherwise approved by the Engineer. Securely fasten nameplates in place on a clean surface using the adhesion of the tape. For each device with a specific identity (relay, module, power supply, fuse, terminal block, etc.) mounted in the interior of a piece of equipment provide a nameplate with the inscription as shown on the Drawings and described herein. Where no inscription is indicated on the Drawings or described herein, furnish nameplates with an appropriate inscription providing the name and number of device used on the submittal drawings. Stamp the nameplates with the inscriptions as approved by the Engineer in the submittal.

C. Equipment Tags - When there is no space or it is impractical to attach an engraved plastic nameplate with screws, as is the case with most field devices and instruments, the Contractor shall attach a tag to the equipment with the same inscriptions as specified above in paragraph A. The tag shall be made from stainless steel material and the size of the nameplate shall be no smaller than 3/8"h x 2"w with 3/16" machine printed or engraved lettering unless otherwise approved by the Engineer. The tag shall be attached to the equipment with stainless steel wire of the type normally used for this purpose.

2.03 FASTENERS

A. Fasteners for securing equipment to walls, floors, or ceilings, shall be stainless steel. The minimum size fastener shall be 3/8 inch diameter.

2.04 COMPONENTS

A. Switches and Pushbuttons

1. Switches (HS) and pushbuttons (HC) for general purpose applications shall be water and oil tight as defined by NEMA 4X, corrosion resistant as defined by NEMA ICS 6-110.58, U.L. listed, standard 30 mm diameter, with plastic holding nut.

2. Switches and pushbuttons shall have contacts rated NEMA A600 or 10 amperes continuous and 600 VAC. Provide NO and NC contacts as required.

3. Engraved black legend plates shall be provided to define each switch and pushbutton function.

4. Selector switch handles and pushbutton caps shall be black unless otherwise noted on drawing. Lock-out stop caps shall be red.

5. Selector switches for hand-off-auto (HOA) applications shall have the hand position to the left, off in center, and auto in the right position.

6. Pushbuttons and selector switches in hazardous locations shall have hermetically sealed contacts or explosion proof enclosures.

7. Lockout stop pushbuttons shall include padlocking attachment. Pushbutton type shall be coordinated with padlock attachment type.

8. Switches and pushbuttons shall be Allen-Bradley 800H, or equal.

B. Indicating Lights

1. Indicating Lights for general purpose applications shall be NEMA 4X, corrosion resistant as defined by NEMA ICS 6-110.58, U.L. listed, 30 mm diameter, with plastic lens, plastic holding nut, and miniature bayonet lamp base.

2. Lamp shall be full voltage 120 VAC with 28 chip (min) High Intensity LED.

3. Indicating lights shall have contacts rated NEMA A600 or 10 amperes continuous and 600 VAC. Provide NO and NC contacts as required.

4. Engraved black legend plates shall be provided to define each lights function.

5. Indicating light type and color of lens shall as follows or as otherwise shown on the Drawings:

a.	Open/On	Green
b.	Closed/Off	Red
c.	Alarm	Amber or Blue
d.	Power On	White

6. Indicating lights designated "PTT" on wiring diagram or shown with push-to-test wiring shall be provided with a push-to-test switch and wiring.

7. Indication lights shall be Allen-Bradley 800H, or equal.

C. Relays and Timers

1. General: Relays and timers shall be provided with N.O. or N.C. contacts as shown on the Drawings. All spare contacts shown shall be provided. Contacts shall be rated 10 amps minimum at 120 VAC, 60 Hz unless otherwise shown on the Drawings. Coil voltage shall be 120 VAC unless otherwise described or shown on the Drawings. Relays and timers shall be designed for continuous duty. All relays shall be U.L. listed. All relays and sockets shall be the product of a single manufacturer. The following is a summary of abbreviations associated with relays and timers:

CR	– Control relay
TR	– Timing relay
TDOE	– Time delay on energization
TDOD	– Time delay on de-energization
PR	– Power Relay

2. Sockets for plug-in relays and timers shall be standard industrial type DIN rail mount with barrier type pressure plate screw terminals. Sockets shall be rated 300 VAC, 10 amps minimum.

   a. Blade 8 or 11 pin for coil voltage above 90 volts AC or DC.

   b. Octal 8 or 11 pin for coil voltage below 90 volts AC or DC.

3. Control relays (CR) shall be plug-in type with neon indicating lights and clear see-through sealed housing to exclude dust. Provide IDEC Type RR, or equal. Two form-C contacts (minimum) shall be provided on each relay.

4. Time delay relays on energization (TR-TDOE) shall be solid state plug-in relays with adjustable timer ranges from 1 second to 10 hours selectable unless other ranges are shown. Provide LED timer energized indicator lamp. Time delay relays shall be IDEC RTE, or equal.

5. Time Delay Relays (TR-TDOD)

a. Time delay relays on de-energization (TR-TDOD) (continuous power control input) shall be solid state plug-in relays with a timer adjustable range from 1 second to 10 hours selectable unless other ranges are shown. Provide LED timer energized indicator lamp. Time delay relays shall be IDEC RTE, or equal.

b. Time delay relays on de-energization (TR-TDOD) (true off) shall be solid state plug-in relays with a timer adjustable range from 1 second to 10 minutes unless other ranges are shown. True off time delay relays shall be IDEC GT3F-2, or equal.

6. Power relays (PR) shall be plug-in type and clear see-through sealed housing to exclude dust. Provide Schneider Electric Type 389FXCXC-120A, or equal. 3PDT contacts rated 20A or 1 HP at 240 VAC (minimum) shall be provided on each relay. Furnish compatible blade type relay socket model 70-788EL11-1 or equal.

D. Amperage Switch:

1. Amperage switch shall be self powered and provide a closed contact which closes the output contact when current is measured through the integral current transformer above adjustable setpoint (1-6, 6-40, or 40-175 amps selectable). The switch shall have an accuracy of 5% and repeatability of 1/2% of full scale (minimum). Switch shall include LED for quick visual indication of contact status. Operating temperature range shall be -20 deg C to 50 deg C. Transducer shall have separate zero and span and time delay adjustments. Insulation between output and case shall be rated at 1000VAC. Amperage switch shall be as manufactured by Neilsen-Kuljian (NK technologies) ASX series or equal.

2.05 MOTOR CONTROL ACCESSORIES

A. Control Power Transformer:

1. Control power transformer shall be epoxy encapsulated for dust and moisture protection. The internal wiring shall be copper and have 105 deg. C insulation rating. The unit shall feature barriered screw terminals for connection to electrical circuits. Provide with time-delay, slow-blow secondary fuse rated to protect the transformer and interrupt 10,000 amperes at 120VAC. Two primary fuses rated for 480 VAC and AIC as shown in the Drawings shall be provided. Transformer minimum size and voltage ratings shall be as shown on Contract drawings. Control power transformer shall be Micron Impervitran, Cutler Hammer MTE or equal.

2.06 DEVICES

A. Switches

1. General purpose commercial grade switches shall be manufactured in

accordance with UL 20. Switches shall be one pole, brown, 20 amps at 277 VAC, 1HP at 120 VAC, 2 HP at 240 VAC. Switches shall have copper alloy contact arm with silver cadmium oxide contacts. Switches shall have slotted terminal screws and a separate green grounding screw. Provide Leviton 1221, or equal.

2. Wall mount commercial grade motion detector switches (denoted with M next to switch symbol in drawings) shall utilize passive infrared detection with 180 deg field of view to determine if the space is occupied by personnel. The device shall be capable of switching incandescent (800W at 120V) and fluorescent (1200VA at 120V) lamps with electronic ballasts. The device shall feature a manual-off-auto switch. A delay off time adjustment shall be settable from 30 seconds to 30 minutes. The device shall incorporate a photocell with light intensity adjustment to keep the switch from activating when light levels are above setting. Provide Leviton ODS10, or equal.

3. Special purpose switches shall be provided with the amperage, voltage, and configuration as shown on the Drawings. Switches used as motor disconnects for single phase motors shall be horsepower rated.

B. Receptacles

1. General purpose receptacles shall be commercial grade, duplex and rated 20 amps, 120 VAC, 2 pole, 3 wire grounding, NEMA 5-20R configuration, specification grade, and side wired to screw terminals. Face color shall be brown when paired with stainless steel covers. General purpose receptacles shall be specification grade Leviton 5362-B or equal.

2. Ground fault circuit interrupter receptacles shall be used where noted as GFI on plan or where in outdoor NEMA 3R locations. GFI receptacles shall be commercial grade, duplex, brown, 20A, 120V, back and side wired, with "test" and "reset" buttons. “Daisy Chain” connecting multiple receptacles from one GFI unit is not acceptable. GFI receptacles shall be Leviton 8898, Leviton MGNF2-B, Leviton 7899, or equal.

3. Boxes shown in NEMA 3R environments and outdoor locations shall be weatherproof while in-use. Furnish in-use weatherproof covers and weatherproof boxes for these areas.

4. Definite purpose receptacles and plugs in NEMA 4 or 4X environments where a receptacle is shown and a device is to be connected continuously, shall be listed as UL type 4, 4X, (Plug) and NEMA 3R (flip cover). Receptacles, plugs, and housings shall be fabricated of impact resistant plastic with o-rings and gaskets to prevent the entrance or water, vapors, and chemicals when unplugged or plugged. Circular plugs shall be retrofitted onto equipment so as to be compatible with the receptacles to maintain in-use ratings. Furnish Hubbel Watertight

Wiring Devices and Accessories, or equal.

2.07 DISCONNECTS

A. Disconnect Switch:

1. Disconnect Switch shall be heavy duty, horsepower rated, three pole, single throw, fusible/non-fusible with quick make/break operating mechanism. The enclosure shall be 316 stainless steel and rated NEMA 4X. The enclosed switch shall be rated for 480 Volt, and 10HP (minimum) unless otherwise shown on the drawings. Provide fuses, auxiliary contacts, or indicators as required by the motor control or one-line diagram. The operator shall actuate the switch side mounted handle and have provisions for up to 3 padlocks. Disconnect switch shall be Cutler Hammer DH series, Square D or equal.

2.08 ELECTRIC GATE CONTROLS

A. Automatic Vehicle Identification Receiver: (AVI)

1. The Reno A&E Model AVI-B Automatic Vehicle Identification (AVI) Receiver identifies vehicles equipped with a uniquely coded AVI transmitter and provides a relay contact closure. Two LEDs on the front panel indicate 1.) the presence of power (green LED) and 2.) a valid-coded transmitter within the loop area (red LED). The receiver is connected to a loop installed in the pavement. The AVI transmitter must be in close proximity to, or over, the loop for the receiver to respond. The receiver is factory programmed to identify a single specific transmitter code (City Specific) and does not require any adjustments or setup. The receiver is fully operational immediately upon application of power.

a. Connections: 120 VAC, vehicle detection loop, dry contacts for gate operator.

b. Install loop for detecting the vehicle identification.

B. Exit Loop controller

1. Furnish and install exit loop and controller for exit access.

2. If vehicle is detected (any vehicle), the controller will close a contact to allow the gate to open.

2.09 VIDEO MONITORING SYSTEM

A. NVR
1. 4K High Definition Network Video Recorder (NVR)
2. Furnish 16TB, 3.5”, 7200RPM, SATA Hard Drive Storage, installed.
3. LAN/WAN Ethernet port for remote monitoring
4. Continuous recording, 20 4k channels minimum.

5. Motion sensing and timed modes
6. Replay and export functions
7. Phone app and web interface monitoring
8. Ubiquiti NVR Pro, no equal

B. Cameras
1. Fixed manual zoom and focus
2. 4K Resolution, Ultra HD
3. POE Cat 5E
4. Weatherproof for outdoor installation
5. Night vision – 150 ft
6. Quantity as shown in drawings
7. Ubiquiti G5 Pro, no equal

C. POE Switch

1. Ubiquiti Standard 16 POE

D. Accessories
1. Ethernet cables.

E. Firewall Router
1. Ubiquiti UDM SE, no equal.

2.10 RADIO SYSTEM

A. RADIO MODEM

1. Re-use existing radio in new control panel.

a. Existing radio is MDS 9310.

B. ANTENNA

1. Reuse existing Antenna

C. TRANSMISSION CABLE

1. Provide 50 Ohm, ½” weatherproof coaxial cable from lighting arrestor to antenna. The coax cable shall have a corrugated outer conductor of copper, copper-clad aluminum inner conductor with foam dielectric. The coax cable shall be jacketed for corrosive environment and ultra-violet exposure. The coax cable shall be capable of a minimum bending radius of 5 inches. The cable shall be installed as one continuous length from the antenna to the lighting arrestor. Antenna cable shall be Andrew Superflex FSJ4-50B, 1/2" coax cable or equal.

2. Cable end “N” connectors shall be furnished for field installation after the cable is run in conduit. Provide straight connectors as required for the installation as required.

3. Pigtail connector. Provide low loss connection cable for connecting the Radio antenna connection to the lightning arrestor. Pigtail shall have compatible connectors for the radio and lightning arrestor.

4. Furnish an antenna lighting arrestor with "N" connector on the antenna coaxial transmission line. The lighting arrestor shall be grounded to the control panel ground buss by a #8 AWG or larger bonding wire. The lighting arrestor shall be insulated from the backpan. The lightning arrestor shall be a PolyPhaser IS-50NX-C2 or equal.

5. The cable shall be carefully installed to prevent damage to the jacket and routed with a minimum bending radius of 8 inches except where required at the conduit to free-air transition.

6. Provide connector weatherproofing kits for outdoor exposed connectors. All mating connectors that are exposed to weather shall be wrapped with a sealing material designed to protect against water and dirt entry into the connectors.

PART 3: EXECUTION

3.01 CONSTRUCTION METHODS

A. Equipment shall be assembled and wired by the manufacturer prior to shipment. Field modifications or changes are not allowed without a written "change order" to the Contract. Field changes, however large or small, shall be executed using the components, materials, wiring, labeling, and assembly methods identical to that of the original supplied equipment.

B. Electrical plugs, receptacles, cords, and connectors required to power or interface the equipment and panels shall be furnished and installed by the Contractor.

C. Factory as-built drawings for each custom manufactured control panel or MCC shall be shipped with the equipment and placed inside in waterproof envelopes.

3.02 EQUIPMENT FABRICATION

A. All electrical equipment, including custom manufactured equipment, shall meet the requirements of Underwriters Laboratories (UL) and bear the appropriate label. Panels shall be affixed with UL label prior to shipment and be built in accordance with the UL guidelines and procedure that corresponds to the UL label. Custom control panels shall bear a UL-508A label for general use, minimum, with additional UL labels as required per intended service.

1. Design and furnish a Low Voltage Limited Energy Circuit for any device(s) not bearing a UL listing or registration that are required to be installed into a UL labeled panel.

2. Revise voltages for any electrical parts and equipment that are

specified that do not bear the UL listing or registration.

B. Panel cutouts for devices (i.e. indicating lights, switches) shall be cut, punched, or drilled and smoothly finished with rounded edges. Exposed metal from cutouts that are made after the final paint finish has been applied shall be touched up with a matching paint prior to installing device.

C. Equipment doors shall swing freely and close and latch with proper alignment.

D. Component within the electrical equipment shall be securely mounted on an interior subpanel or backpan and arranged for easy servicing. Mounting bolts and screws shall be front mounted for device removal without special tools or removal of entire mounting panel.

E. A ground bus shall be provided in each enclosure or cabinet. It shall have provisions for connecting a minimum of ten grounding conductors. Screw type lugs shall be provided for connection of grounding conductors. All grounding conductors shall be sized as shown on plans or in accordance with NEC Table 250-95, whichever is larger.

F. Bolts and screws for mounting devices on doors shall have a flush head which blends into the device or door surface. No fastening devices shall project through the outer surfaces of equipment.

3.03 WORKMANSHIP

A. All work in this division shall conform to the codes and standards outlined herein.

B. Installation shall be performed by qualified personnel providing first class workmanship per Electrical Specifications [Electrical General, Qualifications].

C. Maintain equipment installed (or to be installed) in new condition. Protect equipment from damage while in Contractor care from dust, water, or mishaps that are typical to construction sites

D. Confirm that equipment and materials are correct for their intended duty and will be installed per manufacturer guidelines. Equipment and components found to be installed inconsistent with manufacturer guidelines and/or these specifications will not be acceptable and subject to removal and replacement.

E. Upon completion of daily work, remove excess materials, scraps, and debris from the work area and from the inside of equipment.

F. Upon notification, stop work on any portion of the installation that is determined to be non-compliant with contract or being installed by unqualified personnel.

G. Perform all work to correct improper installations at no additional cost to the owner.

H. Equipment furnished under this contract or provided to Contractor for installation shall be installed in accordance with manufacturer's instructions, installation calculations, and contract documents.

3.04 EQUIPMENT SHIPMENT AND STORAGE

A. Shipment -- Any equipment whose destination (jobsite) is more than 25 miles from the factory shall be carefully protected for shipping. All openings shall be protected by plywood securely fastened to the framework of the equipment. Equipment shall be adequately covered during local delivery.

B. Storage -- From the time of receipt until the equipment is installed and energized, the equipment shall be considered in storage. While in storage, a 120V, 1 phase source of power shall be made available and connected to space heaters in all items of equipment so equipped. Equipment not provided with space heaters shall be provided with a light bulb or electric heater while in storage to prevent moisture condensation. Unless stored indoors, it shall be a least 1 foot above grade covered with at least 2 layers of heavy polyethylene plastic sheets and anchored to prevent damage by high winds. All equipment shall be protected from dust and moisture prior to and during construction.

3.05 DAMAGED PRODUCTS

A. Damaged products that cannot be repaired to new condition shall be replaced with new products. All equipment and materials shall be in like-new condition at start-up and commissioning.

B. Any equipment furnished outside of contract to the Contractor shall be repaired or replaced if damaged while in the Contractor’s care. The Contractor shall pay for the parts and/or services of the original equipment manufacturer (OEM) to troubleshoot, asses, and repair damaged equipment.

C. Minor cosmetic damage shall be repaired by spray painting, after properly preparing the surface, all scratches or defects in the finish of the equipment. Only identical paint furnished by the equipment manufacturer shall be used for such purposes.

3.06 INSTALLATION

A. General

1. Install all products per manufacturer's recommendations and the Drawings.

2. Provide all necessary hardware, conduit, wiring, fittings, and devices to connect the electrical equipment provided under other Sections.

3. Protect wiring insulation from wear by installing rubber cushions, bushings, or strip insulation, or by fastening the wiring to a rigid surface with zip ties and anchors.

4. Provide additional devices, wiring, conduits, relays, signal converters, isolators to complete interfaces of the electrical and instrumentation system.

5. If required normally open contacts will be changed to normally closed contacts or vice versa.

6. Add additional relays to provide more contacts as necessary.

7. All programmable devices (not specifically excluded herein) shall be programmed, set-up and tested by the Contractor prior to startup. Programming and set-up parameters shall be adjusted or changed as directed by the Engineer during start-up and throughout the warranty period.

8. Coordinate with the Engineer and setup all alarm, process, and operation setpoints.

9. Keep a copy of the manufacturer's installation instructions on the jobsite available for review at all times prior to and during the installation of the associated equipment.

B. Panels and enclosures:

1. Install panels and enclosures at the location shown on the Plans or approved by the Engineer.

2. Install level and plumb.

3. Seal all enclosure openings to prevent entrance of insects and rodents.

4. Clearance about electrical equipment shall meet the minimum requirements of NEC 110.26

C. Conduits and Ducts:

1. Install all conduits and ducts per Electrical Specifications [Conduit and Boxes] and [Grounding].

2. Minimum wire bending space at terminals and minimum width of wiring gutters shall comply with NEC tables 312-6 (a) & (b).

D. Wiring, Grounding, and Shielding:

1. Observe proper grounding and shielding practices as this application environment is generally noisy. The shield of shielded cables shall be terminated to ground at one end only, the origination end. The shield at the other end shall be encased in an insulated material to isolate it from ground.

E. Cutting and Patching:

1. The Contractor shall do all cutting and patching required for installing his work. Any cutting which may impair the structure shall require prior approval by the Engineer. Cutting and patching shall be done only by skilled labor of the respective trades. All surfaces shall be restored to their original condition after cutting and patching.

F. Cleaning and Touch up:

1. At the completion of the work, all parts of the installation, including all equipment, exposed conduit, and fittings, shall be thoroughly cleaned of grease and metal cuttings. Any discoloration or other damage to parts of the building, the finish, or the furnishings, due to the Contractor's failure to properly clean the system, shall be repaired by the Contractor.

2. The Contractor shall thoroughly clean any of his exposed work requiring same.

3. Vacuum and clean the inside of all electrical and instrumentation enclosures prior to applying power.

4. The Contractor shall paint scratched or blemished surfaces with the necessary coats of quick drying paint to match existing color, texture and thickness. This shall include all prime painted electrical equipment including but not limited to enclosures, poles, boxes, devices etc.

3.07 APPLICATION OF POWER

A. The Engineer will direct the energization and de-energization of all existing and new equipment. The Contractor is not authorized to energize or de-energize any equipment unless they have been given written permission to do so or while in the presence of the Engineer.

1. Any equipment that is under repair, demolition or installation shall be locked off and tagged out of service with Contractor supplied padlocks and tags.

2. The Contractor is required to comply with NFPA 70E and specifically in regards to safety when working on live equipment. Obtain work permits when needed to do live work.

B. The Contractor is responsible for grounding of high and medium voltage cabling and/or bus during installation and removal of equipment. The contractor is responsible for complying with all California Electrical Safety Orders (ESO) and Occupational Safety and Health Act (OSHA) safety requirements and procedures while working in or near medium voltage equipment.

3.08 WARRANTY

A. The Contractor shall warrant all electrical and instrumentation equipment &

software for a period of 1 year from date of final acceptance. Standard published warranties of equipment which exceed the preceding specified length of time shall be honored by the manufacturer or supplier.

B. The Contractor shall have a staff of experienced personnel available to provide on-site warranty service on 2 working days notice during the warranty period. Such personnel shall be capable of fully testing and diagnosing hardware & software and implementing corrective measures.

3.09 FINAL ACCEPTANCE

A. Final acceptance will be given by the Engineer after the equipment testing is complete, each deficiency has been corrected, final documentation has been provided, and all the requirements of Contract documents have been fulfilled.

B. At the end of the project, following the completion of the field tests, and prior to final acceptance, the Contractor shall provide the following:

1. Each "operation and maintenance" manual shall be modified or supplemented to reflect all field changes and as-built conditions.

2. Two (2) disk copies of all final documentation to reflect as-built conditions.

C. Keys: Submit two sets of all keys for locks supplied on this project. Wire all keys for each lock securely together. Tag and plainly mark with lock number or equipment identification, and indicate physical location, such as panel or switch number.

END OF SECTION

SECTION 26 01 10

CONDUIT AND BOXES

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Labor, materials, equipment, tools, safety gear, test equipment, incidentals, services, and transportation for a complete electro-mechanical installation as shown on the Drawings, included in these Specifications, or as can be reasonably implied from project descriptions.

B. The scope of work includes:

1. Furnish and install conduits, wireways, raceways, cable trays, junction boxes, pull boxes, and associated hardware. Provide conduit, fittings, hardware, hangars, mounting channel, and other parts for a complete raceway installation.

2. Replacement of liquid tight flex conduit that is sun exposed for any conduit that is getting new conductors.

3. Furnish and install grounding system required by drawings, or if not shown or defined, as required by Article 250 of the NEC.

4. Installations shall be designed and installed with components meeting the NEMA area designation.

C. Work includes that specified in Electrical Specifications [Electrical General].

1.02 REFERENCES

A. Electrical Specifications [Electrical General]
B. Electrical Specifications [Low Voltage Wire & Data Cable]
C. Electrical Specifications [Grounding]
D. Project Drawings

1.03 QUALIFICATIONS

A. Material furnished under this specification shall be installed by qualified installers meeting requirements specified in Electrical Specifications [Electrical General, Qualifications].

1.04 SUBMITTAL REQUIREMENTS

A. Provide submittals and drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].

PART 2: PRODUCTS

2.01 CONDUIT, RACEWAYS AND WIREWAYS

A. GENERAL - Conduit, raceways, and wireways, wiring methods, materials, installation shall meet all requirements of the NEC, be UL labeled for the application, and meet the minimum following specifications.

1. All wiring shall be installed in conduits, raceways, or wireways when interconnecting equipment and devices.

   a. The minimum size conduit shall be 3/4-inch unless indicated otherwise on the Drawings or for special connections to equipment.

   b. Provide cords and cord seals for devices or instrumentation requiring waterproof seal to maintain NEMA 4 or 4X ratings. Example devices include lighting and pipe mounted instruments that are located below grade.

2. Conduits may connect into junction boxes or wireways as shown in the drawings or as requested by Contractor and approved by Engineer. Junction boxes (circle with J in drawings) can be as simple as a condulet or JIC box, or larger box as determined by contractor and needed for the installation. Drawing may or may not depict junction box requirements that may be required by code. Wireways or junction boxes shall be rated for area (as noted in the Drawings), or furnish minimum NEMA 4 if not noted.

3. The Contractor shall use conduit material types (SPEC per conduit schedule) as defined below or as otherwise shown in the contract drawings or as specifically called out in the conduit schedule.

   a. Non-exposed underground portions of conduit run shall be PVC-40 for all signals and voltages unless otherwise shown in the conduit schedule.

b. Exposed conduit material (not underground and beyond transition) shall be per the following table unless specifically noted otherwise in the plan drawings. The conduit schedule denotes the conduit type for non-exposed (under-ground, in-concrete, etc.) and does not apply or coordinate with this table. Exposed condulets, elbows, fittings, device boxes, and hardware shall be of the same material and finish as the adjacent conduit.

Location	Material
NEMA 1 or 12	Galvanized rigid steel (GRS)
NEMA 3R	Galvanized rigid steel (GRS)
NEMA 4	PVC-Coated Steel (GRS-PVC)
NEMA4X	PVC-Coated Steel (GRS-PVC)

4. Conduit stubs and transitions:

a. Conduit transitions shall be GRS-PVC for 6" on either side of the transition point (minimum) or as shown in drawing details. Conduit transition is defined as conduit sections emerging from or through concrete or earth or from below to above grade or through walls or vaults, non-exposed to exposed.

b. Beneath pad mounted electrical equipment, where not exposed, shall be installed or trimmed to 2" or less above slab and have bushing or end bell installed. Overall height of conduit entering into the base of equipment shall be enough for bushings/bells to be installed but be high enough for conduit tags to be installed.

c. Uniform in height for each panel or section. Conduits end bushings/bells shall not vary in height above slab more than ½" from lowest to highest.

d. Conduits shall be spaced apart such that bushings and end bells may be installed without interfering with the adjacent conduits.

e. Transitions to PVC shall include PVC coated locknuts to shield exposed steel pipe threads.

f. Through walls – shall protrude approximately 2" and include end bell or bushing. Pack space around conduit with non-shrink grout if the thru-hole was core drilled.

g. Conduits for future use shall be capped with coupling and plug. Identify each end with conduit labels.

h. Existing conduits that are no longer able to be used due to removal of a section or shown demolished and that protrude

above graded shall be cut flush and filled with grout.

5. Conduit Tags

   a. All conduits listed in the "Conduit and Wire Routing Schedule" shall have conduit tags at both ends of each conduit run with tag number from schedule identified. This shall include ends within underground pull boxes.

   b. All conduits shall have temporary tags during construction. Temporary tags may be made from duct tape with hand written ink marking or suitable equivalent. Temporary tags shall be removed by Contractor at time of installation of permanent tags.

   c. Tag material shall be rigid laminated red plastic with white lettering. The size of the tag shall be ¼" thick by ¾" round or ¾" x 1" rectangle minimum.

   d. Letter height shall be ¼" minimum. Engrave the tags with the conduit number or acronym. Labeling shall be neatly installed for visibility and shall be clearly legible. Securely fasten tags in place using 20ga stainless steel tie wire through a pilot hole on the tag.

   e. Conduit tags shall be Custom manufactured per specification.

6. Supports

   a. Cross section of a single channel shall be 1-5/8" x 1-5/8" and cross-section of a double channel shall be 1-5/8" x 3-1/4". The channel wall thickness shall be 12 gauge as applicable.

   b. One-Hole clamps shall be intended for pipe mounting on support channels and equipped with clamp-backs. The clamps shall be Efcor, Thomas and Betts, Appleton or equal

   c. Spacers, provided to support underground conduits in concrete encasements, shall be plastic. The spacers shall be Carlon, Johns-Manville, Underground Products or equal

   d. Anchors shall be expansion type for securing equipment to concrete foundations, floors and walls. Anchors shall have length identification mark on the exposed end of the bolt. Provide Hilti Kwik Bolt 3, or equal.

   e. Stanchions shall be provided as needed to mount equipment and electrical components. Stanchions shall be shop fabricated from welded 4" c-channel, 12" x 12" x ¼" steel base plate, coated with a rust inhibiting primer and top coat of gray polyurethane gloss paint. Attach equipment to the stanchion

direct or on a ¼" aluminum sheet sized for the equipment supported.

f. Conduit Hangers shall be trapeze construction, with double channel, 3/8-inch rods and nuts. Suspend from suitable structural support.

g. Support material and finish shall be per the following table unless otherwise noted in the drawings. Brackets, fittings and hardware shall be of the same material and finish.

Location	Material
Indoors NEMA 12	Galvanized steel
Outdoors NEMA 3R	Galvanized steel
Outdoors NEMA 4	Stainless Steel type 316
Corrosive areas NEMA4X	PVC bonded, 40 mil, factory applied

h. Equipment mounting racks shall be designed by installer for rigid equipment and conduit mounting. Racks shall be bolted or welded construction and sized for equipment or as shown on the drawings.

i. Strut channels shall be used for mounting equipment to walls and for supporting conduit runs. Double strut channel type shall be used for fabricating equipment mounting racks as required and/or as detailed on the drawings. Add additional supports to rigid mounting locations as needed to prevent wobbling and to meet seismic requirements. All field cut surfaces of the strut channels shall be deburred and coated to prevent rust.

B. Galvanized Rigid Steel Conduit - (GRS)

1. Manufactured from high-strength steel and hot dipped zinc galvanized inside and out. Conduit and fittings shall meet UL 514B, UL 6, and conform to NEMA RN 2. Conduit shall be capable of being used as an equipment grounding conductor per NEC 250.

2. Provide galvanized rigid steel factory sweeps and elbows for 90 degree transitions.

3. Cast fittings and device boxes shall be malleable iron or aluminum. Appleton type FS/FD or equal.

4. In hazardous locations, fittings shall meet and be listed UL 886.

5. All fittings, hubs, couplings, pulling elbows and connectors shall be threaded-type. Set-screw type and compression-type are not acceptable. All thread conduit is not allowed over 1/2" exposed length. Cover plates shall be cast iron with sealing gasket in NEMA 3R

locations.

6. Conduits entering enclosures shall be fitted with insulated grounding bushing; O-Z "HBLG", Appleton "GIB", or approved equal. All grounding bushings shall be tied to the grounding system with properly sized bonding conductors per the NEC code.

7. Combination expansion-deflection fittings installed exposed shall be Type XD as manufactured by Crouse-Hinds Co.; Type DX as manufactured by O.Z. Gedney Co.; Type DF as manufactured by Appleton Electric Co., or equal

C. Galvanized Rigid and Coated Steel Conduit (GRS-PVC)

1. Galvanized Rigid Steel conduit with a 40-mil thick polyvinylchloride exterior coating and a 2-mil urethane interior coating meeting NEMA RN-1, UL-6 and ETL PVC-001. The bond of the PVC to the zinc coated pipe must be stronger than the tensile strength of the PVC.

2. Provide PVC coated galvanized rigid steel factory sweeps and elbows for 90 degree transitions.

3. Cast fittings and device boxes shall be malleable iron or aluminum with a 40-mil thick PVC coating meeting the same

4. In hazardous locations, fittings shall meet and be listed UL 886.

5. Provide PVC coated threaded-type fittings, hubs, pulling elbows, couplings, and connectors; set-screw type and compression-type are not acceptable. Form 8 conduit fittings, ½" through 4", must have a tongue-in-groove gasket to effectively seal out the corrosive elements. Covers shall be supplied with plastic encapsulated stainless steel cover screws. Form 8 fittings shall be UL and type 4X and IP69 listed.

6. A "PVC Coated Sealing Locknut" shall be used on all exposed male threads transitioning into female NPT threads which do not have sealing sleeves, including transitions from PVC couplings/female adapters to PVC Coated GRC elbows in direct burial applications. "PVC Coated Sealing Locknuts" are not to be used in place of a myers hub

7. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.

8. All junction and metal pull boxes shall be galvanized with exterior surfaces PVC coated to 40 mils thickness.

9. Unistrut, strut clamps, pipe straps, and clamp back spacers, shall have 40 mil thick PVC coating. All mounting anchors shall be stainless steel.

10. Conduits entering enclosures shall be fitted with insulated grounding bushing. All grounding bushings shall be tied to the grounding system with properly sized bonding conductors per the NEC code.

11. Installers of PVC Coated Conduit must be certified by the manufacturer and be able to present a valid, unexpired certified installer card.

12. GRS-PVC conduit to be Robroy Plasti-bond, Perma-Cote, KorKap, T&B OCAL or equal.

D. PVC Conduit, Schedule 40 or 80 (PVC-40, PVC-80)

1. Shall be high impact schedule 40 or 80 polyvinylchloride suitable for use underground, direct burial and for use with 90 C wires, and shall conform to UL 651. Shall be UL listed and labeled for "direct" burial.

2. A copper bonding conductor shall be pulled in each raceway and bonded to equipment at each end with approved lugs.

3. Each underground run shall be placed in a trench with a five (5) inch sand bed evenly compacted on all sides, top and bottom unless otherwise noted.

4. Elbows, and risers shall be per exposed conduit transition detail. PVC conduit is not allowed above ground except where specifically called out on the Drawings.

5. PVC fittings shall have solvent-weld-type conduit connections. Fittings and device boxes shall be PVC with factory fabricated conduit connections. Provide Carlon or equal.

6. Conduits entering enclosures shall be fitted with a glued male adapter, lock ring and bushing to prevent wire chafing. Conduits entering panels through concrete to an open bottom or entering a pull box shall have a glued end bell fitting.

7. PVC conduit shall be stored on a flat surface and shielded from the sun.

E. Liquid Tight Flexible Non-metallic Conduit (up to 2”) - (FLEX)

1. Liquid tight flexible Nonmetallic Conduit shall be constructed of flexible PVC and have a smooth inner surface with integral crush resistant reinforcement within the conduit and be designated as a Type LFNC-B (for FNMC-B).

2. Liquid tight Flexible Nonmetallic Conduit shall be sunlight, oil, and flame resistant and approved for the installation of electrical conductors in indoor and outdoor applications.

3. Liquid tight Flexible Nonmetallic Conduit shall be listed to UL standard

UL1660.

4. Liquid tight flexible non-metallic conduit shall be installed in accordance with Article 351, Part B of the National Electrical Code (NEC) and other applicable sections of the NEC and/or local electrical codes.

5. Liquid tight Fittings shall be listed for the use with Liquid tight Flexible Nonmetallic Conduit and shall be marked LFNC-B (FNMC-B).

6. Flexible Non-Metallic Conduit shall be Carlon Carflex or equal.

F. Liquid Tight Flexible Metal Conduit (above 2-1/2") - (FLEX)

1. Liquid Tight Flexible Metal conduit shall be moisture and oil-proof with PVC jacket extruded over a galvanized flexible steel conduit.

2. Liquid Tight Flexible Metallic Conduit shall be sunlight, oil, and flame resistant and approved for the installation of electrical conductors in indoor and outdoor applications.

3. Liquid Tight Flexible Nonmetallic Conduit shall be listed to UL standard UL 360.

4. Liquid Tight flexible metallic conduit shall be installed in accordance with Article 351, Part B of the National Electrical Code (NEC) and other applicable sections of the NEC and/or local electrical codes.

5. Liquid Tight Fittings shall be listed for the use with Liquid tight Flexible Metallic Conduit and conform to UL514B.

   a. Outdoors when extension of GRS-PVC: PVC coated galvanized steel with insulated bushings.

   b. Outdoors when extension of GRS: Galvanized steel with insulated bushings.

   c. Indoors or outdoors when extension of stainless steel: 316 stainless steel with sealing ring and insulated bushing.

   d. Indoors: Galvanized steel with insulated bushings.

6. Flexible Metallic Conduit shall be Amer-Tite type GP or equal.

G. EMT Conduit, Electrical Metallic Tubing

1. Thinwall electroplated galvanized steel suitable for indoor and outdoor use with 90 C wires, and conform to UL 797.

2. All fittings, hubs, couplings, pulling elbows and connectors shall be compression-type, set screw type are not acceptable.

2.02 DEVICE BOXES

A. BOXES

1. Device boxes shall be of zinc-galvanized malleable iron or cast aluminum with shape and size best suited for the particular application, rated for the location installed, and shall be supported directly to structure by means of screws, anchors, or bolts.

2. Box dimensions shall be in accordance with size, quantity of conductors, and conduit clearances per NEC articles 314 requirements.

3. Boxes exposed to the weather or in moist locations shall be weatherproof (WP) by means of gasketing under a weatherproof cover.

4. Boxes connected to GRS-PVC conduit runs shall be PVC coated with 40 mil coating.

B. DEVICE PLATES and COVERS

1. Indoor general purpose device plates and covers shall be stainless steel. Plates or covers shall be attached with stainless steel screws. An engraved plastic label denoting circuit breaker number and panelboard name shall be affixed to each cover with #4 stainless steel screws.

2. Weatherproof switch, outlet, and receptacle boxes shall be fitted with gasketed covers rated for wet locations. Each access cover shall have a padlockable cover to maintain security and weatherproof integrity even when a plug is connected to the receptacle. Screws and hinge springs shall be stainless steel. Weatherproof access covers shall be Leviton 5977-CL, Cooper 4966, or equal.

2.03 PULL BOXES

A. JUNCTION BOXES

1. Where required for best installation or where specifically called out in the Drawings, junction boxes shall have JIC type construction with hinged door, NEMA 4X rating, manufactured of type 304 stainless steel or as otherwise shown. Door shall be fastened with clamps and stainless steel screws. No devices, screws, rivets, or bolts shall protrude through the exterior surface unless specifically shown on the Drawings. Boxes shall be Hoffman, Circle AW, or equal.

B. UNDERGROUND BOXES

1. Underground pull boxes shall be prefabricated "Christy Box" size and type as noted in the Drawings or equal. Size shall be as shown or dimensioned on the Drawings. Provide larger boxes as needed to meet code or as determined in field to allow for adequate pull area at Contractor discretion. Extension sections shall be provided as

necessary to reach the depth of underground conduits with maximum depth of 48". All boxes shall have galvanized steel hold down bolts and hardware. Boxes shall be H/20 loading rated and have traffic rated covers. Steel covers or lids shall be galvanized and grounded with bonding jumper to the local grounding circuit per NEC. Pull box covers shall be labeled electrical, signal, utility, and telephone, whichever applies. Pull boxes shall be Christy Concrete Products, Brooks or equal.

C. PULL BOX AND VAULT IDENTIFICATION

1. Engrave or bead weld box covers with minimum thickness of ¼" x 1" lettering with pullbox name (i.e. PBX-XXX) and purpose (electrical, signal, fiber, telephone, etc.). Provide an additional identifier "high voltage" for boxes with 600 volts or higher.

2. Utility pull boxes shall be labeled per Utility Company standards.

PART 3: EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

3.02 INSTALLATION

A. System:

1. Install all products per Electrical Specifications [Electrical General, Installation].

B. Rigid Conduits and Ducts:

1. Exposed conduits shall be neatly arranged with runs perpendicular or level and parallel to walls. Bends shall be concentric.

2. Except as expressly indicated or approved, all conduits shall be surface mount on block walls, concealed behind gypsum walls, and buried to required depth below floor slabs.

3. Pipe threads shall be treated with conductive thread compound.

4. Installation of the GRS-PVC conduits must be in accordance with the manufacturer's installation procedures using recommended tools.

a. Apply touch up compound at each fitting sealing sleeve edge to improve watertight seal.

b. To ensure compliance, the installer(s) must be "manufacturer certified" before installation can proceed.

c. Certification available by contacting manufacturer's representative and attending a brief instructional course. Valid and unexpired certification card shall be available for review per installer.

5. Repair GRS-PVC coating utilizing a touch-up compound as provided by the manufacturer of the conduit of the same material as the coating. Overlap beyond the damaged area to cover the PVC coating. Contact from touchup compound to PVC is required to maintain integrity. The entire conduit shall be replaced if the repair exceeds 1" combined length.

6. A maximum of three equivalent 90 degree elbows are allowed in any continuous run. Install pull boxes where required to limit bends in conduit runs to not more than 270 degrees or where pulling tension would exceed the maximum allowable for the cable.

7. Route all above grade conduits parallel or perpendicular to structure lines and/or piping. Conduits installed above grade shall be braced in place with stanchions. Expansion joints shall be installed every 100 feet. Bends shall be concentric.

   a. Combination expansion-deflection fittings installed exposed shall be Type XD as manufactured by Crouse-Hinds Co.; Type DX as manufactured by O.Z. Gedney Co.; Type DF as manufactured by Appleton Electric Co., or equal

8. Care shall be exercised to avoid interference with the work of other trades. This work shall be planned and coordinated with the other trades to prevent such interference. Process Pipe, mechanical and HVAC shall have precedence over conduits for routing and space requirements.

9. Seal each bottom entrance conduit into the MCC and other electrical enclosures with plugging compound sealant to prevent the entrance of gasses, insects and rodents. Plugging compound sealant shall be Gardner Bender Duct Seal or equal.

10. Exposed conduit stubs for future use shall be capped with coupling and plugged. Drill hole in plug for pull rope as necessary.

11. Explosion proof seal-off fittings shall be provided on all conduits that enter or leave hazardous areas per requirements of the National Electrical Code, Chapter 5 and UL 886. The seal-off fitting shall prevent hazardous gases and/or flames from passing from one type area to another through the conduit system. Ceramic or other non-asbestos fiber material and sealing compound shall be placed in the fitting to complete the seal.

12. Hazardous location conduit outlet boxes shall be used in hazardous locations for change in direction, access to conductors and as pull and splice boxes.

13. All spare conduits shall have ¼" inch true tape installed.

C. Flexible Conduit and Cords

1. Final connections to vibrating equipment such as motors, heaters and fans shall be made with liquid tight flexible conduit.

2. Flexible conduit lengths shall not be greater than 36 inches for sizes up to 2 ½" and 48 inches for 3" and larger conduit.

3. Flexible conduit shall include a ground conductor for equipment bonding in circuits over 30 VDC or as shown in the conduit schedule.

4. Flexible conduit shall only be installed in exposed or accessible locations.

5. Where equipment is cord connected, submersible rated, and conduit connections are not possible without modification, devices and equipment may be free-air cord connected in lieu of flexible conduit. Connection to adjacent rigid conduit shall be through liquid-tight cord connector fitting specifically designed for the purpose and sized appropriately for the cord. Cord connectors shall be rated similar to the adjacent conduit they are connected to: Stainless steel, galvanized or plastic.

D. Excavation and Back Filling:

1. Trenches for conduit below floor slabs and other underground electrical conduit shall be excavated to the required depths per utility requirements or specific detail. Conduits under floor slabs shall have minimum trench depth to contain bends without any portion of the radius visible at finished grade.

2. Underground conduits outside of structures, excluding utility conduits, shall have a minimum cover of 24 inches except under roadways where minimum cover shall be 30 inches or as otherwise shown in the Contract Drawings. Back filling shall be done only after conduits have been inspected. Excavation and back fill of conduits shall conform to the requirements of other applicable Specifications sections unless modified on plans, and to other entities (Utilities, etc.) as required.

3. Install spacers to support underground conduits. Horizontal and vertical separation shall be maintained by plastic spacers set every four feet. Spacers shall be Carlon Snap-Loc or equal.

4. At all times during the installation of the electrical system, the Contractor shall provide barricades, fences, guard rails, etc., to

safeguard all personnel, including small children, from excavated trenches.

E. Underground pullboxes:

1. Pullboxes shall be located in areas that will experience the least traffic loading and in the general vicinity as shown in the Drawings. Boxes in pavement shall be set at final grade and boxes in planter areas shall be set 1" above final grade. Boxes shall not be buried by landscape material.

2. Steel pull box lids shall be grounded per NEC 250.4(A)(5) and 314.4.

3. Boxes shall be set on compacted base and base rock to minimize settling of the box over time. If the box is located in a paved traffic area, a 6" x 6" concrete ring shall be poured around the box below the pavement.

F. Device Mounting Heights:

1. Mounting heights of fixtures and devices shall be as follows unless otherwise indicated or when height has to be adjusted to be over or under counter tops.

Wall switches	=>	48 inches
Convenience outlets	=>	18 inches
Telephone outlets	=>	18 inches
Bracket fixtures	=>	7 feet 6 inches

G. Cutting, Coring, Patching and Repairing:

1. The Contractor shall do all cutting and patching required to install his work. Any cutting which may impair the structure will require prior approval. Cutting and patching shall be done only by skilled labor of the respective trades. Where it is becomes necessary to cut into existing work for the purpose of making electrical installations, locate existing post tension cables, rebar and electrical services prior to core drilling using ground penetrating radar or similar technologies. All surfaces shall be restored to their original condition after cutting and patching.

3.03 FIELD ASSISTANCE

A. General: Provide all equipment and supplies necessary to perform all testing. The Owner Representative shall have the option to witness and participate in the on-site tests performed by the installer.

B. Per Electrical Specifications [Factory and Field Testing].

3.04 WARRANTY

A. Provide warranty as specified in Electrical Specifications [Electrical General,

Warranty].

END OF SECTION

SECTION 26 01 20

LOW VOLTAGE WIRE & DATA CABLE

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Labor, materials, equipment, tools, safety gear, test equipment, incidentals, services, and transportation for a complete electro-mechanical installation as shown on the Drawings, included in these Specifications, or as can be reasonably implied from project descriptions.

B. The scope of work includes:

1. Furnish and install wire, splices, lugs, or other miscellaneous devices as defined in this specification.

2. End to end wiring and terminations for each system, device, instrument, and piece of equipment shown in the Drawings as new, or rehabilitated, or reconnected.

3. Testing of conductors and completed wired systems.

4. Installations shall be designed and installed with components meeting the NEMA area designation.

C. Work includes that specified in Electrical Specifications [Electrical General].

1.02 REFERENCES

A. Electrical Specifications [Electrical General]
B. Electrical Specifications [Conduit and Boxes]
C. Electrical Specifications [Grounding]
D. Project Drawings

1.03 QUALIFICATIONS

A. Material furnished under this specification shall be installed by qualified installers meeting requirements specified in Electrical Specifications [Electrical General, Qualifications].

1.04 SUBMITTALS AND DRAWINGS

A. Provide submittals and drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].

PART 2: PRODUCTS

2.01 WIRING AND ELECTRICAL DEVICES

A. GENERAL

1. General

a. Provide wiring and electrical devices specified herein and install field and internal panel wiring as shown on the Contract Drawings.

b. This section applies to all wires or conductors used internal (non-field) to electrical equipment or external for field wiring.

c. Field wire quantity and size shall be per "Conduit and Wire Routing Schedule."

2. Analog Signals

a. Analog signal transmission between electric or electronic instruments shall be 4-20 milliamperes and shall operate at 24 volts DC unless otherwise specified. Milliampere signals shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.

b. Provide powered current isolators wherever the loops' load resistance exceeds the originating current signal transmitter's rating. Associated shunt resistors shall be located on rail-mounted terminal blocks. Exposed resistor leads shall be insulated with heat-shrink tubing.

B. LOW VOLTAGE WIRE AND CABLE (through 600V except instrument signals)

1. General: Low voltage conductors shall be used for power, control, lighting and miscellaneous circuits. This Section applies to all wires or conductors used internal for all electrical equipment or external for field wiring. Wire shall be new, plainly marked with UL label, gauge, voltage, type of insulation, and manufacturer's name.

a. Conductors shall be copper with a minimum of 98% conductivity.

b. Class C stranding. Solid conductors may be used for lighting and receptacle circuits.

c. Wire shall be rated 600 volt (min).

d. Size all conductors per NEC minimum or as shown on the drawings.

1) Minimum #12 AWG for wires used in power transmission circuits or as defined on the drawings.

2) Minimum #14 AWG for wires used in signal transmission circuits or as defined on the drawings.

2. Wire colors and sizes shall not change within the circuit.

3. Wire shall be properly fused or breaker protected at or below the maximum amperage rating allowed by the NEC.

4. Control and Power Wiring:

a. Field wire in conduit:

1) Type XHHW-2, XLPE insulation, rated 90 °C in wet or dry locations, oil resistant.

i Use for power circuits carrying voltages higher than 200 volts phase to ground.

2) Type THHN / THWN, PVC with nylon jacket insulation, rated 90 °C in dry locations and 75 °C in wet locations, oil resistant, UL83.

i Use for power circuits with voltages below 200 volts phase to ground, or control circuits.

3) Minimum #12 AWG for wires used in power transmission circuits or as defined on the drawings.

4) Minimum #14 AWG for wires used in signal transmission circuits or as defined on the drawings.

b. Field wire in tray (Tray Cable type TC):

1) Individual cables - Insulation type THHN/THWN, rated 90 °C in dry locations and 75 °C in wet locations, oil resistant, UL83.

2) 3 or more conductor plus ground wire in a single cable.

3) UL Listed as sunlight resistant, direct burial, and open wiring.

4) Conductor sizing per ICEA Publication P-54-440 for cable tray and ICEA P-46-426 for conduit

5) Minimum #12 AWG for wires used in power transmission circuits or as defined on the drawings.

6) Minimum #14 AWG for wires used in signal or conrol transmission circuits or as defined on the drawings.

c. Power cord

1) Flexible wire cord shall be type SOW, SOOW, or G and be provided in 2, 3, or 4 conductor plus ground as required for connected load.

2) EPR insulation, 90 deg C rating, oil and abrasion resistant., overall jacket plus individual conductor jackets. 600V rated

3) Conductors shall be stranded copper.

4) Cord shall be installed with cord grips on each end where it enters termination enclosures.

d. Nonfield control panel or factory installed equipment internal wiring:

1) Insulation - Type MTW, NFPA standard 79, UL 1063 with tinned copper.

2) Minimum #16 AWG for wires used for individual conductor circuits 100 volts and above.

3) Minimum #18 AWG for wires used for individual conductor circuits below 100 volts.

5. Instrument wiring:

a. Field: Instrument cables shall have 600V tray cable rated insulation and 100% individual shielded twisted pair #18 conductors with drain wire. Single twisted shielded pair (TSPR) cables shall be Belden 9341, or approved equal. Three wire twisted shielded cables (#18 TS3W) shall be Belden 1119A or equal.

b. Non-Field: Instrument cables shall have 300V rated insulation and 100% individual shielded twisted pair #18 conductors with drain wire. Single twisted shielded pair (TSPR.) cables shall be Belden 8760, or approved equal. Three wire shielded cable shall be Belden 8770 or equal.

c. Field multi-pair instrument cable as required per conduit schedule shall have 300V rated insulation and 100% individual shielded twisted pair #18 conductors with drain wire. Multiple twisted shielded pair (T.S.PR.) cables shall be Belden 9773 thru 9777, or equal.

d. Multi-pair cable is not allowed (unless specifically called out in conduit schedule or on plans) for use in field or non-field applications. One T.S.PR cable is required for each signal.

6. Manufacturer Supplied Cables

a. Cables and wiring for special systems provided by the manufacturer with the equipment shall be installed per the manufacturer's recommendations.

7. Data Cable

a. Data network category 6 cable (indoor) shall consist of 4 pair unshielded twisted pair #23 awg solid copper conductors. The cable shall be rated by IEEE for service intended – plenum and dry.

1) Cable: IEEE Category 6, various manufacturers.

2) Connectors: Standard RJ-45 with boot.

b. Data network cable (outdoor) shall consist of 4 pair foil and braid shielded twisted pair #24 awg solid copper conductors with anti-crosstalk divider, and drain wire. Rated Level 2 Category 5e Outdoor Carrier by IEEE for use in plenum, conduit, wet or dry.

1) Cable: IEEE Category 5e, Ubiquiti Tough Carrier, Belden, or equal

2) Connectors: Grounded RJ-45 with drain wire crimp.

8. Temporary motor or panel hook-up

a. Temporary cable may be cord without conduit or PVC conduit with wiring. In either case, the cabling must be protected from damage during construction. Sections may be located out of harms way, buried, or sleeved in steel conduit as needed.

b. Power Circuits: Provide 2, 3, or 4 conductor plus ground power supply cable(s) for temporary pump connections or electrical power circuits. Cables shall be sized for breaker rating amperage, (minimum).

c. Provide multi-conductor (TC) cables for digital control circuits. Provide quantity of conductors as needed.

d. Provide instrument wiring for 4-20 ma instrumentation.

e. Voltage drop in power circuits shall not exceed 15% during motor start and 5% during operation.

C. COLOR CODE

1. All wires #8 and below shall have wire insulation the color specified. Wires #6 and larger may be black with color electrical tape at termination points.

2. No other colors shall be used without prior approval.

3. Color code - color code of all wire shall conform with the following table:

WIRE COLOR CODE TABLE

Description	**Phase/Code Letter**	**Field wire or tape color**	**Non-Field Wire Color**
480V, 3 Ph	A	Brown	Brown
	B	Orange	Orange
	C	Yellow	Yellow
240V or 208V, 3 Ph	A	Black	-
	B	Red (Orange if high leg)	-
	C	Blue	-
	Neutral	White	White
240 / 120 V, 1 Ph	L1	Black	Black
	L2	Red	-
24V Positive	24+	Blue	Pink
24V Negative	24-	Gray	Gray
12V Positive	12+	Blue	Red
12V Negative	12-	Black	Black
AC Control		Red	Red (Yellow for foreign circuits)
DC Control		Blue	Blue
Ground	G	Green	Green
Shielded Pair	+	Red, Clear, or White	Clear or White
	-	Black	Black

2.02 WIRE MARKING

A. All panel, enclosure and field wiring shall have wire labels on both ends of each wire. Labeling shall be neatly installed for visibility and shall be clearly legible. Each conductor of instrument shielded signal wiring shall be labeled. Wire labels shall be machine printed with on white heat shrinkable tubing. Each label shall fit a minimum 23 characters, 3/16" in height before shrink. Tubing shall be oversized for the wire and shrunk into place using an electric heat gun. The "shrunk" label shall have just enough give to allow the label to be rotated. Hand lettered wire labels are not acceptable and shall be replaced at the Contractor's expense. Provide Brady "PermaSleeve" or equal.

1. **Node Style Wire Identification** - All wires that are electrically the same (connected to common termination points) and do not pass through a contact or other switching device shall have the same wire identification. The wire labeling code for each end of the same wire shall be identical.

a. The wire identification code for **internal panel** wiring shall be the number/letter as designated on the Contract elementary and/or approved shop drawings.

b. Wire labeling for **field** wiring shall contain the panel/equipment name as a prefix and the termination point name. (I.E. PLC50-A103 or P10-124). The hierarchy of label names is 1) PLC panel name, 2) MCC equipment name, and 3) Equipment name. Therefore, wires from PLC50 to the MCC50 P10 cubicle will be labeled PLC50-XXX. Wires from MCC50 P10 to field pressure switch PSH10 will be labeled P10-XXX.

c. Wire labels shall be exactly per interconnection submittal and/or control panel drawings -- abbreviations determined in the field are not allowed. Abbreviations may be used in the wire label as submitted and approved in the interconnection drawings submittal.

d. Wire labels for lighting and receptacle circuits shall consist of the panel board and circuit number and a unique node number. (I.E. LP#3-A, LP#3-B, LP#3-N)

e. Wire labels may be omitted on "neutral jumpers" less than 8" in length.

2.03 ELECTRICAL TAPE / SHRINKABLE INSULATORS

A. Vinyl tape shall be 7 mil, 600 volt rated, flame retardant, hot and cold weather resistant conforming to UL510. Provide 3M Scotch Super 33+ vinyl tape or equal

1. Vinyl tape for color coding shall be 7 mil, ¾" width, vinyl tape conforming to UL 510. Provide 3M Scotch 35 vinyl tape or equal.

B. Rubber Tape: EPR rubber, 90 deg C continuous rated. Provide 3M 130C

rubber tape or equal.

C. Varnished Cambric Tape: Adhesive backed, 7 mil, bias cut cotton tape, coated with yellow insulating varnish. Provide 3M Scotch 2510 or equal.

D. Shrinkable insulators shall be heat shrinkable, polyolefin thick wall sleeves, end caps and cable repair sleeves are designed for use in splicing, sealing and re-jacketing of direct bury secondary cables. The insulators shall comply with UL 486D and be rated up to 1000 Volts. They shall provide long-term reliable performance overhead, underground or submerged with mechanical and environmental protection. Shrinkable insulators shall be 3M ITCSN or 3M IMCSN per manufacturer instructions for the application or equal.

PART 3: EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

B. Perform work to remedy non-compliant installations after inspection.

C. Upon notification, stop work on any portion of the installation that is determined to be substandard or being installed by unqualified personnel.

3.02 FABRICATION AND INSTALLATION

A. System:

1. Install all products specified in Electrical Specifications [Electrical General, Installation].
2. Panels shall be completely factory wired and tested before shipment.
3. All spare PLC input / output points shall be wired to terminal blocks.
4. A minimum of 20% spare unwired terminals shall be provided in each panel.

B. Wiring Methods:

1. Wiring Separation: Wires carrying 100 volts and above shall be physically separated from lower voltage wiring by using separate bundles or wire ways with sufficient distance to minimize the introduction of noise, crossing only at 90 degree angles.

2. Harness: All wiring shall be neatly bundled and laced with plastic tie-wraps, anchored in place by screw attached retainer. Where space is available, wiring shall be run in slotted plastic wireways with dust covers. Wireways shall be sized such that the wire fill does not exceed 60%. Tie-wraps shall be T&B TY-RAP or equal.

3. Retainers: Wireways, retainers, and other devices shall be screw

mounted with round-head 316 stainless steel screws or mechanically mounted by push-in or snap-in attachments. Glue or sticky back attachment of any type or style shall not be used. Retainers shall be T&B TC series or equal.

4. Hinge Loops: Where wiring crosses hinged surfaces, provide a "U" shaped hinge loop protected by clear nylon spiral wrap. The hinge loop shall be of sufficient length to permit opening and closing the door without stressing any of the terminations or connections. Spiral wrap shall be Graybar T25N or equal.

5. Routing: Wires and cable shall be routed such as to maintain separation between 100 Volt or higher from 100 volt or lower wiring being run in the same duct or bundle. Wires and cables shall have sufficient length to allow slack and to avoid any strain or tension in the wire or cable.

   a. Wires shall be routed in slotted plastic wireways with snap covers. Wires carrying 120 VAC shall be separated as much as possible from other wires and signal cables, and shall be routed only in ducts for 120 VAC. If the power wiring has to cross the signal wiring, the crossing shall be as close to a right angle as possible. Wireways for 24 VDC wiring shall be used for all other wires and cables. Routing of 120 VAC in combined wireways shall be minimized. Wires and cables shall be placed in the wireways in a straight, neat and organized fashion and shall not be kinked, tangled or twisted together. Additional wire ducting shall be provided for use by the electrical subcontractor for routing field wires to their landing points in the each electrical and instrumentation panel.

   b. Provide 2” minimum separation between wireway and terminal blocks.

   c. Wiring not routed in wireways shall be neatly bundled, treed, and laced with plastic ties.

C. Wire Terminations

1. Single wire and cable conductors shall be terminated according to the requirements of the terminal device as follows:

   a. Crimp-on 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 Blocks: Remove the last +/- 0.25 inches insulation from of the conductor and insert it under the pressure plate to full length of the bare portion of the conductor. Tighten the screw to close the pressure plate onto the conductor. No more

than two conductors shall be installed in a single terminal. All strands of the conductor shall be captured under the pressure plate.

c. Screw-less terminals: wire shall be stripped back and inserted per the terminal manufacturer's instructions.

d. Motors with pigtail leads: Install terminal connectors on the motor pigtails and the cable to be connected. Terminals shall be non-insulated crimp-on type applied with a rachet-type crimping tool. The terminals shall be bolted together with a nut, bolt and lock washer combination. The connection shall be booted with 3/16" thick rubber boot. Boot kit shall include rubber boot for each motor connection, plastic locking pins, silicone grease, and mastic sealing strips, Boot kits shall be 3M Motor Lead Pigtail Splice #5302, #5303,or #5404 as applicable for wire size applied.

2. When stripping insulation from conductors, do not score or damage conductor.

3. The drain wire and stripped end of outer jacket of shielded cables shall be covered with heat shrink insulating tubing. The drain wire shall be covered along its full bare length between the cable jacket cover and the terminal lug and placed on end outer jacket to cover foil.

4. Condulets with wire nut connections shall be supplied for wire termination to devices with leads instead of terminals (i.e. solenoid valves, level probe, etc.).

D. Wire Splicing

1. No wires shall be spliced without prior approval.

2. Where splices are allowed or approved they shall conform to the following:

a. Wire splicing devices shall be sized according to manufacturer's recommendations.

b. Splices of #10 and smaller, including fixture taps, shall be made with nylon self-insulated twist on wire nuts; T & B "Piggys", Ideal "Wing-Nut" or equal.

c. Splices of #8 and larger shall be hex key screw, two way connectors, insulated with molded high-dielectric strength plastic; NSI Polaris IPL or IPLD Series terminal blocks or equal.

d. Non-Motor Splices #6 and smaller in underground pullboxes shall have wire-nut connections which are sealed with non-hardening silicone based sealant that protects the connection

from moisture and corrosion. The wire nuts shall be factory filled with sealant and UL listed for waterproof connections. Provide Ideal Model 60 or equal.

e. Non-Motor Splices #4 and larger in underground pullboxes shall have double hex crimp barrel connections applied with adhesive/sealant filled heat shrinkable rubber insulation applied over the exposed connection. The cross-linked polyolefin shrink tube shall extend 4" on each side of the exposed connection minimum. Heat shrink tubing shall be 3M ITCSN or equal.

E. Wire Installation

1. Exercise care in pulling wires and cables into conduit or wireways so as to avoid kinking, stressing the cables, or damaging the insulation. Use a UL listed pulling compound for lubrication within conduits as necessary. The raceway construction shall be complete and protected from weather before cable is pulled in. Swab conduits before installing cables and exercise care in pulling, to avoid damage to the insulation or conductors.

2. All wire and cables (with the exception of coaxial antenna cable) shall be installed within UL listed raceways or enclosures. Install all wires and cables in one continuous length unless splices are per Contract Drawings, required to connect equipment or submitted and favorably reviewed.

3. Bundle incoming wire and cables in panels. Zip-tie at intervals of 2" and neatly spread into trees and connect to their respective terminals. Allow sufficient slack in cables for alterations in terminal connections. Do not bundle, tape or tie wires within conduits.

3.03 WARRANTY

A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

SECTION 26 32 13

ENGINE GENERATOR

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Because of potentially long permit applications processes and manufacturing lead times for the generator equipment, the Contractor is required to submit the complete generator submittal within 14 days of notice-to-proceed and/or contract award.

B. These specifications describe the minimum requirements for a STANDBY duty three phase engine driven generator. The "Generator Data Sheet" at the end of this specification lists the minimum sizing for the generator and accessories. A larger generator shall be supplied when necessary to meet the requirements of this section. The Contractor shall complete this form with proposed generator values and include it with the generator submittal.

C. The generator shall be provided as described in the following specification and as shown on the Contract drawings, herein designated as the design documents. The generator shall comply with all applicable sections of NFPA 30, 37, 70, 72 and 110, California Fire Code Articles 79 and 80 as well as State Statues.

D. The equipment furnished under these specifications shall meet the requirements of NEC Article 702, "Optional Standby Systems" and any other applicable articles of the NEC.

E. The system shall meet the requirements of NFPA 704 Hazard Identification System Diamond indicating the hazards associated with the fuel being stored.

F. The generator shall be delivered as a skid mounted unit, completely assembled to the extent possible and factory tested.

G. Only new models in current production by a U.S. firm that meet the requirements of these specifications and which are cataloged by the manufacturer and for which manufacturer's published literature and printed specifications are currently available, will be considered. Special options may be included only when recommended by the manufacturer of the unit approved.

H. All equipment/options are to be factory installed. If the equipment/options are not available factory installed, dealer installed equipment/accessories may be acceptable. The bidder is to specify those items which will be dealer installed in the submitted bid document.

I. The manufacturer's local representative shall be an authorized distributor who maintains a stock of spare parts for the supplied generator and has a service

facility with factory-trained service personnel. The manufacturer's local representative shall be located within a radius of 100 miles of the project.

J. The Contractor shall perform complete startup, training and testing services for the generator per Electrical Specifications [Factory and Field Testing] and as detailed herein.

K. Generator system shall be EPA Certified and meet all current Local, State and Federal air emissions requirements at time and location of installation.

L. Generator system shall be coordinated and compliant with all current Local and State building and Fire Protection codes and requirements at time and location of installation. Furnish alarms, signage, fuel containment, shutdowns, and other devices and systems as required.

M. The Contractor shall supply the generator, labor, testing and associated documentation as specified herein. This document describes the materials and intended operation, but does not necessarily describe all devices necessary for a functional system. All components and devices shall be furnished and installed as required to provide a complete, operable and reliable system for accomplishing the functions and meeting the performance set forth hereinafter.

N. The generator scope of work includes:

1. Engine driven electric generator
2. Sub-base fuel tank with fuel pump and associated piping.
3. Battery charger (120 VAC operated) mounted to generator frame.
4. Sound attenuating housing.
5. All auxiliary apparatus and accessories shall be provided as required for a fully functional generator and to meet local code requirements.
6. Install a steel reinforced concrete pad, adequately sized to support the specified generator and fuel tank.
7. Trenching, back filling, compaction and paving of each underground conduit route
8. Field installation, startup, testing and training for the generator and associated equipment as part of this scope of work.
9. Fuel for use during testing and full tank top off upon testing acceptance.

1.02 REFERENCES

A. Electrical Specifications [Electrical General]

B. Project Drawings

C. The following manufacturing and installation standards apply to this section:

1. ASTM International (ASTM): A335/A335M, Specification for Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service.

2. Best Available Control Technology Standards (BACT)

3. Code of Federal Regulations (CRF): Title 40 Volume 18, Control of Emissions from New and In-Use Non-road Compression-Ignition Engines.

4. National Fire Protection Association (NFPA):

   a. 37, Installation and Use of Stationary Combustion Engines and Gas Turbines.

   b. 70, National Electric Code.

   c. 110, Emergency and Standby Power Systems.

5. SAE International (SAE): J1074, Engine Sound Level Measurement.

6. Underwriters Laboratories, Inc. (UL):

   a. 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.

   b. 2085, Protected Aboveground Tanks for Flammable and Combustible Liquids.

   c. 508, Industrial Control Equipment.

   d. 1236, Battery Chargers for Charging Engine-Starter Batteries.

   e. 2200, Stationary Engine Generator.

D. The bidder shall carefully examine the plans and specifications, and be familiar with the conditions of the location of installation.

1.03 QUALIFICATIONS

A. Equipment manufacturers shall be represented by a company capable of servicing and testing the generator unit from a mobile service vehicle dispatched from within a 200 mile radius.

1.04 SUBMITTAL REQUIREMENTS

A. Submit shop documents and drawings for approval in accordance with this subsection and as specified in Electrical Specifications [Electrical General, Submittal Requirements]. All non-relevant items not provided on this project shall be crossed-off or deleted from all submitted documents and drawings.

B. Submit a specification compliance statement, describing differences between specified and proposed equipment. Note equipment provided specifically to meet local agency or authority having jurisdiction requirements.

C. Complete "Generator Data Sheet" at the end of this section and submit this form with the generator submittal.

D. Submit data sheets and catalog information detailing:

1. Engine:

   a. Make and model.
   b. Fuel type.
   c. Number of cylinders and cylinder arrangement.
   d. Bore and stroke.
   e. Compression ratio.
   f. Piston speed, Feet per Minute, at rated RPM.
   g. Cylinder head, piston, valve, and block material.
   h. Crankshaft material.
   i. Main bearings, quantity and type.
   j. Rated RPM and HP at rated RPM.
   k. Governor type.

2. Generator:

   a. Make and model.
   b. Generator full load electrical rating, KVA, KW, Voltage, Amperage, Frequency (Hz), # of Phases, # of Wires, Power Factor.
   c. Generator and Exciter type.
   d. Insulation material, class, and temperature rise.
   e. Bearings, quantity and type.
   f. Peak motor starting, KVA.
   g. Voltage regulator type and regulation % from no load to full load.
   h. Frequency regulator type and regulation %, from no-load to full load.
   i. One step load acceptance.
   j. Unbalanced load capability.
   k. Number of leads.
   l. Generator transient (x'd) and subtransient (x"d) reactance in per unit.
   m. Ambient temperature range.

3. Electrical

   a. Control and instrument panel.
   b. Generator main breaker.
   c. Batteries and battery charger.

4. Cooling System

   a. Maximum ambient temperature.
   b. Capacity (gallons).
   c. Coolant flow (gpm).
   d. Fan diameter (in).
   e. Fan HP requirement at rated RPM.

5. Accessories:

    a. Exhaust silencer, stack, and piping system.
    b. Fuel tank and piping system.
    c. Vibration isolation system.
    d. Block Heater system.
    e. Weatherproof/Soundproof Housing as specified herein.
    f. Paint Finish.

E. Submit electrical schematics and wiring diagrams for:

1. Generator control panel.
2. Battery charging system.
3. Main generator.
4. Voltage regulator.
5. Governing system.
6. Generator main breaker.

F. Submit dimension drawings for:

1. Engine generator side, front, and top.
2. Pad construction (minimum) size, anchor details.
3. Enclosure (if required).
4. Fuel tank and containment basin.
5. Exhaust muffler and air intake baffle.
6. Conduit stub-up areas under generator frame and/or sub-base fuel tank.

G. Submit reports, calculations, and curves for:

1. Generator sizing calculation (computer generated report acceptable) showing that the unit is sized adequately to start all loads as shown on Contract Drawings "Load Calculation" without exceeding the maximum voltage dip specified.

2. Generator air emissions data, prototype or actual, suitable for submission to governing air quality management agency where generator is to be installed. Emissions data shall be for fuel type as required by local air quality agency.

3. Sound level data showing that the complete generator package meets the sound level requirements stated herein.

4. Engine generator fuel consumption data at 25%, 50%, 75% and 100% electrical loading.

5. Proposed concrete pad dimensions, reinforcement method and isolation material (as necessary) for submitted generator.

6. Seismic calculations for bolt down anchorage for seismic site class D. Calculation shall be signed by a California Registered Professional

Structural Engineer. Generator installation shall meet applicable CBC or IBC requirements for stand-by power systems.

a. Calculations shall include calculations for wind loading on equipment to be mounted outdoors.

b. The Contractor shall submit a copy of the current ICBO anchor evaluation report for each type of anchor submitted.

c. The Contractor shall submit a copy of the concrete mix design to include the concrete design strength.

d. The Contractor shall submit Near Fault Vicinity and Location maps.

H. Air Quality Management Applications and Permits

1. The Contractor shall obtain the correct ATC application from the AQMD and preliminarily complete the application by inserting the project specific generator technical information. Submit preliminary partially completed application to the Engineer for use by the Owner in preparation of the final completed ATC application.

2. The Contractor shall submit all generator specific information required to complete the ATC permit application. The Owner will not submit the application until all the information is received and the submittal receives a status of "make corrections noted" or "approved." Submit information in sufficient time for application processing and submittal review as to not delay project completion. The generator will not be considered approved until the ATC permit is obtained.

3. The Owner shall complete and apply for the "Authority to Construct" (ATC) permit from the Air Quality Management District or Board with jurisdiction for this generator system. Fees for permit and application will be paid by the Owner. The Owner will submit the permit application within 14 days of submittal approval. Allocate 12 weeks for Owner to obtain ATC permit once application has been submitted.

4. The Contractor shall confirm that the submitted generator meets all AQMD guidelines prior to submittal of the generator unit or preliminary application. Failure to do so will delay the ATC permitting and submittal approval.

I. Descriptive literature shall be provided that describes the generator and all accessories. This literature shall provide sufficient detail to determine that the generator has all the accessories, options, features, and characteristics specified herein. Items that are not provided shall be neatly lined out.

J. Deviations from the Contract documents shall not be incorporated into the work without prior written approval. A "Change Order" directive is required prior to incorporating any deviation from the Contract documents that has

costs associated. The cost differential associated with this change order must be negotiated to amend the Contract to reflect the costs or savings.

K. Exceptions to the Specifications or Drawings or equipment or procedures submitted as "equal" to specified equipment shall be clearly identified by the equipment supplier in a letter at the front of the submittal. Submittal data for "equal" equipment or procedures shall contain sufficient details so a proper evaluation may be made. The Contractor is responsible for verifying proper application/operation of substituted equipment.

L. The Owner will not accept any ownership for material or equipment until the corresponding submittals have been reviewed by the Owner and approved.

M. Submit complete and specific information with regard to equipment representatives and service facilities.

1.05 OPERATION AND MAINTENANCE INFORMATION

A. Provide six (6) sets of operating, maintenance & parts instructions in original manuals (no copies allowed).

PART 2: PRODUCTS

2.01 QUALITY

A. The generator shall be as manufactured by Caterpillar, Cummins, Generac, Kohler or equal with accessories as defined herein.

B. The equipment supplied and installed shall meet the requirements of the National Fire Protection Association (NFPA 70 and NFPA 110) and all applicable local codes and regulations.

C. The generator system shall be designed as a "black start" unit capable of starting and operating without any external power.

D. Provide all of the features, options, and accessories specified herein and shown on the design drawings. Finished equipment shall be complete and site tested as an installed unit with all accessories functioning.

E. All rotating parts shall have guards to protect against accidental contact in accordance with Federal OSHA and Cal-OSHA requirements.

2.02 RATING

A. The engine generator shall have a minimum continuous standby rating as listed in "Generator Data Sheet" at the end of this section. Standby rated shall mean that generator starts within 60 seconds upon being called and operates continuously for the total duration of the generator call or fuel supply. Rating of the generator shall be based on operation when equipped with all necessary operating accessories such as radiator, fan, air cleaners, lubricating oil pump, governor, exhaust silencer, etc.

B. No derating from the ratings specified shall occur for ambient temperatures below 122°F or installation elevation below 1,000 feet.

C. The generator will be installed at approximately 500 feet above sea level. The generator shall operate as specified at ambient temperatures between 0 degrees Fahrenheit and 122 degrees Fahrenheit.

D. The engine/generator shall accept 100% of its nameplate rating at 0.8 PF in one step, in compliance with NFPA 110, Paragraph 5-13.2.6.

E. The generator shall be capable of successfully providing three phase, four wire, 60 hertz power to start and continuously operate at the specified KW rating and below for loads shown in the drawing and/or with power factors between 0.5 lag to 0.9 lead. It shall be capable of operating in noisy electrical environments that are typical of variable frequency drive motor loads. The nominal voltage and maximum step voltage dip shall be per the "Generator Data Sheet," as measured line to line at the generator terminals, during start of any of the station loads.

F. Generator set mean time between failures shall be a minimum of 5,000 hours.

2.03 ENGINE

A. The engine shall be a turbocharged compression ignition engine type, water cooled, four cycle, with vertical inline or V-type cylinders and an overhead valve configuration.

B. The engine shall utilize only NO. 2 diesel fuel. Generator shall operate per manufacturer's specifications using fuel approved by local air quality authorities.

C. The engine shall be of direct injection design, i.e. pre-combustion chambers shall not be incorporated in the cylinder heads. Glow plugs shall not be used for engine starting.

D. The engine shall have sufficient power to produce the specified ratings when operating with all accessories including exhaust, fuel, cooling, and battery charging systems, etc.

E. The engine shall be equipped with:

1. Engine driven or electric fuel transfer pump, fuel filters, and electric fuel shutoff valve. The fuel transfer pump shall be capable of lifting the fuel from the sub-base fuel tank. Primary and secondary fuel filters shall be provided. The fuel filters shall be replaceable and conveniently located for servicing.

2. Electrical governor; consisting of a magnetic pickup speed sensor, adjustable electronic control, and an electrical actuator mounted integrally with the fuel pump. The governor shall provide automatic

engine generator set frequency regulation adjustable from isochronous to 5% droop. Governors using external throttle linkages are not acceptable.

3. An electric starting system complete with batteries, battery charger, battery rack, connector cables, and any other equipment required to start the standby generator. The starting system shall not require an auxiliary AC power supply to start, fully load, and operate the standby generator. The batteries shall be sized to provide five starts with 30 seconds cranking for each start attempt. The battery charger shall be sized to fully recharge the batteries within 12 hours. If required to maintain the above criteria, an electrical heat pad for the batteries shall be provided to keep the batteries in a ready state at the specified minimum ambient temperature. The charger shall be furnished with charger trouble alarm and an automatic equalize timer for fast recharge. The charger shall alarm on loss of power and cause a generator common alarm output.

4. Positive engagement solenoid shift-starting electric starter with DC voltage as listed in "Generator Data Sheet."

5. Battery charging alternator with a minimum ampere output as listed in "Generator Data Sheet."

6. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain. The oil pump shall be capable of supplying adequate lubricating oil under pressure to the main bearings, crankshaft bearings, pistons, piston pins, timing gears, camshaft bearings, and valve rocker mechanism. The cartridge oil filters shall be full flow type, conveniently located for servicing. Filters shall be equipped with a spring loaded bypass valve to ensure oil circulation if filters are clogged.

7. An electric DC motor-driven pre-lube oil pump shall be provided if required by the engine manufacturer's design for "black start" of the standby generator.

8. Dry type replaceable air cleaner elements. The dry-type air cleaner shall be equipped with a self-cleaning dust and water evacuator and a vacuum restriction gauge to indicate maximum allowable restriction of the air cleaner system according to the engine manufacturer's recommendations. The air cleaner elements shall be conveniently located for servicing. The air filters shall be supplied with automatic swing open louvers to allow inlet air flow during engine operation.

9. Unit mounted radiator, blower fan, water pump, and thermostat. The radiator with blower type fan shall be sized to maintain safe operation at 122° F ambient temperature. The engine cooling system shall be filled with a solution of 50/50 ethylene glycol/water antifreeze or equivalent as recommended by the manufacturer.

10. Replaceable type cylinder liners.

11. Replaceable insert main bearings.

2.04 GENERATOR

A. The generator shall be a synchronous wye-connected generator designed for direct connection to the engine. It shall be salient-pole, brushless, 12-lead reconnectable, self-ventilated, drip-proof construction, with amortisseur rotor or damper windings and skewed stator for smooth voltage waveform. The unit shall conform to the applicable standards for synchronous generators, salient pole type.

B. The generator shall have the following features:

1. Temperature rise of the rotor and stator shall be limited to 125° C for the specified KW and KVA ratings.

2. Steady state voltage regulation from no load to full load within +/- 0.25% for electronic governors, +/- 0.8% for mechanical governors.

3. Steady state regulation from no load to full load within +/- 0.25%.

4. The insulation material shall meet the NEMA standard (MG1-22.40 and 16.40) for class H and be vacuum impregnated with epoxy varnish to be fungus resistant per MIL I-24092.

5. The excitation system shall be of brushless construction controlled by a solid state voltage regulator with adjustable volts-per-hertz operation capable of maintaining voltage within +/- 2% at any constant load from 0 to 100% of rating. The regulator isolated from the load to prevent tracking when connected to SCR loads. The regulator shall be protected from the environment by conformal coating and provide individual adjustments for voltage range, stability and volts-per-hertz operations. Provide permanent magnet (PM) excitation for generators above 150KW or AREP excitation for generators smaller than 150KW.

6. The generator shall have a single maintenance-free bearing and be connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.

7. Radio interference suppression to meet the BS.800 and VDE Class G and N standards.

8. Telephone interference factor of less than 50 per NEMA MG1-22.43.

9. AC voltage waveform total harmonic distortion of less than 5% total from no load to full load. Any individual harmonic shall have less than 3% THD.

C. The generator shall be inherently capable of sustaining at least 300% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current support devices.

D. On starting each listed load, the instantaneous voltage dip shall not exceed that listed in "Generator Data Sheet" and shall recover to +/- 1% of rated voltage within one second.

2.05 CONTROLLER & INSTRUMENT PANEL

A. Provide a generator-set mounted controller & instrument panel. The controller top shall be mounted no higher than 6 feet above finished grade. Controller mounting shall be vibration isolated from the rest of the engine / generator set.

B. Emergency stop maintained pushbutton located at maximum 6 feet above grade.

C. Remote mounted emergency stop glass covered pull switch located as shown in the drawings at maximum 54 inches above grade.

D. Controller Features

1. All solid state construction, except for interface relays. The controller shall utilize a microcomputer based logic with a ROM based control algorithm. Circuit boards shall be coated to protect from environmental damage.

2. Graphical display with preconfigured screens for parameter and alarm viewing and setpoint changes.

3. Voltage, current and power metering, engine and generator parameter viewing.

4. Real time clock for time stamping of diagnostic events and maintenance reminders.

5. Non-volitile memory for setpoint storage through power failures.

6. Security through password access.

7. Control of generator output circuit breaker for generator protection and synchronizing functions.

a. Paralleling functions to including automatic and manual synchronizing, dead bus arbitration, load sharing, and load sense/load demand.

b. Protective relaying functions – phase sequence, over/under voltage, over/under frequency, reverse power, overcurrent, current balance.

8. Communications to SCADA systems through included Ethernet Modbus TCP port.

E. Control circuitry shall be of plug-in design for quick replacement. The controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall be capable of operation from –40°C to 85°C.

F. Input circuitry from fuel tank devices such as fuel level switches and level transmitters, shall be designed to be suitable for the application and consist of current limiting circuitry and/or non-sparking devices.

G. Control must meet NFPA-110 Level 1 requirements (2005 version) and meet NFPA-70.

H. The panel display shall include as a minimum:

1. AC voltmeter.
2. AC ammeter.
3. Frequency meter.
4. Water temperature gauge.
5. Oil pressure gauge.
6. Battery voltmeter gauge.
7. Engine running time meter (non-resettable)
8. Voltage adjustment.
9. Pre-alarms:

    a. Auxiliary fault.
    b. Battery Charger Fault.
    c. Fuel low level/pressure.
    d. Low oil pressure.
    e. Low engine temperature
    f. High engine temperature.
    g. High battery voltage
    h. Low battery voltage
    i. Fuel leak alarm

10. Engine shutdowns:

    a. Auxiliary Shutdown.
    b. Emergency Stop.
    c. Low coolant level
    d. Overcrank.
    e. Overspeed.
    f. Low oil pressure.
    g. Low fuel level.
    h. High engine temperature.

11. Audible Alarm:

    a. Generator switch not-in-auto.

12. Functions:

a. Three position (RUN-OFF-AUTO) function: In the RUN position the engine shall start and run regardless of the position of the remote starting contact. In the AUTO position, the engine shall start when contacts in the remote control circuit close and stop five minutes after those contacts open following the engine cooldown sequence. In the OFF position the engine shall not start even though the remote start contact closes. This position shall also shutdown engine immediately.

I. Wiring – The manufacturer shall furnish, install at the factory, and test all wiring required between devices mounted within or on the standby generator unit base. All wiring shall be neatly and carefully installed in wiring gutters, wire looms, or raceway. All power supply circuits shall be provided with suitable isolation/electrical protection means consisting of either fuses or circuit breakers. All internal wiring shall be marked at both ends of the conductor.

J. Operation:

1. Two-wire generator start/stop control from an automatic transfer switch (normal start and stop with cooldown) and from a remote emergency stop (immediate stop with fuel shutoff).

2. Engine starter control for:

a. Cranking cycler with 15 second ON and OFF cranking periods or as recommended by the manufacturer. Cranking shall cease upon engine starting and running.

b. Two methods of cranking termination shall be provided:

1) After three 15 second cranking cycles.
2) After 75 seconds if the engine fails to start or as recommended by the manufacturer
3) Each condition shall lockout the engine, and visually indicate an overcrank alarm.

c. Starting system shall be designed for restarting in event of a false engine start. It shall permit the engine to completely stop rotating before reengaging the starter.

3. Provide wiring circuitry and sensing devices as required for emergency shutdown of the engine on any occurrence of the following conditions.

a. Low coolant level.
b. Over speed.
c. Over-crank.
d. High engine temperature.
e. Low oil pressure.

f. Low fuel
g. Emergency stop
h. Auxiliary shutdown

4. Engine cool down timer factory set at five (5) minutes to permit unloaded running of the generator set after the call to operate is dropped.

5. Programmable I/O contacts to be provided and brought out to terminals for connection to remote monitoring equipment:

a. A common alarm dry contact, normally open which closes on any alarm condition.
b. A generator running dry contact, normally open which closes when the engine is running.
c. A generator in cool-down dry contact, normally open which closes when the engine is running but opens when the engine enters cool-down.
d. Low fuel level dry contact, normally open which closes on low fuel alarm condition.
e. Fuel level (0-100% full) 4-20 mA output for PLC/SCADA monitoring.
f. Auto switch position dry contact that closes when the three position (RUN-OFF-AUTO) selector switch is in the "AUTO" switch position.
g. Remote emergency shutdown from normally closed switch.

2.06 ACCESSORIES

A. Engine block heater. Thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA-99 and NFPA-110, Level 1. Wattage and voltage shall be per "Generator Data Sheet."

B. Exhaust System:

1. The complete exhaust system (silencer, stack, and exhaust piping) shall be sized to ensure that exhaust back pressure falls within the manufacturer's minimum and maximum limitations under all operating conditions.

2. Exhaust Silencer: Provide exhaust silencer including flexible piping & fittings properly sized and installed according to the manufacturer's requirements. The silencer shall be critical type (30dB attenuation minimum) and coated to be temperature and rust resistant. The flexible connector section(s) shall be seamless, stainless steel and the ends shall be pipe thread (2" maximum) or SAE flanged. Support for exhaust silencer shall be from overhead or side supports or as shown and shall not be carried by the exhaust manifold.

3. Exhaust Stack and Piping: Provide thin-gauge steel pipes with flange

connections, high temperature gaskets, elbows and straight runs to complete the exhaust system. The exhaust system shall extend vertically above roof to direct exhaust and heat away from building or enclosure or as shown on the drawings. Provide wall thimble and roof penetrations designed for high heat applications and a gravity actuated steel rain cap at end of exhaust pipe. Exhaust system shall be supported from side or above utilizing galvanized steel channel trapeze hangars, gusseted wall brackets or custom welded brackets per manufacturer's recommendations to meet the specified seismic design conditions. Design system to accommodate engine vibration and not loosen or break exhaust system mounts.

C. Vibration Isolation

1. Engine Generator: Vibration isolation dampeners between the engine and steel mounting skid.

2. Exhaust Silencer: Mount with vibration isolators and/or flexible exhaust piping.

3. Enclosures shall be mounted with vibration isolators and/or steel structural stiffeners to minimize added noise due to vibration.

4. The generator shall have provisions for shipping/transit such that expected shocks will not damage the vibration isolators or generator.

D. Sub-Base Fuel Tank:

1. Fuel tanks shall be sized to provide fuel for a minimum full load run time in hours at full load listed in "Generator Data Sheet."

2. The sub-base fuel system shall be listed under UL 142, sub section entitled Special Purpose Tanks EFVT category, and will bear their mark of UL Approval according to their particular classification

3. Comply with local code requirements depending on location of installation. For example, furnish or provide the following:

   a. Tank pressure test
   b. Tank venting
   c. Spill containment.
   d. Hazardous labeling
   e. Fuel Filling Level alarm
   f. Others as required per code.

4. Perform a 2 hour site fuel tank pressure test. Local codes will govern the requirements and need for pressure testing. Comply with local codes.

5. The fuel tank shall have the following features:

a. Constructed of sheet steel with steel framing suitable for mounting the generator on top.
b. 1-1/4" mechanical fuel level gauge. Readout shall be fraction of full tank with indicators at 25%, 50%, 75%, 95% and 100% full. Provide Krueger Sentry Gauge or equal.
c. Flexible fuel line(s) rated 300°F and 100 PSI ending with pipe thread connections. Provide normally closed solenoid shutoff valve at fuel tank outlet that will energize/de-energize with generator run command.
d. 3/8" suction and return connections (minimum).
e. 3/8" diameter drain (minimum).
f. Primer and enamel exterior.
g. Venting per NFPA 30 and American Petroleum Institute Standard No. 2000.
h. Code required spill containment around 2" fill port with normally closed valve to release spilled fuel into the primary steel tank. Provide cover for spill containment area.
i. Secondary containment tank sized to contain 110% of the capacity of the fuel tank. A 3/8" minimum drain plug and 1" leak detection threaded hole and plug shall be provided.
j. Fuel level switches that are rated for use in fuel or fuel vapor atmosphere that are non-sparking. Switches shall actuate on a float mechanism which operates a sealed switch for connection to the generator control panel. Provide the following independent or combination switches:
    1) High High (90% full) level audible alarm.
    2) High (85% full) level audible alarm.
    3) Low (25% full) level for low fuel alarm indication.
    4) Low Low (5% full) for low fuel engine shutdown and indication.
    5) Secondary Containment Leak for fuel tank leak alarm.

6. Fuel pump as required for the installation per generator manufacturer. The fuel pump shall be powered from the generator's DC electrical system. Provide foot valve on suction tube in tank to keep the line primed and expansion relief on feed line to bleed excess fuel into tank.

E. Batteries: Support tray with plastic battery enclosure, tie downs, battery cables, and 12-volt batteries all mounted to the engine/generator skid. The batteries shall be capable of delivering the cold-cranking amps required at zero degrees Fahrenheit per SAE Standard J-537.

F. Signage:

1. Signage shall be posted on the sides of the generator enclosure facing the main approaches to the system.

2. Provide an engraved placard with fuel filling procedure, tank capacity, fuel type, and maximum fill guidelines.

3. Provide signage 0.08" thick white painted/silk-screened aluminum with

1-1/2" red lettering to read "No Smoking". Signs shall be posted on all sides of generator enclosure.

4. Provide signage 4" x 6" x 0.08" white painted aluminum with red lettering to read "Generator Emergency Stop" for installation at a remote emergency stop switch as shown on the drawings.

5. Provide 8" x 6" x 0.08" sign with 4 ft galvanized (1-1/2" diameter) pole "Generator foam fire suppression hook-up" and similar sign without pole denoting "This Generator Equipped with Internal Fire Suppression Piping."

G. Automatic Battery Charger suitable for continuous operation to maintain the battery charge voltage with no manual intervention. Battery charger features shall be as follows:

1. Solid state circuitry with charging modes as described to automatically recharge the starting batteries. When battery voltage drops below the specified value the battery charger shall operate at the high rate constant current mode until the battery voltage rises to the preset equalize level. The equalize mode will continue until the current required to maintain this voltage drops to 50% of the high rate level.

2. A current limiting circuitry to prevent charger overload under low battery voltage conditions. Provide minimum DC voltage and amp ratings (minimum) as listed in "Generator Data Sheet."

3. The battery charger shall provide temperature compensation of -2 mv/°C per cell over the ambient temperature of –40°C up to 60°C. This shall automatically adjust the "float" and "equalize" voltage settings to prevent the batteries from overcharging at high temperature and under charging at low ambient temperatures.

4. The complete charger unit shall be U.L. listed.

5. The charger shall be mounted to the engine/ generator skid. The charger shall be operational through an ambient temperature range of –40°F to 140°F. It shall include the following features:

   a. Fused AC input and DC output overload & short circuit protection.

   b. DC ammeter and voltmeter, 5% full scale accuracy, to indicate battery charging amps and volts.

   c. "Power on" lamp to indicate when the charger is operating.

   d. DC voltage regulation +/- 1% from no load to full load and over AC input line variations of +/- 10%.

   e. Reverse polarity protection to prevent the charger from energizing outputs if improperly connected.

f. Current limiting. Current limiting circuitry shall be provided to prevent damage to the charger from being overloaded at low battery voltage such as occurs during short circuit conditions or during engine starter cranking.

g. The battery charger shall be powered from 120 VAC.

H. Sound Attenuating Weatherproof Housing for the generator shall be as follows:

1. Manufactured from heavy-gauge aluminum or galvanized sheet steel and painted with the manufacturer's standard finish. Paint color shall be submitted to Owner for approval. Color choices shall include but not be limited to autumn white and beige. All surfaces shall be painted inside and out.

2. The interior of housing shall have a heat resistant thermo-acoustic insulation system designed to meet sound attenuation requirements for the life of the generator. The placement, type, thickness and weight of the attenuator panels shall provide sound dampening to the specified level of allowable noise outside the generator. The air intake and exhaust shall have similar dampening and allow ample air flow for proper engine cooling, without having to remove side panels. The insulation shall be mechanically held against walls, ceiling and doors behind full sheets of perforated galvanized sheet steel. All insulation shall be covered with the exception of the exhaust piping.

3. The enclosure shall house the engine, generator, control & instrument panel, battery charger, generator breaker, and all accessories.

4. The radiator discharge shall be directed upwards through the use of a vertical duct mounted to the enclosure. The duct shall include drip holes to allow rain water to drain out the bottom.

5. All exterior panels shall have lockable latches to prevent unauthorized entry.

6. The specified exhaust silencer shall be mounted in or on the roof of the enclosure with vibration isolators.

7. Pressure drops through the enclosure openings shall not exceed limits set by the manufacturer of the generator.

8. The enclosure shall be free standing and anchored to the concrete pad (or trailer) supporting the engine generator. The enclosure may be mounted to the generator skid only if a skid mounted enclosure can meet the sound attenuation requirements specified.

9. The enclosure shall be designed so that sound levels measured at a 25 feet radius from any side of the enclosure (free field) and 5 feet above ground level, noise levels shall not exceed (Generator Data Sheet) dB

with the engine generator running at full load and full speed inclusive of exhaust noise.

I. CIRCUIT BREAKER DISCONNECT

1. GENERAL

a. Circuit breakers and motor circuit protectors shall be manufactured by Eaton Cutler-Hammer, Square D, G.E., Siemens, or equal.

b. Sized by Generator manufacturer to meet UL standards, cabling requirements per plans, and "Generator Data Sheet."

c. Multiple-pole circuit breakers shall be designed so that an overload on one pole automatically causes all poles to open. The use of tandem or dual circuit breakers in a normal single-pole space to provide the number of poles or spaces specified are not acceptable.

d. Molded case circuit breakers shall be operated by a single toggle-type handle and shall have a quick-make, quick-break switching mechanism. An automatic trip of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and have flash reduction arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

e. Minimum interrupting capacity:

1) 480 volt circuit breaker shall have a minimum interrupting capacity of 42,000 amperes.

2) 120 or 208 or 240 volt breaker shall have a minimum interrupting capacity of 22,000 amperes

f. Circuit Breakers shall have thermal-magnetic (TM) trip units and inverse time-current characteristics unless protecting full voltage or solid state reduced voltage motor starters, 15kva or larger transformer secondary, or as specifically shown on drawings.

g. Where indicated on drawings, provide UL listed circuit breakers for continuous duty at 100% of their ampere rating in the intended enclosure.

PART 3: EXECUTION

3.01 WORKMANSHIP

A. The construction methods specified herein shall be followed by the manufacturer of the generator. If the manufacturer fails to comply, the Contractor shall pay all costs required to make the changes to the equipment

to conform to these construction methods.

B. Screw type solderless terminals or lugs shall be provided for all field connected power cables, control and instrument wiring. All connections shall be accessible from a designated connection panel without removal of internal components.

C. A terminal strip shall be provided for control and instrument wiring. Number all terminals with machine printed lettering.

D. All internal and external control and instrument wiring shall have permanent identification at each point of connection. Wire identification shall be by machine printed numbered "shrink-tube" wiring sleeves. Internal wire numbers shall be per generator manufacturer's wiring diagram. External wire numbers shall be determined by the connected control panel(s).

E. Control and instrument wiring shall be neatly bundled and secured in place with screw down anchors and plastic cable ties. Wiring shall be protected with plastic spiral wrap where it is subject to mechanical damage or crosses over to a hinged door.

F. The generator and any accessories shall be a product of excellent workmanship and shall be free from any defects or imperfections that will affect their appearance or serviceability.

G. The generator's neutral shall be grounded per generator manufacturer's installation instructions for 3 wire distribution systems.

3.02 INSTALLATION

A. The generator shall not be delivered to the job site until the manufacturer's certified factory test report has been submitted, reviewed and accepted. A non-existent or non-reviewed certified factory test report shall be sufficient cause for the unit to be rejected.

B. The Contractor shall remove rejected equipment immediately from the jobsite at his expense until the generator submittal and/or factory test report is approved.

3.03 FACTORY INSPECTION AND TESTS

A. Factory or Factory Authorized Dealer shall be considered one in the same for the purposes of inspection, testing, service facility and herein after may be referred to as "factory" or "manufacturer."

B. Prior to delivery, the Contractor shall notify and give the Owner Representative the opportunity to inspect and witness each test of the generator at the test location. Written notice shall be provided to the Owner Representative seven (7) days prior to the date for the factory test. Costs associated with Owner Representative attending factory inspection and/or testing will be paid by the Owner Representative. Regardless of Owner

Representative testing attendance, the generator shall not be shipped from the Factory prior to acceptance of factory test report.

C. Factory Tests: Each generator to be supplied shall be tested by the manufacturer prior to shipment. All tests shall be made with all accessories installed. The factory tests shall be made under varying loads (30% to 100%) for a minimum of one hour total.

The factory testing shall include the following tests:

1. Single step load pickup.
2. Transient and steady state governing.
3. Safety shutdown device testing.
4. Voltage regulation.
5. Rated power.
6. Maximum power.
7. Test all generator control panel alarms, status lights & indicators.
8. Test all remote connection status and alarm points (dry contacts).
9. Simulate remote ATS start/stop of generator utilizing a wire jumper.

D. A typewritten factory test report shall be provided which lists the factory tests performed. The results of the each test, name & phone number of person who performed the tests, date(s) when tests were performed, serial & part number of equipment tested, setting values, failures encountered, and repairs made during testing.

3.04 FIELD ASSISTANCE

A. The Contractor shall take all precautions necessary to ensure the safety of all personnel during the tests. Absolutely no tests shall be run that could potentially cause injury or jeopardize personnel safety.

B. The initial setup of each generator shall be performed by a factory-trained service person of the manufacturer's local representative. Fill the engine fuel, lubricants, and cooling system and make all preliminary tests and checks required before engine start-up the day prior to witness field testing.

C. The Contractor shall be responsible for and pay the costs for the necessary fuel to fill each generator tank prior to the start of the field tests. The fuel shall include a fuel conditioner as recommended by the manufacturer.

D. The Contractor shall pay for a factory-trained service representative to perform one (1) 8-hour day of field tests for each generator, beginning at 8:00 a.m. any weekday, except Friday.

1. Each failure mode, alarm, and control function shall be demonstrated to Owner by the Contractor's factory-trained service representative prior to performing any other field tests.

2. The generator manufacturer representative shall furnish a temporary 1.0 PF load bank and connection cabling rated for a load equal to no

less than 100 percent of the generator nameplate KW. The load bank shall be connected to the generator output terminals for a four (4) hour, full-load test. The Owner Representative shall be allowed to change loads during the tests to simulate normal operating conditions. The factory-trained service person shall be responsible for running the generator during the load tests. Any defects or failures discovered during these tests shall be corrected or adjusted by the factory-trained service person. The engine generator load test shall be restarted after each repair or adjustment that requires shutdown of the generator. The test shall be restarted as many times as necessary until the generator runs for four (4) continuous hours without shutdown or failure.

3. The temporary load bank shall be set-up the day before testing. Under no circumstances shall the testing be allowed to extend beyond 5:30 p.m.

4. All field tests shall be witnessed by Owner. Written notice shall be provided to the Owner Representative seven (7) days prior to the date for the field test.

E. The Generator Field Checklist (GCL per Electrical Specifications [Factory and Field Testing] shall be completed by the generator manufacturer representative prior to beginning of operational testing. The checklist shall be signed by the representative submitted prior to the start of operational load bank testing.

F. The Generator Performance Test Report (GPT per Electrical Specifications [Factory and Field Testing].) shall be completed by the generator manufacturer representative during operational testing. The forms shall be signed by the representative and given to the Owner Representative prior to completion of operational load bank testing.

G. The Generator Sound Level Data Form (GSLD Electrical Specifications [Factory and Field Testing] shall be completed by the generator manufacturer representative during operational testing. The forms shall be signed by the representative and given to the Owner Representative prior to completion of operational load bank testing.

H. Training

1. The local representative's factory-trained service person shall instruct in the proper operating and maintenance procedures for all components of the generator. This instruction shall be given for a minimum length of two (2) hours. The training shall cover "operation" and "maintenance". Training shall not begin until Operation and Maintenance manuals are approved and field tests have been completed.

3.05 WARRANTY

A. The Generator System Supplier shall have a staff of experienced personnel available to provide service on two (2) working days notice during the warranty period. Such personnel shall be capable of fully testing and diagnosing the equipment delivered; and of implementing corrective measures.

B. If the Generator System Supplier fails to respond in two (2) working days, the Owner at its option will proceed to have the warranty work completed by other resources; the total cost for these other resources shall be reimbursed in full by the Contractor. The use of other resources, as stated above, shall not change or relieve the Contractor from fulfilling the remainder of the warranty requirements.

C. Prior to final acceptance, the Contractor shall furnish a listing of warranty information for all manufacturers of materials and equipment supplied under the scope of work covered in these design documents. The listing shall include the following:

1. Manufacturer's name, service contact person, phone number, and address.
2. Material and equipment description, equipment number, part number, serial number, and model number.
3. Warranty expiration date.

D. Hardware support:

1. The Contractor shall provide warranty of all equipment for a period of one (1) year from date of final acceptance. Standard published warranties of equipment which exceed the preceding specified length of time shall be honored by the manufacturer.

2. The Contractor shall provide all labor and material to replace or repair any hardware that fails during the warranty period, at no additional cost to the Owner.

3.06 FINAL ACCEPTANCE

A. Final acceptance will be given by the Owner after the equipment has been field tested satisfactorily, each deficiency has been corrected, documentation has been provided, and all the requirements of design documents have been fulfilled.

B. At the end of the project, following the completion of the field tests, and prior to final acceptance, the Contractor shall provide the following to the Owner:

1. Fuel tank top off. The Contractor shall supply up to one entire tank of fuel at the end of the project.
2. Each "operation, maintenance and parts" manual shall be modified or supplemented by the Contractor to reflect all field changes and as-built conditions.
3. Two sets of keys for all locks.

GENERATOR DATA SHEET (Lake Pump Station)

The following data sheet is a summary of generator required specifications. Not all specification requirements are listed below. The Contractor/Supplier shall return this page with the Submitted Value column completed. If submitted values are less than those listed in the Specification Minimum column, then the supplier shall explain reasons for the exception in cover letter.

Description	Specification Minimum	Units	Submitted Value	Units
Generator Continuous Output Power	**275**	KW		KW
(Oversize alternator may be required)	**344**	KVA		KVA
Three phase voltage (Nominal)	**480**	Volts AC		Volts AC
Continuous amperage at 0.8 power factor	**413**	Amps AC		Amps AC
Power Frequency	**60**	Hz		Hz
Maximum voltage dip with motors per load calculation (defines alternator size)	**15**	%		%
Reactance – Subtransient (X"d)	**	%		%
Reactance – Transient (X'd)	**	%		%
Reactance – Synchronous (Xd)	**	%		%
Engine horse power at rated KW	**	HP		HP
Engine RPM at rated power	**1800**	RPM		RPM
Engine Fuel Type	**No. 2 Diesel**	-		-
Engine aspiration (Normal/Turbo)	**Turbo**	-		-
System Voltage	**	Volts DC		Volts DC
Alternator output (at system voltage)	**	Amps DC		Amps DC
Battery charger output	**10**	Amps DC		Amps DC
Engine block heater power	**	W		W
Alternator condensation strip heater	**	W		W
Heater(s) voltage (1 phase)	**240**	Voltage		Voltage
Fuel tank capacity (hrs @ 100% load)	**24**	Hours		Hours
Type (Sub-base/Remote)	**Sub-base**	-		-
Main Breaker Maximum Rating	**600**	Amps		Amps
Trip Features Per Spec	**TM**	-		-
Interrupt Rating	**42**	KAIC		KAIC
Load Bank (Radiator Mounted, None) Load Bank Rating Percentage	**None**	% of FLA		
Enclosure type (Sound Atten., Weatherproof, None)	**75 dB Sound Attenuating**			

** Sized per manufacturer recommendations to meet intent of plans and specifications, codes, and environmental conditions at location of installation. Please highlight any deviations from drawings and specifications.

GENERATOR DATA SHEET (Sneath Pump Station)

The following data sheet is a summary of generator required specifications. Not all specification requirements are listed below. The Contractor/Supplier shall return this page with the Submitted Value column completed. If submitted values are less than those listed in the Specification Minimum column, then the supplier shall explain reasons for the exception in cover letter.

Description	Specification Minimum	Units	Submitted Value	Units
Generator Continuous Output Power	**300**	KW		KW
(Oversize alternator may be required)	**375**	KVA		KVA
Three phase voltage (Nominal)	**480**	Volts AC		Volts AC
Continuous amperage at 0.8 power factor	**451**	Amps AC		Amps AC
Power Frequency	**60**	Hz		Hz
Maximum voltage dip with motors per load calculation (defines alternator size)	**15**	%		%
Reactance – Subtransient (X"d)	**	%		%
Reactance – Transient (X'd)	**	%		%
Reactance – Synchronous (Xd)	**	%		%
Engine horse power at rated KW	**	HP		HP
Engine RPM at rated power	**1800**	RPM		RPM
Engine Fuel Type	**No. 2 Diesel**	-		-
Engine aspiration (Normal/Turbo)	**Turbo**	-		-
System Voltage	**	Volts DC		Volts DC
Alternator output (at system voltage)	**	Amps DC		Amps DC
Battery charger output	**10**	Amps DC		Amps DC
Engine block heater power	**	W		W
Alternator condensation strip heater	**	W		W
Heater(s) voltage (1 phase)	**240**	Voltage		Voltage
Fuel tank capacity (hrs @ 100% load)	**24**	Hours		Hours
Type (Sub-base/Remote)	**Sub-base**	-		-
Main Breaker Maximum Rating	**600**	Amps		Amps
Trip Features Per Spec	**TM**	-		-
Interrupt Rating	**42**	KAIC		KAIC
Load Bank (Radiator Mounted, None) Load Bank Rating Percentage	**None**	% of FLA		
Enclosure type (Sound Atten., Weatherproof, None)	**75 dB Sound Attenuating**			

** Sized per manufacturer recommendations to meet intent of plans and specifications, codes, and environmental conditions at location of installation. Please highlight any deviations from drawings and specifications.

END OF SECTION

SECTION 26 36 23

AUTOMATIC TRANSFER SWITCH

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall supply the automatic transfer switch (ATS) as specified herein.

B. The ATS scope of work includes:

1. Providing and installing one automatic transfer switch of rating shown on Contract Drawings.
2. Submittal data and drawings.
3. Startup assistance.
4. Factory and field testing.
5. Operation and maintenance manuals.
6. Warranty of all components.

C. Startup and configuration of ATS with installed voltages and loads.

D. As required under Electrical Specifications [Factory and Field Testing], furnish all required labor, materials, safety equipment, transportation, test equipment, incidentals and services to perform factory and/or field testing.

1.02 REFERENCES

A. Electrical Specifications [Electrical General]
B. Electrical Specifications [Factory and Field Testing]
C. Project Drawings

1.03 SUBMITTALS REQUIREMENTS

A. Provide Submittals as specified in Electrical Specifications [Electrical General, Submittal Requirements].

B. Include a record of each parameter available to be changed by the user. The list shall include factory defaults and space for entered values.

1.04 OPERATION AND MAINTENANCE INFORMATION

A. Provide operation and maintenance information as specified in Electrical Specifications [Electrical General, Operating and Maintenance Information].

B. Include a record of each ATS parameter setup during startup and testing and place a copy of setting in each O & M manual.

PART 2: PRODUCTS

2.01 AUTOMATIC TRANSFER SWITCH

A. General:

1. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATSs which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.

2. The ATS shall be rated to close on and withstand 42,000 RMS symmetrical short circuit amperes at the ATS terminals or otherwise shown. Provide overcurrent protection as shown on the Contract drawings.

3. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

4. ATS types utilizing components of molded-case circuit breakers, contactors, or parts thereof, are not acceptable.

5. The switch assembly shall be installed in a NEMA enclosure located as shown on Contract drawings.

6. The automatic transfer switch shall be an ASCO Model 7000, Zenith ZTSD, each with options to meet specified requirements, or equal.

B. Switch Unit:

1. The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be solenoid operated and only momentarily energized to minimize power consumption and heat generation.

2. The transfer switch shall feature a delayed transition mode. The switch shall remain in the neutral position (neither emergency nor normal) until the associated time delays have expired and allow the switch to complete the transfer.

3. The switch shall be 3 pole double-throw with inherently interlocked construction. A solid neutral shall be provided for all systems.

4. Wide contact gaps shall be provided to insure positive isolation of the normal and emergency power sources.

5. The switch shall be fully rated for amperage shown on Contract Drawings, for switching all types of loads including induction motors. The ratings shall apply to the voltage and mounting arrangement as shown in the drawings.

6. The main power contacts shall have silver alloy contact construction featuring a wiping action each time the switch is operated. Arc chutes shall be utilized to contain the inherent spark created when switching under load.

7. The main contact design shall allow repeated making and breaking of rated full load current, with a combination of motor and other loads and without damage or undue wear to the contacts.

8. All main power contacts and auxiliary contacts shall be mechanically driven from a common actuator shaft.

9. The bus shall be constructed of silver plated copper.

10. Inspection of all contacts, linkages and moving parts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors.

11. All switch and relay contacts, coils, mechanical linkages, and control elements shall be serviceable or removable from the front of the mounted switch or accessory assembly without removal of the switch or assembly from the compartment and without disconnection of the power cables or control wiring.

12. The switch shall have a manual operating handle for maintenance purposes.

13. Compression screw type solder-less terminals or lugs shall be provided for connecting all external line & load power cables and control wiring. All connections shall be accessible from the front without removal of internal components.

14. A terminal strip shall be provided for terminating all control wiring. All terminals shall be numbered with machine printed lettering matching the wire number of the terminated wire.

15. All control wiring shall have permanent identification at each point of connection. Wire identification shall be by machine printed numbered wiring sleeves. Electrically common wires shall have the same wire number. Electrically different wiring shall have unique wire numbers.

16. Control wiring shall be neatly bundled and secured in place by plastic cable ties. Wiring shall be protected with plastic spiral wrap where it crosses over a hinge to the door.

C. ATS CONTROL PANEL

1. A control panel shall be provided to direct the operation of the transfer switch. The modules sensing and logic shall be a controlled by a built-in microprocessor. Control panels that do not utilize microprocessor electronics to control the operation of the switch are

not acceptable.

2. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port.

3. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.

    a. Sensing and control logic shall be provided on multi-layer printed circuit boards.
    b. The panel shall be enclosed with a protective cover and be outer door or deadfront mounted such that it may be operated with the door closed for safety and ease of maintenance.

4. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to ± 1% of nominal voltage. Frequency sensing shall be accurate to ± 0.2%.

    a. The under-voltage of each phase of the normal source shall be monitored, with pickup adjustable from 85% to 100% of nominal and the dropout adjustable from 75% to 98% of pickup setting, both in increments of 1%. These adjustments shall be factory set at 85% dropout, and 90% pickup.
    b. The voltage of each phase of the emergency source shall be monitored, with pickup adjustable from 85% to 100% of nominal. This adjustment shall be factory set at 95% pickup.
    c. Frequency sensing of the emergency source shall be provided, with pickup adjustable from 90% to 100% of nominal. This adjustment shall be factory set at 97% pickup.

5. The transfer switch control panel shall be capable of operating over a temperature range of -20 to +60 degrees C.

6. The control panel shall include the following field adjustable time delays:

    a. Time delay to override momentary normal source outages, adjustable from 0 to 5 minutes. This adjustment shall be field set to place emergency generator on-line in 1 minute.
    b. Transfer to emergency time delay for controlled timing of load transfer to emergency, adjustable from 0 to 5 minutes. This adjustment shall be field set switch position in 5 seconds after power has stabilized.
    c. Emergency source failure time delay to ignore momentary transients during initial generator set loading, adjustable from 0

to 6 seconds. Set at 2 seconds.

d. Retransfer to normal time delay, adjustable 0 to 60 minutes. This adjustment shall be factory set at 5 minutes. The time delay is automatically bypassed if the emergency source fails and normal source is acceptable.

e. Unloaded running time delay for emergency engine generator cooldown, adjustable from 0 to 60 minutes. This adjustment shall be factory set at 5 minutes.

f. Delayed transition time delay for setting the dead time when all power is removed from the load side of ATS, adjustable 0 to 5 minutes. Set at 1 minute.

g. Generator Exercise Timer: Timer provided for operator adjustment of day of week, time of day and run duration for exercising the generator under operating loads by activating the automatic transfer switch. Timer shall be mounted on the ATS outer deadfront door.

h. The controller shall provide an integral engine exerciser. The timer shall be field set by the Contractor with date and time during training. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:

    1) Enable or disable the routine.
    2) Enable or disable transfer of the load during routine.
    3) Set the start time of day, day of week, week of month, alternate or every time start, duration of run.
    4) At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

7. The controller shall commit-to-start engine which requires the engine to reach proper output and run at least the duration of the cooldown setting, regardless of whether the load is transferred.

8. Provide interface relays or main switch follower contacts to comply with I/O interface requirements as defined in the P&ID diagram. Interfacing relays shall be industrial grade plug-in type with dust covers. Interface connections shall be wired to backpan terminal blocks. At minimum, the switch shall have the following unused I/O contacts available:

    a. Switch in Normal – SPDT rated 10 amps, 120 VAC
    b. Switch in Emergency – SPDT rated 10 amps, 120 VAC
    c. Engine starting contact -- DPDT gold-flashed contacts rated 10 amps, 32 VDC
    d. Emergency Power available – SPDT rated 10 amps, 120 VAC
    e. Normal Power available – SPDT rated 10 amps, 120 VAC

9. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal.

10. Provide separate LED signal lights with nameplates indicating the following:

    a. Utility power is available (green)
    b. Generator power is available (red)
    c. ATS is connected to Utility source (green)
    d. ATS is connected to the Generator source (red)
    e. ATS in neutral position (wht)

11. A three position momentary-type test switch shall be provided for the test / automatic / reset modes:

    a. Test: simulate normal source failure
    b. Automatic: normal operation
    c. Reset: bypass the time delays on either transfer to emergency or retransfer to normal.

12. All adjustments shall be field adjustable without the use of tools, meters, power supplies, or special test equipment and can be made safely without personal exposure to live parts

13. Each adjustment resolution shall be settable within minimum increments of 1%.

14. Repetitive accuracy of timer, voltage and frequency settings over a temperature range of –20° C to 70° C shall be within +/-2%.

15. The control panel programming shall be lockable via password protection.

16. The wire harness for connection of the control panel to the transfer switch shall have sufficient length to reach between the mounting locations shown on the Contract drawings.

17. Provide the following displays on the controller:

    a. Event log to display 99 logged events with the time and date of the event, event type and event reason.
    b. Total number of ATS transfers.
    c. Number of ATS transfers caused by power source failures.
    d. Total number of days ATS has been in operation.
    e. Total number of hours that the normal and emergency sources have been available.

PART 3: EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

3.02 FIELD ASSISTANCE

A. Testing, checkout and start-up of the ATS equipment shall be performed under the technical direction of a factory trained authorized manufacturer representative.

1. The setup and programming of the ATS shall be provided by a factory-trained representative who is authorized by the ATS manufacturer to perform the startup. This setup and programming shall be done prior to and during the first application of power.

2. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

B. Provide 1 hour of "ATS Setup" Training on operating and maintenance procedures.

3.03 WARRANTY

A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

SECTION 26 44 13

LOW VOLTAGE SWITCHBOARD

PART 1: GENERAL

1.01 SCOPE OF WORK

A. This section applies to specifies switchboards rated 600 volts and below.

B. Provide Switchboard(s) (SWBD) as specified herein and shown on the Drawings.

1. The System Integrator shall perform and be responsible for procurement, submittals, shop drawings, interconnection drawings, factory testing, and all control wiring for the SWBD. System Integrator is defined in Electrical Specifications [Electrical General].

C. All wiring, wire color codes, wire labeling and terminal blocks within SWBD shall be as specified in Electrical Specifications [Low Voltage Wire & Data Cable].

D. The SWBD scope of work includes:

1. Providing SWBD structure and all internal components.
2. Installation of the SWBD on concrete pad per details.
3. Submittal data and drawings.
4. Startup and configuration of SWBD internal components.
5. Factory and field testing.
6. Operation and maintenance manuals.
7. Warranty of all components.
8. Seismic Anchorage Design Calculations and conforming installation.
9. Conduit – support systems, wire, and grounding system, for equipment interconnection, and operation.
10. System calibration, testing and documentation.

E. Electrical Specifications [Factory and Field Testing]. Furnish all required labor, materials, safety equipment, transportation, test equipment, incidentals and services to perform factory and/or field testing.

F. All electrical equipment and materials, and methods - including installation, calibration, and testing - shall conform to the applicable codes and standards listed in this and other Sections. All electrical materials and work shall conform to published standards of the National Electric Code (NEC), Institute of Electrical and Electronic Engineers (IEEE), and Underwriters Laboratories Inc (UL).

1.02 REFERENCES

A. Electrical Specifications [Electrical General]

B. Electrical Specifications [Low Voltage Wire & Data Cable]
C. Electrical Specifications [Automatic Transfer Switch]
D. Electrical Specifications [Panelboard and Power Transformer]
E. Electrical Specifications [Factory and Field Testing]

1.03 SUBMITTALS REQUIREMENTS

A. Provide Submittals as specified in Electrical Specifications [Electrical General, Submittal Requirements].

B. Include a record of each configurable parameter available to be changed by the user for internal components. The list shall include factory defaults and space for entered values for each configurable component.

1.04 OPERATION AND MAINTENANCE INFORMATION

A. Provide operation and maintenance instructions as specified in Electrical Specifications [Electrical General].

PART 2: PRODUCTS

2.01 SWITCHBOARD

A. General:

1. The Switchboard shall be Cutler Hammer, Square D or approved equal.

2. The Switchboard (SWBD) shall be built and tested in accordance with:

a. NEMA Standards
b. ANSI
c. Underwriters Laboratories, Inc.

3. Switchboard enclosure shall be NEMA rated as shown in the drawings.

B. Metering Panel:

1. Provide metal enclosed, front accessible, self contained utility metering panel. Voltage, phase, AIC and continuous amperage rating shall be as shown on Contract Drawings. Panel will include meter socket, factory installed main breaker(s) and test by-pass facility.

2. Design utility entrance and termination and other features per NEC, local codes, and serving Utility requirements.

3. Enclosure shall be NEMA rated construction for underground utility service as shown in the drawings. The enclosure shall be finished with ANSI 61 gray enamel paint. Provide pad mount, surface mount or flush mount cabinet per installation detail.

4. Utility metering switchboard shall be Cutler Hammer Pow-R-Line,

Tesco Metering Switchboard or equal.

C. Switchboard:

1. Switchboard shall be front accessible with group mounted, buss connected circuit protective devices. Where provisions for future circuit protective devices are required, space for the device, corresponding vertical buss, device connectors and the necessary mounting hardware shall be supplied.

2. Distribution section shall meet all requirements per NEC, local codes, and as defined in the drawings.

3. Buss shall be copper. Aluminum buss is not equal to copper buss. Furnish buss mounted cable lugs sized for cabling that is required to be directly buss connected.

4. Buss shall, 3 phase, 4 wire, 480 volt, 65,000 AIC minimum symmetrical (or as shown otherwise in the drawings).

5. Power buss:

a. Continuous amperage rating at least equal to the main circuit breaker or the power source and shall be braced to withstand stresses resulting from the maximum short-circuit current available.

b. Horizontal bus shall extend through all sections of the switchgear unless shown otherwise in the drawings with vertical connections to circuit breakers in each section.

c. Buss shall be mounted on heavy-duty insulated glass polyester supports, and main bus joints shall be bolted using a minimum of two bolts.

d. Shipping splits and provisions for future bus extensions shall have tin-plated bolted connections.

6. Neutral bus, when specified or required, shall have the same capacity as the main bus.

7. Ground buss shall be rated per NEC relative to the power buss amperage rating and shall extend the entire length of the switchboard.

2.02 MOLDED CASE CIRCUIT BREAKERS

A. General

1. Circuit breakers and motor circuit protectors shall be manufactured by Eaton Cutler-Hammer, Square D, G.E., Siemens, or equal.

2. Circuit breakers shall be the bolt-on type.

3. Multiple-pole circuit breakers shall be designed so that an overload on one pole automatically causes all poles to open. The use of tandem or dual circuit breakers in a normal single-pole space to provide the number of poles or spaces specified are not acceptable.

4. Molded case circuit breakers shall be operated by a single toggle-type handle and shall have a quick-make, quick-break switching mechanism. An automatic trip of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and have flash reduction arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

5. Minimum interrupting capacity:

   a. 480 volt circuit breaker shall have a minimum interrupting capacity of 42,000 amperes.

   b. 120 or 208 or 240 volt breaker shall have a minimum interrupting capacity of 22,000 amperes

6. Circuit Breakers protecting full voltage or solid state reduced voltage motor starters shall be motor circuit protector (MCP) breakers with adjustable magnetic trip unless otherwise noted on the drawings.

7. Circuit breakers shall be UL listed for series application.

8. Where indicated circuit breakers shall be current limiting.

9. Where indicated on Drawings, provide UL listed circuit breakers for continuous duty at 100% of their ampere rating in the intended enclosure.

10. Furnish add-on features such as auxiliary position status contacts, trip indication contacts, zone interlocking, shunt trip coils, etc, as shown in the drawings.

B. Trip Unit – Molded Case Circuit Breakers

1. Circuit Breakers over 400 volt and over 90A trip units as defined herein. All other circuit breakers shall have shall have non-electronic thermal-magnetic (TM) trip units with inverse time-current characteristics.

2. The trip unit shall be Eaton type Power Expert Release (PXR) or equal.

   a. Each circuit breaker trip unit shall have three (3) current sensors, voltage sensors, microprocessor, and flux transfer trip solenoid at minimum.

   b. Trip units shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored

and is fully operational.

c. Trip units shall be powered from the primary voltage connected to the circuit breaker. Current flow shall not be required for settings functions. Circuit breaker trip units shall be operable and adjustable with zero current flowing through the circuit breaker.

d. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current and voltage sensors, and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached.

e. Trip units shall be provided with a display panel. Trip units shall have an information system that provides LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip

f. Programming may be done via a keypad at the faceplate of the unit. Programming via the communication network if or as shown in drawings.

g. The trip unit shall offer a three-event trip log that will store the trip data, and shall time and date stamp the event.

h. The trip unit shall have the following advanced protective features integral to the trip unit:

    1) Adjustable undervoltage release (defeatable)

    2) Adjustable overvoltage release (defeatable)

    3) Reverse power and fault current

    4) Reverse sequence voltage

    5) Under-frequency

    6) Over-frequency

    7) Voltage phase unbalance and phase loss during current detection.

i. Although not preferred but if needed, furnish 24VDC redundant power supply with terminal blocks and 0.5A miniature circuit breakers to distribute control power to each circuit breaker trip unit that requires it for settings. The power supply shall be connected below the main breaker and transfer switch but

above any feeder circuit breakers. Provide option for external power supply input.

3. System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:

   a. Adjustable long-time setting (set by adjusting the trip setting dial to an amount not to exceed rating plug)

   b. Adjustable short-time setting and delay with selective flat or I^2t curve shaping,

   c. Adjustable instantaneous setting

   d. Adjustable ground fault setting and delay with selective flat or I^2t curve shaping.

4. The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.

5. Furnish internal ground fault protection with adjustable settings. Provide neutral ground fault sensor for four-wire loads. Bypass neutral sensor for 3 wire loads.

6. Include ARMS technology for all circuit breakers 400A and above or where shown on drawings.

   a. Activation and deactivation of the ARMS technology and local indication shall be accessible from the face of the trip unit without opening the circuit breaker door or cover and exposing operators to energized parts.

   b. Recalibration or adjustment of trip unit parameters shall not be required when enabling / disabling the ARMS technology.

7. Breakers shall have built-in test points for testing the long-time delay, instantaneous, and ground fault functions of the breaker by means of a test set.

C. Manual operators

1. Furnish door interlocked manual operators for mains and selected feeder circuit breakers as shown in the drawings.

2. Manually operated mechanisms designed to open, close and reset circuit breakers.

3. Operators shall be available in three basic configurations— flange mounted, through-the door rotating and direct handle through door to provide a variety of options for different applications and enclosure ratings.

2.03 ACCESSORIES

A. Space Heaters:

1. Outdoor rated switchgear shall be provided with 120 volts AC thermostatically controlled space heaters. Heater wiring shall be to terminal blocks for connection to external power source. One heater shall be provided in each vertical breaker section. Heaters shall have guards to prevent accidental contact with power or control wiring.

B. Bug Screens:

1. Provide on louvered or other ventilation openings.

C. Key Interlocks:

1. Key interlocks shall be provided as shown on the drawings. The switchgear manufacturer shall be responsible for coordinating interlocks for switchgear main circuit breakers interlocked with generator circuit breakers. Key interlocks shall be as manufactured by Kirk Key Interlock Company, or equal.

D. Surge Protective Device (SPD)

1. SPD shall be suitable Service entrance location per ANSI/IEEE C62.41, IEEE C62.45, and UL1449 3rd edition and tested according to IEEE C62.44 as Secondary Surge Arrestor.

2. Unit shall be sealed and not allow vapors from entering the switchboard enclosure after a voltage surge event.

3. Modes of protection – Line to Line, Line to Ground, Line to Neutral (as applicable). Voltage, phase and neutral connections per one-line diagram. Current surge capacity shall be 60,000 amps per mode minimum

4. The SPD shall be factory installed inside the switchboard during assembly by the original equipment manufacturer. The OEM design shall be integral to the design of the switchgear with special paneling and cutouts specifically designed for unit mounting.

5. The SPD connections shall be located as close as possible to the load side of main disconnect device and ground/neutral bar.

6. The SPD shall have integral 30-amp disconnect and fuses. Service of the SPD assembly, fuses or other serviceable components shall be from front access of the switchboard and shall not require disassembly of switchboard panels to repair or replace parts.

7. SPD shall be Cutler-Hammer Clipper, Current Technology TransGuard or equal.

E. Power Monitor:

1. General:

a. Microprocessor based multifunction power and energy meter

b. Designed for multifunction electrical power, voltage, and current measurement on 3 phase power systems.

c. Measured parameters: voltage, current, frequency, unbalance, kW, KVAR, KVA, power factor, kWh.

d. Support for 3-Element Wye, 2.5 Element Wye, 2 Element Delta, 4 wire Delta systems.

e. 200 ms update for power measurement, 100ms update for voltage, current, Hz.

f. Din rail mounting

g. 85 to 264 VAC control power, 5W.

h. Furnish compatible current transformers with ratio as shown in the drawings or as needed to measure full feeding circuit breaker rated current.

2. Voltage Inputs

a. Configurable to potential transformer ratio.

b. Input impedance of 1 Mega Ohm, 0.014W at 120 Volts.

c. Direct voltage input range

1) 347 Volts Line to Neutral

2) 600 Volts Line to Line.

d. 2500V withstand.

3. Current Inputs:

a. Configurable to current transformer (CT) ratio 1A or 5A input.

b. Burden 0.05VA, Impedance 0.002 ohms

c. Meter shall have a maximum burden of 0.005VA per phase, at the maximum of 15 Amperes continuous input.

d. Fault current withstand shall be 200 Amps for 1/2 second.

4. Digital I/O:

a. Two status inputs 24VDC, dry contact.

b. One KYZ output, 24VDC, 30mA

5. Accuracy

a. Revenue meter accuracy

b. +/- 1% or better for volts and amps

c. +/- 1% for power and energy functions.

d. True RMS measurements

6. Communications

a. Ethernet - 100BaseT Ethernet IP Allen Bradley protocol

b. Modbus TCP

7. Acceptable Products

a. Allen Bradley PM1000 1408-EM3A-ENT Ethernet

F. CT Shorting Terminal Block

1. Panel mount inside control equipment with front screw terminal connections. Inserting a thumb screw shall short terminals to a top mounted ground bar. Provide quantity of terminal poles as required for function and as shown in Drawings. Furnish Flex Core 170xSC or equal.

G. Current Transformers

1. Furnish mounted (preferable) or unmounted current transformers based on space allocated and installation requirements. The current transformer shall have wire leads or binding posts and ratio as shown on the drawings. The accuracy shall be metering accuracy class 0.6 at a minimum burden at 60 hz shall be 2.5 VA and as required to meet specified accuracy of device(s) fed.

PART 3: EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship] and as specified herein.

3.02 INSTALLATION

A. Vertical sections shall be mounted on steel channel sills continuous on two sides. The steel channel sills shall be heavy duty to meet the specific seismic requirements of this project location. These sills shall be mounted on the concrete pad to be installed per the Contract Drawings.

B. Conduit entering Switchboard shall be stubbed up 1" into the bottom horizontal wireway (typically) directly below the vertical section in which the conductors are to be terminated.

C. Base of Switchboard shall be adequately grouted, caulked or sealed to prevent the entry of insects and rodents.

3.03 FIELD ASSISTANCE

A. Provide field testing as specified in Electrical Specifications [Electrical General, Testing].

3.04 WARRANTY

A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

SECTION 26 44 50

GROUNDING

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Labor, materials, equipment, tools, safety gear, test equipment, incidentals, services, and transportation for a complete electro-mechanical installation as shown on the Drawings, included in these Specifications, or as can be reasonably implied from project descriptions.

B. The scope of work includes:

1. Furnish and install grounding system required by Drawings, or if not shown or defined, as required by Article 250 of the NEC. Ground conductors shall be sized for the protective device, minimum.

2. Furnish and install conduits, junction boxes, underground boxes, and associated hardware. Provide hardware, conduit, fittings, and other parts for a complete grounding installation.

3. Installations shall be designed and installed with components meeting the NEMA area designation.

C. Work includes that specified in Electrical Specifications [Electrical General].

1.02 REFERENCES

A. Electrical Specifications [Electrical General]
B. Electrical Specifications [Low Voltage Wire & Data Cable]
C. Project Drawings

1.03 QUALIFICATIONS

A. Material furnished under this specification shall be installed by qualified installers meeting requirements specified in Electrical Specifications [Electrical General, Qualifications].

1.04 SUBMITTAL REQUIREMENTS

A. Provide submittals and Drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].

B. Submit manufacturer's product information for connections, clamps, rods, terminals, and grounding system components.

PART 2: PRODUCTS

2.01 GROUNDING SYSTEM

A. General

1. Grounding conductors shall be sized as shown on the Drawings or in accordance with NEC table 250, whichever is larger.

2. Components of the grounding electrode system shall be manufactured in accordance with UL 467 - Standard for Safety Grounding and Bonding Equipment.

B. Grounding System

1. The utility service ground shall be tied to a building ground grid consisting of a "UFER" and/or ground rod type grounding system.

2. Electrical Contractor shall design layout of ground system if one is not shown on drawings per requirements herein.

3. The UFER shall consist of minimum 25 feet minimum of code sized bare copper wire conductor laid at 3 foot minimum depth encased with ground enhancement material or as detailed on the Contract Drawings. UFER ground shall be located where soil moisture content will be maximized. Terminate UFER ground at ground rod in inspection box.

4. Ground enhancement material shall be permanent and be designed to lower earth resistance in all soil conditions. Once set, material shall have resistivity of not more than 20 ohm-cm resistance. Material shall be set by mixing it with water to form a slurry and shall not dissolve or decompose once cured. Ground enhancement material shall be Erico Ground Enhancement Material (GEM), Lyncole XIT, or equal.

5. Utility services 200A and below: Provide 1 ground rod connected to the service panel with #2 bare copper ground wire and as shown on the drawings.

6. Utility services- 400A: Provide 2 ground rods 8 feet apart, connected together, and to the UFER ground, and to the service panel with #2 bare copper ground wire. Connect ground system to switchboard ground bus in two places from ground rods.

7. Utility services - 600A to 800A: Provide 3 ground rods 8 feet apart, connected together, and to UFER ground, and to the service panel with #1/0 bare copper ground wire. Connect ground system to switchboard ground bus in two places from ground rods.

8. Utility services 1000A to 1600A: Provide 4 ground rods 12 feet apart minimum, connected together, and to UFER ground, and to the service panel with #4/0 bare copper ground wire. Connect ground system to switchboard ground bus in four places from ground rod inspection boxes.

9. Utility services 2000A: Provide 4 ground rods 12 feet apart minimum, rectangular pattern, connected together, and to the UFER ground, and to the service panel with #250 bare copper ground wire. Connect ground system to switchboard ground bus in four places from ground rod inspection boxes.

10. Utility services 3000A to 4000A: Provide 6 ground rods 16 feet apart minimum, rectangular pattern, connected together, and to the UFER ground, and to the service panel with #500 bare copper ground wire. Connect ground system to switchboard ground bus in four places from ground rod inspection boxes.

11. The ground bonding wire(s) from the ground rod(s) shall extend through and appropriately sized conduit into the electrical panel. Connect the ground wire(s) to the ground bus with readily visible UL approved "ground clamp" attached to the ground bus.

12. Install bare copper ground bond wires from the UFER ground to the various locations shown on the Drawings.

C. Raceway Grounds

1. Metallic conduits shall be assembled to provide a continuous ground path. Metallic conduits shall be bonded using insulated grounding bushings.

2. Provide separate code size wire ground conductor for PVC conduits

D. Equipment and Enclosure Grounds

1. Electrical and distribution equipment shall be connected to the grounding system. Cables shall be sized as specified.

E. Components

1. Ground rod shall be ¾" x 10 ft solid steel with 10-mil copper-cladding.

2. Provide ground well enclosures for all outdoor ground rods. Furnish Christy type F8, Christy N9, or Christy B1017 (traffic areas), marked "GROUND" or equal unless otherwise shown on the Drawings.

3. Ground rod clamps shall be bolt-on type as manufactured by O-Z Gedney type GRC, or equal.

4. Every piece of equipment shall be grounded per NEC.

5. Each electrical enclosure shall have a copper ground bus. Screw type fasteners shall be provided on all ground busses for connection of grounding conductors. Ground bus shall be a Challenger GB series, ILSCO CAN series or equal.

PART 3: EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in specified in Electrical Specifications [Electrical General, Workmanship].

3.02 INSTALLATION

A. Grounding System:

1. Install all products per Electrical Specifications [Electrical General, Installation].

2. Each nonmetallic conduit shall contain a code sized grounding conductor.

3. The system neutral conductor and all equipment and devices required to be grounded by the National Electrical Code shall be grounded in a manner that satisfies the requirements of the National Code.

4. The system neutral (grounded conductor) shall be connected to the system's grounding conductor at only a single point in the system. This connection shall be made by a removable bonding jumper sized in accordance with the applicable provisions of the National Electrical Code if the size is not shown on the Drawings. The grounding of the system neutral shall be in the enclosure that houses the service entrance main overcurrent protection.

5. Utilize mechanical connections in accessible locations and exothermic connections in non-accessible or buried locations.

6. The secondary on all transformers shall be grounded.

7. All raceway systems, supports, enclosures, panels, motor frames, and equipment housings shall be permanently and effectively grounded.

8. Install insulated grounding conductor with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards and distribution panels with 12ga. conductor to grounding bus

9. All receptacles shall have their grounding contact connected to a grounding conductor.

10. Branch circuit grounding conductors for receptacles or other electrical loads shall be arranged such that the removal of a lighting fixture,

receptacle, or other load does not interrupt the ground continuity to any other part of the circuit.

11. Attachment of the grounding conductor to equipment or enclosures shall be by connectors specifically provided for grounding. Mounting, support, or bracing bolts shall not be used as an attachment point for ground conductors.

12. Install grounding electrode conductor and connect to reinforcing steel in foundation footing. Electrically bond building steel to ground system. Bond metal siding not attached to grounded structure.

3.03 FIELD QUALITY CONTROL

A. Inspections:

1. Ground system shall be inspected prior to cover.

B. Testing:

1. Complete applicable test forms if provided in testing specifications [Factory and Field Testing]. If form is not provided, furnish results on a vendor standard form.

2. Test each grounding connection to determine the ground resistance. The grounding test shall be IEEE 81.2 and NETA 7.13. The current reference rod shall be driven at least 100 feet from the ground rod or grid under test. The measurements shall be made at 10-foot intervals beginning 20 feet from the test electrode and ending 80 feet from it, in direct line between the ground rod or center of grid and the current reference electrode. Investigate ground resistance in excess of 1 ohm and revise or install new or additional ground electrodes as needed to reduce point to point resistance to less than 1 ohm.

END OF SECTION

SECTION 26 44 70

PANELBOARD AND POWER TRANSFORMER

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall supply panelboards and power transformers as specified herein and as shown in the Contract Drawings.

B. The Contractor shall perform complete startup and testing services for the panelboard and power transformer per Electrical Specifications [Factory and Field Testing].

C. Work includes that specified in Electrical Specifications [Electrical General].

D. Reference drawings for panelboard and transformer location – electrical structures or stand-alone. If within electrical structures, the Contractor shall supply the electrical section with factory installed panelboard and transformer. If stand-alone, the Contractor shall install individual components with enclosures as specified herein.

1. The quantity of breakers with size and number of poles as shown on panelboard schedules.
2. Submittal data and drawings.
3. Startup assistance.
4. Panelboard testing.
5. Operation and maintenance manuals.
6. Warranty of all components of the panelboard and power transformer.

1.02 SUBMITTAL REQUIREMENTS

A. Provide submittals and drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].

B. Provide ratings and characteristics including voltage, temperature rise, KVA, efficiency, materials of construction, NEMA enclosure rating, voltage taps, and impedance.

C. Provide catalog cuts for circuit breakers and devices.

D. Submit panelboard schedule for approval.

1.03 OPERATION AND MAINTENANCE INFORMATION

A. Provide operating instructions as specified in Electrical Specifications [Electrical General, Operating and Maintenance Instructions].

PART 2 – PRODUCTS

2.01 PANELBOARDS

A. General

1. The Contractor shall furnish panelboards of a type indicated on the one-line Contract drawings and specified herein.

2. Furnish and install padlock lock-off attachment for each circuit breaker.

3. Panelboards shall comply with the applicable sections of UL, NEC, and NEMA and shall be Cutler Hammer Pow-R-Line, Square D, ITT or equal.

4. A machine-typed circuit directory with clear plastic cover shall be supplied mounted on the inside of door in a frame when equipment is shipped. Circuit directory shall be as approved in the Submittal.

B. Interiors

1. Interiors shall be completely factory assembled with bolt-on devices.

2. Main and feeder breakers shall include lockout padlock hasp suitable for frame size. Provide Cutler Hammer QLPB123PL, PLK1, or similar.

3. Full size insulated neutral bars shall be included. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

4. Main bus bars shall be plated copper sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 50 degrees C above an ambient 40 degrees C maximum.

5. A copper ground and neutral bus shall be included in all panelboards with terminal screws.

C. Boxes

1. Provide minimum gutter space in accordance with the National Electric Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.

D. Trims

1. Provide a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a catch, lock and trim.

2. Surfaces of the trim assembly shall be properly cleaned, primed and a

finish coat of gray ANSI 61 or 49 or to Switchboards and MCCs.

3. Surface trims shall be same height and width as box for surface mount, and ¾" (min) beyond box on all sides for flush mount.

E. Panelboard Ratings

1. Panelboards shall have voltage, phase and short circuit (AIC) ratings as shown on the drawings.

2. Breakers shall be a minimum of 100 ampere frame. Breakers 15 through 100 amperes trip size shall take up the same pole spacing.

3. Panelboards shall be labeled with a UL short circuit rating. When series ratings are applied with integral or remote upstream devices, a label shall be provided. Series ratings shall cover all trip ratings of installed frames. It shall state the conditions of the UL series ratings including:

a. Size and type of upstream device
b. Branch devices that can be used
c. UL series short circuit rating

2.02 POWER TRANSFORMER

A. The power transformer shall be ventilated dry type. Voltage and KVA ratings shall be as shown on the Contract Drawings. The transformer shall be as manufactured by Cutler Hammer, Jefferson, ACME, Square D, G.E., or equal.

B. Transformer shall meet latest DOE 2016 minimum efficiency standards.

C. Coils shall be manufactured of electrical grade aluminum (if stand-alone) or copper (if within a MCC or Switchboard) and shall be adequately braced for short circuit ratings and defined in ANSI and NEMA standards.

D. Transformers rated 31KVA and above shall have two 2½ percent taps above and below normal full capacity (ANFC and BNFC).

E. The transformer shall carry full load continuously at rated voltage and frequency without exceeding the average temperature rise of 115°C above an ambient temperature of 40°C. Insulation shall be rated for 220°C (UL class 220°C).

F. Impedance (Z): 4.0% +/- 0.3% or above to keep downstream fault currents to a minimum.

G. Low noise. For transformers installed within electrical equipment, vibration isolators shall be installed between the transformer and its mounting surface to reduce case vibration and associated noise.

H. For stand alone transformers, the transformer housing shall be securely

fastened to the mounting surface with bolted connections sized appropriately to withstand seismic zone 4 forces.

I. The transformer shall be finished with two coats of enamel to resist rust and corrosion.

J. Transformers located inside electrical structures or enclosures shall be provided with adequate ventilation for heat removal as required.

K. Transformer neutral shall be grounded in accordance with Article 250-26 and 450-10 of NEC and any applicable local ordinances. Installation and protection of the transformer grounding conductors and attachments shall be per NEC 250-24.

PART 3 – EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

B. Perform work to remedy non-compliant installations after inspection.

3.02 INSTALLATION

A. Provide installation as recommended by the manufacturer and as specified in Electrical Specifications [Electrical General, Installation].

3.03 FIELD ASSISTANCE

A. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

3.04 WARRANTY

A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

SECTION 26 44 81

VARIABLE FREQUENCY DRIVE

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Provide each variable frequency drive as shown on elementary and one-line Drawings. Variable frequency drive shall be provided with full speed bypass, harmonic conditioner, line and/or load reactor, RFI filter and/or other accessories where shown on The Drawings. All VFDs shall be of the same manufacturer.

1. The System Integrator shall perform and be responsible for procurement, submittals, shop drawings, testing, and all control wiring for the VFD. System Integrator is defined in Electrical Specifications [Electrical General].

B. Provide enclosure (and side mounted wire chase as required) for top or bottom feed conduit connection as shown in the Drawings. Enclosure size shall not exceed the space allocated in the Drawings for such use.

C. Provide cooling/ventilation system, mounting hardware, associated components, devices, and field control stations. Some components may be specified in other Electrical Specifications such as terminal blocks, wire, buttons, etc.

D. Installation of the VFD with components as specified in Electrical Specifications [Electrical General]. The VFD scope of work includes:

1. Providing and installing VFD(s) of rating shown on The Drawings.
2. Submittal data and drawings.
3. Startup assistance.
4. Factory and field testing.
5. Operation and maintenance manuals.
6. Warranty of all components.

E. Startup and configuration of VFD with actual motor load.

F. Electrical Specifications [Factory and Field Testing]. Furnish all required labor, materials, safety equipment, transportation, test equipment, incidentals and services to perform factory and/or field testing.

1.02 REFERENCES

A. Electrical Specifications [Electrical General]
B. Electrical Specifications [Low Voltage Wire & Data Cable]
C. Electrical Specifications [Factory and Field Testing]

1.03 SUBMITTALS REQUIREMENTS

A. Provide Submittals as specified in Electrical Specifications [Electrical General, Submittal Requirements].

B. Include a record of each VFD parameter available to be changed by the user. The list shall include factory defaults and space for entered values.

1.04 OPERATING AND MAINTENANCE INFORMATION

A. Provide operation and maintenance instructions as specified in Electrical Specifications [Electrical General].

B. Include a record of each VFD parameter setup during startup and testing and place a copy of setting in each O & M manual.

PART 2: PRODUCTS

2.01 GENERAL

A. 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 and braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. All components and devices installed shall be industrial grade and shall be of sturdy and durable construction suitable for long, trouble-free service. Light duty, fragile, and competitive grade devices of questionable durability shall not be used.

B. The VFD is inclusive of the input stage, buss, output stage, input filters, output filters, and all other assemblies, boards, or conditioning equipment, that make up the entire VFD system. The VFD system is herein referred to simply as "VFD" and is not to be parsed in any way to meet a specification as a specific part or assembly where it cannot be met as a system.

C. Products that are specified by manufacturer, trade name, or catalog number establish a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are favorably reviewed by the Owner and/or Engineer prior to installation.

D. Underwriter's Laboratories (UL) listing is required for all substituted equipment when such a listing is available for the first named equipment.

2.02 QUALITY

A. All equipment and materials shall be new and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product.

B. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be adequately stayed and braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for long, trouble-free service. Light duty, fragile, and competitive grade devices of questionable durability shall not be used.

C. Products that are specified by manufacturer, trade name, or catalog number establish a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are favorably reviewed by the Owner and/or Engineer prior to installation.

D. Underwriter's Laboratories (UL) listing is required for all substituted equipment when such a listing is available for the first named equipment.

2.03 VARIABLE FREQUENCY DRIVE

A. This specification is based on Allen Bradley PowerFlex 755T, Ultra Low Harmonic ABB ACS, or equal.

B. The VFD shall be of the latest technology used to control and maintain a process variable (level, flow, pressure, speed, etc.) by varying the motor speed. The VFD shall be available from a single manufacturer in the horsepower range of 1 to 500 HP.

C. Performance Requirements

1. Harmonic Attenuation (applies to Ultra Low Harmonic (ULH) as shown in Drawings)

a. The VFD shall have an active filter line supply unit which controls the low order harmonic current to reduce the harmonic current impressed on the incoming power feeder.

b. The input current to the VFD shall limit the total harmonic content to less than 5% of the VFD's rated input on any power system and under all operating conditions.

c. The VFD shall comply with IEEE 519 requirements.

2. Open loop static speed regulation shall be 0.5 % to 1% of rated motor speed. When motor speed feedback is provided from a suitable encoder, closed loop speed regulation shall be 0.1% of motor nominal speed. Dynamic speed accuracy shall be less than 1%-sec with 100% torque step open loop and 0.5%-sec closed loop with 100% torque step. 2. Torque control response time shall be less than 10 ms with nominal torque. In the torque regulating mode, torque regulating

accuracy open loop shall be +/- 5%; torque regulating accuracy closed loop shall be +/- 2%;

D. Ratings

1. The VFD shall employ a full wave rectifier to prevent input line notching and operate at a fundamental (displacement) input power factor of 0.98 at all speeds and nominal load.

2. The VFD efficiency shall be 97.5% or better at full speed and load. Efficiency is defined as the output power divided by the input power in terms of percentage. All internal system losses recognized.

3. Load - The VFD shall be designed to continuously operate the following motor/pump load:

   a. Motor NEMA design B, squirrel-cage induction or specialty specific use motor per Mechanical Division Specification as shown in Drawings.
   b. Horsepower at full speed R.P.M. of submitted/approved motor.
   c. Voltage, 230/460 VAC, three phase, 60 Hz.
   d. Service factor, 1.15 S.F.

4. Input Power - The VFD shall be rated to continuously operate under the following input power conditions:

   a. The Drive shall be rated to operate from 3-phase power at nominal voltage (208VAC to 600VAC, +10% /-15% as shown in Drawings), 48Hz to 63Hz.
   b. The overvoltage trip level shall be a minimum of 30% over nominal, and the undervoltage trip level shall be a minimum 35% under the nominal voltage.
   c. Three phase, phase rotation insensitive.
   d. Displacement power factor, 0.95 lagging at all loads and speeds above 10% rated load.

5. Output Power - The VFD shall be rated to continuously operate while providing the following output power conditions:

   a. Voltage, 0 to 500 VAC.
   b. Frequency, 3 to 60 Hz.
   c. Continuous motor horsepower.
   d. VFD amp output (minimum).
   e. Continuous current - as shown in Drawings or 115% of rated motor nameplate amps, whichever is higher.
   f. Short term normal current, 110% of continuous rated current for a minimum duration of 1 minute per every 10 minutes running.
   g. Short term heavy duty overload current, 150% of continuous rated current for a minimum duration of 1 minute per every 10 minutes running.

h. Waveform - sine coded PWM.
i. The drive's switching pattern shall be continually adjusted to provide optimum motor flux and avoid the high-pitched audible noise.
j. Diodes and transistors shall have a minimum withstand of 1,200 peak inverse voltage (PIV).

6. Environmental - The VFD shall be rated to continuously operate under the following environmental conditions:

a. Ambient temperature, 5°F to 122°F (-15°C to 50°C).
b. Altitude, no derating below 3,300 ft.
c. Relative humidity, 95% non-condensing.
d. The drive shall be protected from atmospheric contamination by chemical gasses and solid particles pre IEC 60721-3-3, chemical gasses Class 3C2 and solid particles Class 3S2.
e. The drive shall be protected from vibration per IEC 60721-3-3 Class 3M4 (sinusoidal displacement 3.0 mm, 2Hz to 9Hz; acceleration 10m/s^2, 9Hz to 200Hz).

E. Protection - The VFD shall be provided with the following protection:

1. For each programmed warning and fault protection function, the Drive shall display a message in complete English words or Standard English abbreviations. The three (3) most recent fault messages along with time, current, speed, voltage, frequency and DI Status shall be stored in the Drive's fault history. The last ten (10) fault names shall be stored in Drive memory.

2. The Drive shall include internal MOV's for phase to phase and phase to ground line voltage transient protection.

3. Output short circuit withstand rating and ground fault protection rated for 100,000 AIC shall be provided per UL508C without relying on line fuses. Motor phase loss protection shall be provided.

4. The Drive shall provide electronic motor overload protection qualified per UL508C.

5. Protection shall be provided for AC line or DC bus overvoltage at 130% of max. rated or undervoltage at 65% of min. rated and input phase loss.

6. A power loss ride through feature will allow the Drive to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.

7. Stall protection shall be programmable to provide a warning or stop the Drive after the motor has operated above a programmed torque level for a programmed time limit.

8. Underload protection shall be programmable to provide a warning or stop the Drive after the motor has operated below a selected underload curve for a programmed time limit.

9. Over-temperature protection shall provide a warning if the power module temperature is less than 5°C below the over-temperature trip level.

10. The VFD shall constantly monitor the load current with an electronic thermal overload relay and trip the drive on motor overload. The electronic overload relay shall be adjustable and compensate for the reduced cooling of the motor at reduced speeds. This protection provides an orderly shutdown should the motor's thermal capabilities be exceeded and eliminates the requirement for conventional motor overload relays.

F. Digital programmer/controller –The VFD shall be equipped with a front mounted operator control panel (keypad) consisting of a backlit, alphanumeric, graphic display and a keypad with keys for Start/Stop, Local/Remote, Up/Down and Help. Two (2) Softkeys will be provided which change functionality depending upon the position within the parameter hierarchy or state of panel.

1. All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table.

2. The Display shall have contrast adjustment provisions to optimize viewing at any angle.

3. The control panel shall provide a real time clock for time stamping events and fault conditions.

4. The control panel shall include a feature for uploading parameter settings to control panel memory and downloading from the control panel to the same Drive or to another Drive.

5. All Drives throughout the entire power range shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating.

6. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus.

7. The keypad shall be removable and insertable under Drive power, capable of remote mounting, and shall have its own non-volatile memory.

8. Digital Programmer/Controller (HIM) shall be capable of remote door mounting. Cable for remote digital programmer/controller shall be

supplied as shown in the Drawings. The HIM shall be mounted and housed to maintain the NEMA 12 door rating.

9. The standard operator panel shall provide a start-up, maintenance and diagnostic assistants that guides a new user through initial start-up and commissioning of the Drive as well as provide indications for maintenance and help to diagnose a fault. In addition, a PID assistant, Real-time Clock assistant, Serial Communications assistant, and Drive Optimizer assistant shall be included. A Drive Optimizer assistant permits the user to choose Drive set-up for low nose, drive & motor efficiency or motor control accuracy.

10. The door mounted human interface module (HIM) display shall be capable to view and adjust the following diagnostic and status indicators:

    a. VFD Speed % or Frequency
    b. Instantaneous overcurrent.
    c. Ground fault.
    d. Overtemperature.
    e. Overvoltage.
    f. Undervoltage.
    g. Overload.
    h. Overfrequency.
    i. Amps.
    j. Voltage.
    k. Temperature.
    l. Auxiliary Fault.
    m. Phase loss.
    n. Current limit.
    o. Power and kilowatt hours
    p. Power up delay.
    q. Status of discrete inputs and outputs.
    r. Values of analog input and output signals
    s. Values of PID controller reference, feedback and error signals.

11. Adjustments - The following setting ranges shall be provided and made independently accessible for operator adjustment:

12. Speed/Torque control functions shall include:

    a. Minimum speed/torque limits.
    b. Maximum speed/torque limits.
    c. Selection of up to seven (7) preset speed settings or external speed control
    d. Two (2) independent built-in PID controllers to control a process variable such as pressure, flow or fluid level.
    e. Two (2) analog inputs shall be programmable to form a reference by addition, subtraction, multiplication, minimum selection or maximum selection.

13. Output control functions shall include:

    a. Current and torque limit adjustments to limit the maximum Drive output current and the maximum torque produced by the motor. These limits shall govern the inner loop torque regulator to provide tight conformance with the limits with minimum overshoot.
    b. A torque regulated operating mode with adjustable torque ramp up/down and speed/torque limits.

G. Input and Output Terminations - The VFD shall have terminals for input and output cabling as defined in the Conduit and Wire Schedule as shown on the Contract Electrical Drawings.

1. Provide power terminal blocks for motor lead connections where drive terminals are hard to reach or require drive cabinet disassembly to connect.

2. Five (5) digital inputs, all independently programmable with at least twenty-five (25) input function selections. Inputs shall be designed for 120 volts AC input or as otherwise shown in the Drawings. Input functions must include time delay start and hand and auto (Ethernet) control.

3. Two (2) form C relay contact digital outputs, all independently programmable with at least thirty (30) output function selections. Relay contacts shall be rated to switch a maximum two (2) Amps rms continuous current at a maximum switching voltage of 30VDC or 250VAC. Function selections shall include indications that the drive is ready (no faults and in remote), running, and are addressable from Ethernet as users choice.

4. Two (2) analog inputs, each selectable for 0VAC - 10VAC or 4mA - 20mA, and independently programmable with at least ten (10) input function selections. Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion. If the input reference (4-20mA or 0-10V) is lost, the VFD shall give the user the option of the following: (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The Drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus.

5. Two (2) analog outputs providing 0 (4) to 20mA signals. Outputs shall be independently programmable to provide signals proportional to at least twelve (12) output function selections including output speed, frequency, voltage, current and power.

6. Provide I/O input and relay output expansion card(s) as needed to accommodate the I/O wiring as shown in the Drawings. The option card shall be integrally mounted to the drive.

H. Communications – The VFD shall include communications module for interface to the PLC. All settable parameters and instantaneous operational registers shall be accessible from the communications port.

1. Type

a. Ethernet TCP/IP (Allen Bradley Ethernet/IP)
b. Modbus TCP (Schneider Automation Standard)

2. Add-On Instructions

a. The VFD manufacturer must have an add-on instruction that is compatible with the PLC on this project. The add-on instruction provides a preconfigured message command to send and receive information from the drive. The add-on instruction must be a free download available from the manufacturer website at the time of bid and thereafter.

3. Command and Metering registers to include:

a. Digital input reads (giving status of inputs)
b. Digital output commands (to relay DOs)
c. 3 phase voltage and current
d. Power in KW, KWH and Power factor
e. Elapsed motor run time
f. Start/Stop
g. Running
h. Fault conditions
i. Heat Sink Temperature
j. Others as available.

I. Features - The VFD shall have the following features:

1. Connection of the three incoming line leads and three-motor leads shall be the only connections necessary for manual operation of the VFD unit. All other wiring shall be prewired at the factory and self-contained within the VFD unit. A 120 VAC control power transformer and other auxiliary power supplies shall be provided with the VFD for power to pilot lights, meters, relays, and miscellaneous devices specified to be supplied with the VFD. Lugs shall be provided for connection of all power leads; terminal blocks shall be provided for all other wiring. Relay logic, wiring and enclosure layout shall be equivalent to that shown on the Drawings.

2. The VFD shall be protected by a circuit breaker disconnect unless otherwise shown in the Drawings. The disconnect shall be externally operated and shall have an operator mechanism that is an integral part of the enclosure. An operator mechanism shall be provided to

allow padlocking the disconnect in the "off" position with up to two padlocks.

3. AC input fuses shall be provided on the line and/or load side of the VFD (if required by the manufacturer) to isolate the VFD power circuitry upon a fault condition.

4. The VFD shall be capable of sensing load outside of normal range. A User Load Curve with range settings shall be available to be configured. If the motor horsepower as a function of speed is not within a predefined range, then an alarm shall be set within a setpoint delay. The alarm may be configured to shut down the drive and/or set a digital output for connection to a indicating light or PLC. The intent of this alarm is to protect the machine or pump from operating with a broken shaft, or clog, or flow restriction, or similar condition.

5. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.

6. Transient and surge voltage power line input protection shall be provided for the VFD through use of metal oxide varistors (MOVs), surge protective module, or other approved equal methods. Transient protection integral to the VFD shall be provided to a minimum of 10,000 volts, 50 joules without failure. The transient protection shall meet or exceed ANSI C7, 90-1971 and IEEE 472-1974 Standards without failure. Failure is defined as loss of components in the VFD including power semiconductors and fuses. The VFD shall be protected from the following, as a minimum, power line transients and recover to automatically restart and resume normal operation without posting a fault:

    a. Switching the primary of a power transformer.
    b. Switching power factor correction capacitors "ON" and "OFF" line.
    c. De-energization or energization of contactors, relays, and other power equipment from the power line.
    d. Starting and stopping of other motors when powered from Utility.

7. The VFD shall not be affected by or generate excessive electro-magnetic interference (EMI). The VFD shall be provided with a radio interference filter (RIF) to meet the following requirements:

    a. The use of a 4 Watt hand-held VHF/UHF transceiver within three feet of the VFD with its doors closed shall not cause erratic operation, loss of configuration, or any other deviation from normal operation.

    b. The worst case conducted and radiated EMI generated by the VFD shall not be enough to prevent the use of hand held VHF-UHF transceivers within three feet of the VFD with its

doors closed.

8. Opening of the VFDs input switches, circuit breakers, or output contactors while the VFD is operating under load shall not result in damage to the VFD power or control circuit components.

9. The VFD shall be capable of starting and operating without a motor load connected.

10. Phase loss protection shall be provided to prevent single phasing of the motor load.

11. The VFD shall have an instantaneous electronic trip circuit to protect the VFD from output line-to-line and line-to-ground short circuits. Output line-to-line and line-to-ground short circuits shall not damage the VFD.

12. Automatic fault reset to automatically restart the drive after any type of fault condition. This automatic restart shall repeat up to three attempts. This automatic reset shall be provided to prevent a drive fault from completely locking out on isolated nuisance fluctuations. When the drive is locked out after its automatic reset attempts the operator shall be able to reset the VFD by a local or remote manual reset pushbutton. Fault lockout shall be indicated on the door mounted drive fail pilot light.

13. The VFD shall be capable of continued operation during an intermittent loss of incoming line power up to five cycles.

14. The VFD shall automatically restart upon reapplication of power after a loss of line power. Momentary or sustained power failures shall not fault trip out the VFD or blow any fuses.

15. Any configuration of adjustments or controls not set by a switch or potentiometer shall be stored in nonvolatile memory. No configuration information shall be lost due to power failures of any duration.

16. The VFD shall be capable of starting into a rotating motor without tripping out on a fault.

17. The drive shall have an adjustable voltage boost control capable of providing additional starting torque to the motor at start. This control shall provide the additional voltage only at the frequency range required to start the motor thus reducing the additional motor heating excess voltage would cause at normal operating speeds.

18. The drive shall be equipped with critical frequency jump circuitry which allows the VFD to be setup to skip two bands of frequencies which cause excessive vibration or noise.

J. Enclosure - The enclosure type shall be as shown in the Drawings -

freestanding, wall mount, motor control center full section, or MCC cubicle mount construction. All components shall be accessible from the front of the enclosure. Rear or side access shall not be required in order to remove or service any component. The enclosure shall include the following in its construction:

1. The VFD shall incorporate thermostat/run controlled fans for cooling. The air flow through the VFD compartment shall provide proper cooling of the operating VFD at an (external cabinet) ambient temperature of 104°F. Fan mounting shall include reusable air filters on suction. Provide fans for suction and discharge vents as required maintaining air flow and forcing circulation.

2. Provide specific use fans located within the enclosure to cool, directly, specific components such as line filters or DV/DT filters.

3. Thermostat shall have bi-metallic adjustable set point range of 30° to 140°F. Thermostat shall have a switching capacity of 10A at 120 VAC. Provide Hoffman A-TEMNO temperature switch or approved equal to operate fans. Thermostat shall operate fans in parallel with motor running output of VFD.

4. The VFD, including the enclosure and input protection, shall be UL listed for a minimum of 42,000 RMS symmetrical ampere fault withstand capability. VFDs consisting of the VFD, enclosure, and all accessories, that are not UL listed will not be approved.

2.04 SINGLE TURN POTENTIOMETER

A. Provide manual single turn potentiometer. Potentiometer shall be compatible with the VFD input for manual speed control. Potentiometers shall be Allen-Bradley 800H, Cutler Hammer or equal.

PART 3: EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

B. Requirements of Related Electrical Sections apply to design, documentation construction and assembly of Variable Frequency Drives.

C. Perform work to remedy non-compliant installations after inspection.

3.02 FIELD ASSISTANCE

A. Testing, checkout and start-up of the variable frequency drive equipment shall be performed under the technical direction of a factory trained authorized manufacturer representative.

1. The setup and programming of the VFD shall be provided by a factory-trained representative who is authorized by the VFD manufacturer to perform the startup. This setup and programming shall be done prior to and during the first application of power to the motor. The VFD electronic motor overload protection shall be set to meet the motor nameplate and NEC Code requirements.

2. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

B. Provide 1 hour of "VFD Setup" Training on operating and maintenance procedures.

3.03 WARRANTY

A. Provide warranty as specified in Electrical Specifications [Electrical General; Warranty].

END OF SECTION

SECTION 26 66 00

FACTORY AND FIELD TESTING

PART 1: GENERAL

1.01 SCOPE OF WORK

A. This Section defines factory and field testing requirements of electrical and instrumentation equipment and as specified in this section and in Electrical Specifications. All equipment provided under Electrical Specifications and electrical equipment provided under other sections shall be tested as specified herein.

B. The Electrical Contractor shall coordinate at no additional cost to the Owner, the services of an approved qualified third party independent testing company for the purpose of performing specific tests as outlined in EXECUTION, Field Test of this section.

C. The System Integrator, Application Programmer, Testing Company, and/or Electrical Contractor shall provide all labor, tools, material, power, and technical supervision to perform the specified tests and inspections.

D. The Electrical Contractor shall be present during field testing and assist the System Integrator and/or Testing Company in testing all equipment. The Electrical Contractor shall be ready to correct any wiring problems found during testing.

E. The Application Programmer (defined in Electrical Specifications [Electrical General].) and/or Construction Manager will be actively engaged in Operational Testing and Commissioning. These efforts shall be combined efforts of the Application-Programmer/Construction-Manager/Engineer and Contractor. The Contractor shall facilitate test as outlined herein such that hardware, software and application programming are tested completely and all applicable test documentation is completed.

1. Expect that field testing of plant operational testing, SCADA and PLC checkout, is going to require 2 weeks for each site after pre-operational tests are done. Contractor and System Integrator shall assist in this start-up. Coordinate with Application Programmer to schedule this start-up period.

F. It is the intent of these tests to ensure that all equipment is operational within industry and manufacturer's tolerances and is assembled in accordance with design plans and Specifications.

G. The Owner and/or Construction Manager may witness testing in effort to insure quality and verify results. The Contractor is required to provide notification 2 weeks prior to any test that are intended to be documented and submitted for approval or are final tests. The Owner and Construction

Manager must specifically decline witness of each test to be performed, and the test must be successful, and it must be documented on the day of test, in order for it to not have to be repeated in the presence of an authorized witness. Only the Owner or Construction Manager may assign an authorized witness.

H. All tests shall be documented in writing by the person performing the test on the test forms submitted (and similar to those shown at the end of this section) and signed by the Engineer as satisfactorily completed. The Testing Company, Electrical Contractor or System Integrator performing tests shall keep a detailed log of all tests that failed or did not meet Specifications, including date of occurrence and correction.

I. The Contractor shall perform all applicable testing of Owner supplied or existing equipment as a unit and as part of a system. Testing shall include documentation and witness sign-off.

J. The radio and communications equipment shall be completely configured by the Contractor for permanent operation. Radio diagnostics, addresses, and configuration shall be recorded and provided with testing submittals. Provide data in tabular format on Excel spreadsheet. Contractor is required to test every path, link, repeater until optimum results are obtained. Test form example is not provided for this purpose and must be generated by the Contractor.

1.02 REFERENCES

A. Electrical Specifications [Electrical General]
B. Project Drawings
C. Additional testing may be specified in other Electrical Specifications.

1.03 FACTORY AND FIELD GENERAL REQUIREMENTS

A. Testing General

1. Prior to any field testing Operation & Maintenance Manuals shall have been submitted and approved.

2. The test forms shall be completed by the contractor during testing and calibration of all equipment. All tests shall be witnessed by the Owner’s Representative. Completed test forms shall be given to the Owner’s Representative the day of the test. Complete two sets of test forms if Contractor wants to keep a copy.

3. The Contractor shall give the Engineer 10 working days notice of the dates and time for inspections and testing.

4. Include test results in the Maintenance and Operational Manual.

5. As a minimum, all the tests indicated/specified on the test forms shall be performed and test forms filled out by the Contractor.

6. Prepare and submit formal test procedures and forms at least two weeks prior to the start of testing. Testing shall not commence until the test procedures have been reviewed and approved. Submit a combined test procedure submittal with separate sections for factory and field tests.

7. If the results of any of tests are unacceptable, the Contractor shall make corrections and perform the tests again until they are acceptable; these tests shall be done at no additional cost.

B. Failure to Meet Test

1. Any system, material or workmanship which is found defective on the basis of these tests shall be reported immediately following the test. The Contractor shall replace the defective material or equipment and have tests repeated.

C. Safety

1. Testing shall conform to the respective manufacturer's recommendations. All manufacturers' safety precautions shall be followed.

2. Safety, as shown herein and in other divisions, shall be a combination of all methods and practices described. Safety practices may not be determined based on the least restrictive requirement, but instead, on the most restrictive requirement. Obtain clarification if there is any question prior to performing tests.

3. The procedures stated herein are guidelines for the intended tests, the Contractor shall be responsible to modify these tests to fit the particular application and ensure personnel safety. Absolutely no tests shall be performed in such a fashion that personnel safety is jeopardized.

4. The Contractor shall have two or more personnel present at all tests.

5. Two non-licensed portable radios shall be provided by the Contractor for use during testing.

6. Contractor shall comply with California Electrical Safety Orders (ESO) and Occupational Safety and Health Act (OSHA): All test and procedures shall comply with ESO and OSHA as to safety, protective clothing, clearances, padlocks and barriers around electrical equipment energized during testing.

7. The first set of tests to be performed (**pre-energization**) shall determine the suitability for energization and shall be completed with all power turned off.

1.04 QUALIFICATIONS

A. Testing Company

1. Testing company shall have been actively engaged in the type of electrical testing specified in this Division for the past three years (minimum). The Testing Company representative shall have two years experience in field testing of equipment working for the Testing Company or equivalent. The following Electrical Testing Companies are pre-approved.

   a. EETS (916) 339-9691
   b. Industrial Test (888)-809-8550
   c. Emerson Electrical Reliability Services
   d. Apparatus Testing and Engineering (916) 853-6280
   e. Apparatus Testing and Engineering (925) 454-1363
   f. Power Systems Testing (925) 583-2361

2. Testing Companies not listed are required to submit company and individual representative resumes for review and approval.

B. System Integrator Representative

1. The system integrator representative shall have 1 year experience in field testing of equipment working for the System Integrator or equivalent. If the representative does not demonstrate necessary experience or competence during testing or start-up, the System Integrator shall provide a representative meeting the required competence and experience.

C. Electrical Contractor Representative

1. The Electrician shall have 5 years minimum experience working with industrial control systems and have a Journeyman level experience rating.

1.05 SUBMITTAL REQUIREMENTS

A. The Contractor shall ensure that the Testing Company, System Integrator, and all equipment suppliers provide the submittal documentation required in this section. Submittals shall be complete, neat, orderly, and indexed. The Contractor shall check all submittals required under this Division for the correct number of copies, adequate identification, correctness, and compliance with the Contract Specifications and Drawings, and initial all copies certifying compliance.

B. The System Integrator shall assemble and submit for approval complete testing procedures and forms at least two weeks prior to the start of testing. Contractor is responsible for compiling testing procedures and forms from multiple sub-contractors as required.

C. Test submittal shall include: (as applicable)

1. Proposed procedure for operational testing whether it is performed in the factory or field. Procedure shall include method, simulated I/O requirements, bypass piping, telemetry, and necessary materials and equipment to conduct test.

2. Test forms (for all tests, factory and field, and regardless of who performs tests). Test forms shall be electronically completed prior to submittal with entry spaces filled to the extent possible. The only remaining data that shall require completion during the test is the test data itself. Test forms shall be provided as illustrated at the end of this section or equal.

3. Approved shop one-line, elementary diagrams and PLC I/O drawings.

4. Control strategies photocopied at 75% reduction with room at the side of page for comments on each paragraph or control strategy.

PART 2: PRODUCTS

2.01 TEST EQUIPMENT

A. Test equipment required to perform testing and document results shall be provided by Contractor, Testing Company or System Integrator.

B. Test instruments shall be calibrated to references traceable to the National Institute of Standards and Technology. Instrument calibration shall be current to one year from date of start-up. Test equipment accuracy shall be at least twice the accuracy of instrument being calibrated. Test instrument certificates of calibration shall be on-hand and provided prior to testing.

C. All test equipment to be used as part of the testing shall be listed in the submitted testing sheets. Contractor supplying the component or system to be tested shall provide all necessary test equipment.

D. The overall accuracy of each input and output loop shall be checked to ensure that it is within manufacturer's Specification tolerances. In no case shall the error exceed 0.25% or 0.04 mA.

PART 3: EXECUTION

3.01 FACTORY TESTING

A. General Requirements

1. The System Integrator shall conduct a thorough and complete factory test witnessed by Engineer per the criteria specified herein. Factory test shall be held within 150 miles of project location.

2. Temporary wiring and equipment shall be provided and connected during these tests to simulate the complete assembled system.

3. The testing shall not be started until the manufacturer has completed fabrication, wiring, setup, programming; quality control testing; and can demonstrate the system is complete and operational.

4. The equipment required for factory testing shall consist of, but is not limited to, control panels, MCCs, and/or miscellaneous electrical panels as provided under this contract.

5. Two digital multimeters/signal generators (minimum +/- 0.1% accuracy) with clip-on leads shall be supplied and utilized during testing for measurement of digital and analog outputs.

6. All factory tests shall be conducted at the System Integrator's facility. All factory tests shall be completed prior to shipment to the jobsite. The equipment shall be fully assembled, and connected (and programmed) similar to as it will be installed.

7. The length of the factory testing shall be a minimum of one (1) working day(s) (8 hours per day).

8. Faulty and/or incorrect hardware or software operation of major portions of the system may, at the discretion of the Engineer, be cause for suspension, cancellation, or restarting of the factory test, at no additional cost to the Owner or extension in Contract time.

9. The factory test will be considered complete only when the integrated system has successfully passed all tests. No electrical equipment shall be shipped to jobsite without completed test documentation.

10. During the testing period, under the supervision of the System Integrator, the Owner's Representative shall have unlimited and unrestricted access to the usage and testing of system hardware, configuration, software, meters and tools.

11. The System Integrator shall pay all expenses incurred by his personnel including labor, material, transportation, lodging, daily subsistence, and other associated incidental costs during the factory testing.

12. Acceptance and witnessing of the factory tests does not relieve or exclude the Contractor from conforming to the requirements of the Contract Documents.

13. Upon conclusion of factory testing, and at the request of the Application Programmer, the System integrator shall remove the PLC, OI, and communication equipment for Application Programmer's use and programming. The System Integrator shall provide equipment to Application Programmer immediately or ship unit within 2 working days. The System Integrator shall not be responsible for equipment while in Application Programmer's care.

14. All modifications to documentation as a result of the factory tests shall

be corrected and completed before the submittal and delivery of "Operation and Maintenance" Manuals.

15. Copies of the completed and witnessed factory testing forms shall be included in the Operation and Maintenance Manual.

B. Factory Tests

1. Structured Factory Tests: The associated factory tests are to be performed by the System Integrator and witnessed by the Owner's Representative. The associated test forms shall be completed during each stage of the test.

a. Visual and Mechanical Inspection Tests

b. Wiring Tests

1) Contractor shall confirm correct panel wiring per System Integrator panel shop drawings. Panel shop drawings shall be compared with Contract P&IDs and other Drawings to verify all hardwire logic are accounted for. Panel drawings used in factory tests shall be redlined and inserted into Factory Testing Results submittal.

c. MCC and Control Panel Pre-Operational Tests

d. Logic Controller I/O Point to Point Tests

e. Simulated Alarm Tests

1) Simulate the digital and/or analog signals at the terminals to verify that each PLC I/O point is functional and properly programmed. Verify that all parameters (i.e., setpoints, enable/disable toggle bits, timers, etc.) for the alarms operate according to the Specifications. Multiple alarm states (i.e., LO, LO-LO, HI, HI-HI, etc.) shall be checked.

f. Simulated Operational Control Tests

1) Simulate the digital and/or analog signals at the field terminals to verify that each control system is functional and properly configured and programmed.

2) Each line of control logic in the Control Strategies section shall be checked. When the complete control strategy has been checked, it shall be signed and dated by testing person and person witnessing test.

3) Verify that all parameters (i.e., setpoints, runtimers, totalization, etc.) operate according to the

Specifications.

2. Unstructured Factory Tests: The various unstructured tests shall include, but are not limited to, the following.

   a. Simulate the equipment failure and power fail/restart of PLC. Check the effects of each failure on maintaining operations with the remaining equipment.

   b. The factory tests, as a minimum, shall simulate all normal and abnormal operating conditions including steady state, change of state, variable changes, fluctuations, transients, upsets, start-up, shutdown, power failure, and equipment failure conditions.

   c. Communications test to devices located within control panel and/or in MCCs.

   d. Simulation of PLC communication error. Demonstrate error detection, alarming, and recovery.

   e. Measure and test all power supplies for correct voltage. Operate rechargeable devices under battery power to test run duration, alarms and automatic recovery.

3.02 FIELD TESTING

A. General Requirements

1. Field testing is broken down into 4 components

   a. Pre-Energization testing
   b. Pre-Operational Testing
   c. Operational Testing
   d. Commissioning

2. Project wide, all Pre-Energization testing must be completed prior to Pre-Operational testing, all Pre-Operational testing must be completed prior to Operational Testing, and all Operational Testing must be completed prior to Commissioning.

   a. Any deviation of this order, whether on a component level or larger scale, must be approved.

   b. Out of order testing, if allowed, will be evaluated on a case-by-case basis when brought to the attention of the Owner's Representative. The Owner's Representative may require that the entire system, or portions thereof, be retested once the missing component(s) are installed and functional.

3. All equipment supplied by the Contractor or others shall be tested by

Contractor per these specifications.

4. Two digital multimeters/signal generators (minimum +/- 0.1% accuracy) , AC current meters, torque wrench, and other specialized test equipment shall be provided by the Contractor for use during testing.

5. If the equipment is determined not to be ready for testing, the test will be cancelled and rescheduled for a later date.

6. Faulty and/or incorrect hardware or software operation of major portions of the system may be cause for suspension, cancellation, or restarting of the area of testing, at no additional cost or extension in Contract time.

7. During the Operational testing period, under the supervision of the System Integrator, the Owner's Representative shall have unlimited and unrestricted access to the usage and testing of all hardware and software in the system.

8. The System Integrator shall pay all expenses incurred by his personnel including labor, material, transportation, lodging, daily subsistence, and other associated incidental costs during field testing.

9. Acceptance and witnessing of the tests does not relieve or exclude the Contractor from conforming to the requirements of the Contract Documents.

10. All modifications to documentation as a result of the tests shall be corrected and completed before the delivery of "as-built" documentation.

11. Copies of the completed and witnessed field testing forms shall be included in the Operation and Maintenance Manual.

12. The various contractors on this project (General Contractor, Electrical Contractor, Testing Company, and System Integrator) shall assume the lead role in testing activities as listed below. The Contractor shall obtain assistance of suppliers and/or manufacturers representatives for any major equipment testing.

    a. Electrical Contractor:

        1) Pre Energization Tests
            a) Visual Mechanical Tests
            b) Wire Insulation and Continuity Tests.
            c) Panelboard Tests
            d) Breaker Tests

        2) Operational Tests.
            a) Generator Tests

3) Commissioning.

b. System Integrator:

1) Pre-Operational Tests
   a) Visual Mechanical Tests
   b) Control panel pre-operational test
   c) MCC pre-operational test
   d) Motor Tests.
   e) PLC I/O point to point tests.
   f) Instrumentation switch tests
   g) Instrumentation transmitter tests.

2) Operational Tests.
3) Commissioning

c. Testing Company

1) Grounding System Tests
2) Breaker Device Tests

d. General Contractor

1) Test Scheduling
2) Operational Tests.
3) Commissioning.

e. Application Programmer (software systems)

1) Operational Tests.
2) Trial Period
3) Commissioning.

B. Electrical Field Tests – The following test shall be performed within each test category. Complete test forms for each electrical panel, instrument, and/or device. Provide separate form for each component to be tested.

1. Pre-Energization Inspections and Tests:

a. Visual and Mechanical Inspection Tests
b. Wire Insulation and Continuity Tests
c. Grounding System Tests
d. Panelboard Tests
e. Breaker Tests

2. Pre-Operational Tests:

a. MCC Pre-operational Tests:
b. Control Panel Pre-operational Tests:
c. Motor Testing:
d. Generator Testing (if generator is furnished)

e. Harmonic Measurement: (Required for systems with VFDs)
f. Instrumentation Switch Calibration Tests
g. Instrument Transmitter Calibration Tests
h. PLC I/O point tests.
i. Communication Tests

1) The Contractor shall verify that all communications via radio, telephone, wireline, fiber optic, or other are functional and ready for operational testing. Revise all configurable parameters without additional cost to the Owner as required for an optimally functional system.

2) Verify that all components of the communication system operate together under all operating and power restart conditions. If faults occur, investigate source of problem and correct. Revise all configurable parameters without additional cost to the Owner.

3) Change setpoints from SCADA and confirm that corresponding field setpoint changes correctly. Check every I/O point on every screen, trend, and database.

3. Operational Tests:

a. After all the previous tests in this subsection are complete, the test forms are completed and signed-off, the Contractor shall conduct operational testing.

b. Representatives from the General Contractor, Electrical Contractor, System Integrator, and Owner's Representative shall be present during testing. Operational testing shall be performed by Contractor in the presence of the Owner's Representative.

c. During operational testing the Contractor shall follow the instructions of the Owner. The Owner may place restrictions on operation that must be followed by the Contractor during testing. Any accidents or fines caused by actions of the Contractor where warnings or restrictions were placed, shall be remedied or paid by the Contractor.

d. Alarm Tests

1) Generate the digital and/or analog signals at the primary device to verify that each PLC I/O point is functional and properly programmed. Verify that all parameters (i.e., setpoints, enable/disable toggle bits, timers, etc.) for the alarms operate according to the Specifications. Multiple alarm states (i.e., LO, LO-LO, HI, HI-HI, etc.) shall be checked.

e. Operational Control Tests

1) Generate the digital and/or analog signals at the primary device by raising or lowering the actual measured process. Inject signal into the terminals or utilize a "force" function within the device only as necessary. Verify that each control system is functional and properly configured and programmed.

2) Each line of control logic in the Control Strategies section shall be checked. When the complete control strategy has been checked, it shall be signed and dated by testing person and person witnessing test.

3) Verify that all parameters (i.e., setpoints, runtimers, totalization, etc.) operate according to the Specifications.

4) Verify that all data, setpoints, alarms are being received at SCADA correctly and that all I/O points on screen are true and accurate representations of field information.

f. Other Tests

1) Force a power failure and power fail/restart of PLC and all other systems. Check the effects of each failure on each piece of equipment and automatic recovery.

2) Force a PLC communication error. Demonstrate error detection, alarming, and recovery.

3) Perform additional operational testing that has not already been witnessed.

4) Perform any additional operational testing as necessary to confirm robust and error free operation under all operational conditions.

4. Trial Period

a. Station/Equipment shall be activated to automatically run for 5 days, 24 hours per day Monday through Friday.

b. During the trial period the Owner's Representative will test all modes of operation and will look for errors and malfunctions. A punchlist will be generated to be completed by Contractor and re-tested prior to Commissioning.

c. If equipment failure occurs during the trial period, the Contractor shall repair or replace the defective equipment and shall begin another trial period, Monday through Friday.

d. This test shall be repeated until all new equipment functions acceptably and without failure for consecutive days.

C. Commissioning:

1. Commissioning shall not commence until Operational testing and System Training are complete with documentation submitted and with prior approval.

2. Commissioning period

a. The new equipment shall be activated by the Contractor to operate in full automatic for 10 consecutive days, 24 hours per day. Commissioning shall only start on Mondays or Tuesdays.

b. During Commissioning, the Owner will monitor and run the station in normal automatic mode. If equipment failure occurs during Commissioning, the Contractor shall repair or replace the defective equipment and shall begin another commissioning period after repairs are complete.

c. Parallel, existing and/or back-up systems shall remain in place and functional during commissioning period. Demolition of parallel, existing or back-up systems shall not begin until commissioning is completed.

d. This test shall be repeated until the new equipment functions acceptably for a consecutive commissioning period.

e. Warranty will begin at the start of a successful commissioning period. However, if major hardware failure occurs during commissioning, the warranty and commissioning will restart once the problem has been identified and repaired.

3.03 WARRANTY:

A. Provide warranty per Electrical Specifications [Electrical General, Warranty].

1. The completion of the above tests does not relieve the Contractor from any warranties specified in the Electrical Specifications or other sections.

2. Warranty shall begin on the start date of a successful Commissioning period.

3.04 FINAL ACCEPTANCE:

A. Final Acceptance per Electrical Specifications [Electrical General].

SECTION 16600

TEST FORMS

Index of Forms:

PC	Power Conductor Test Form
CC	Control Conductor Test Form
IC	Instrumentation Conductor Test Form
GS	Grounding System Test Form
VM	Electrical Equipment Visual and Mechanical Inspection Form
PB	Panelboard Test Form
MCO	MCC Operational Test Form
CPO	Control Panel Operational Test Form
BD	Breaker Device Test Form
GCL	Generator Field Check List
GPT	Generator Performance Test Form
GSLD	Generator Sound Level Data Form
MOTOR	Motor Test Form
HM	Harmonic Measurement Test Form
IOP	Programmable Logic Controller I/O Point-to-Point Test Form
ISC	Instrumentation Switch Calibration Test Form
ITC	Instrumentation Transmitter Calibration Test Form

END OF SECTION

POWER CONDUCTOR TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

EQUIPMENT #: _____

INSULATION TESTS						
CONDUIT	PHASE TO GROUND			PHASE TO PHASE		
#	A	B	C	AB	BC	CA

NOTES:

1) Use single form for up to 25 power conduits. Use additional forms as necessary.

2) Disconnect both ends of wiring prior to megger tests.

3) Megger insulation resistances of all 600 volt insulated conductors using a 500 volt megger for 10 seconds minimum (30 seconds minimum for motor leads). Make tests with circuits installed in conduit and isolated from source and load. Each conductor shall be meggered conductor-to-conductor and conductor-to-ground. These tests shall be made on cable after installation with all splices made up and terminations installed but not connected to the equipment.

4) Each megger reading shall not be less than 22 Meg-ohms resistive. Corrective action shall be taken if values are recorded less than 10 Meg-ohms. Conductors with low ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.

5) Values of different phases of conductors in the same conduit run showing substantially different Meg-ohm values, even if showing above 22 Meg-ohms shall be replaced.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

CONTROL CONDUCTOR TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

INSULATION TESTS											
COND. # OF #	COND. TO GROUND	CONDUCTOR TO CONDUCTOR									
1		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X									
2		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X								
3		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X							
4		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X						
5		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X					
6		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X				
7		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X			
8		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X	X		
9		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X	X	X	
10		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X	X	X	X

NOTES:

1) Use single form for each conduit.

2) Disconnect both ends of wiring prior to megger tests.

3) Megger insulation resistances of all 600 volt insulated conductors using a 500 volt megger for 10 seconds. Make tests with circuits installed in conduit and isolated from source and load. Each conductor shall be meggered conductor-to-conductor and conductor-to-ground. These tests shall be made on cable after installation with all splices made up and terminations installed but not connected to the equipment.

4) Each megger reading shall not be less than 22 Meg-ohms resistive. Corrective action shall be taken if values are recorded less than 10 Meg-ohms. Conductors with low ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.

5) Values of different phases of conductors in the same conduit run showing substantially different Meg-ohm values, even if showing above 22 Meg-ohms shall be replaced.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

INSTRUMENTATION CONDUCTOR TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

CONDUIT NUMBER: _____ EQUIPMENT #: _____

CONTINUITY TESTS			INSULATION TESTS	
CONDUCTOR PAIR # OF #	CONDUCTOR TO CONDUCTOR	CONDUCTOR TO SHIELD	CONDUCTOR TO CONDUCTOR	SHIELD TO GROUND

NOTES:

1) Disconnect both ends of wiring prior to megger tests.

2) Megger insulation resistances of all 600 volt insulated conductors using a 500 volt megger for ten seconds. Make tests with circuits installed in conduit and isolated from source and load. Each conductor shall be meggered conductor-to-conductor and conductor-to-ground. These tests shall be made on cable after installation with all splices made up and terminators installed but not connected to the equipment.

3) Each megger reading shall not be less than 10 Meg-ohms resistive. Corrective action shall be taken if values are recorded less than 10 Meg-ohms. Conductors with low ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.

4) Continuity Tests: Each instrumentation conductor twisted shielded pair shall have the conductor and shield continuity measured with an ohmmeter. Conductors with high ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

GROUNDING SYSTEM TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

TECHNICIAN: _____ TEST LOCATION: _____

EQUIPMENT NAME: _____

SOIL CONDITION: circle one WET DRY MOIST DAYS SINCE LAST RAIN # _____ OVER 7 _____

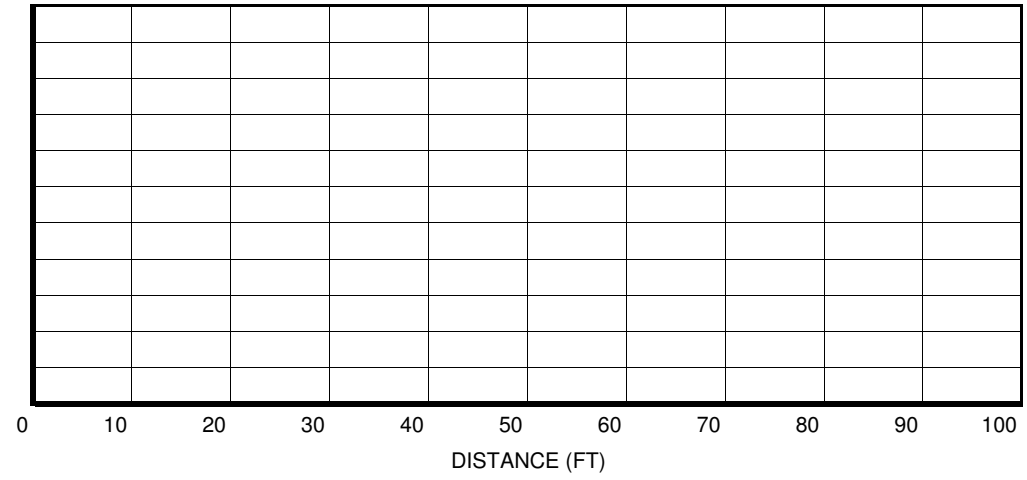
TEST ROD LOCATION RELATIVE TO SYSTEM GROUND UNDER TEST (DISTANCE AND DIRECTION) _____

COMMENTS:

FALL OF POTENTIAL TEST

MEASURED VOLTAGE PROBE	
DIST.	RESIST.
20	
30	
40	
50	
60	
70	
80	
90	

GRAPH OF MEASURED RESISTANCE VS. DISTANCE FROM TEST PROBE



NOTES:

1) Use ground resistance test meter and perform separate ground test for each building or independently derived grounding system.

2) Verify ground system is in compliance with drawings and specifications.

3) Perform the test not less than two days after the most recent rainfall and in the afternoon after any ground condensation (dew) has evaporated.

4) Investigate point-to-point resistance values which exceed 1.0 ohm. Correct (by adding additional grounding systems as necessary) and re-test. Consult design engineer if for direction on additional grounding materials and methods.

5) Connect all ground electrodes and/or UFER ground together and perform fall of potential test.

6) Perform fall-of-potential test in accordance with IEEE Standard 81 and NETA 7.13 on the main grounding electrode or system. Install test electrodes a minimum of 100 feet from system under test.

7) Measurements shall be made at 10 feet intervals beginning 20 feet from the test electrode and ending 80 feet from it in a direct line between the system being tested and the test electrode. Plot resistance readings on graphical chart above.

8) Perform point-to-point tests to verify low resistance between the main grounding system and all electrical equipment connected to the grounding system. Purpose is to check Cad-Weld connections and continuity point to point.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

ELECTRICAL EQUIPMENT
VISUAL AND MECHANICAL INSPECTION FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

EQUIPMENT NAME: _____ EQUIPMENT #: _____

NAMEPLATE DATA (complete as applicable)

MANUFACTURER: _____ ENCLOSURE: _____

MODEL #: _____ U.L. #: _____

VOLTAGE: _____ PHASE: _____

BUS AMPERAGE: _____ SERVICE: _____

BUS TYPE: _____ BUS BRACING: _____

VERTICAL BUS: _____ HORIZONTAL BUS: _____

GROUND BUS: _____ NEUTRAL BUS: _____

SERIES #:

PHYSICAL INSPECTION CHECKLIST

ENTER A-ACCEPTABLE R-NEEDS REPAIR OR REPLACEMENT NA-NOT APPLICABLE

ITEM	CHECK	NOTES
CHECK NON-ELECTRICAL FASTENERS FOR TIGHTNESS		
TORQUE TEST ALL WIRING AND BUS CONNECTIONS		
VERIFY ANCHORAGE IS PER SPECS AND/OR CALCS		
CHECK BUS BRACING AND CLEARANCE		
CHECK MAIN GROUNDING CONNECTION AND SIZE		
VERIFY GROUND BUS BONDING		
VERIFY EQUIPMENT GROUNDS		
VERIFY CONDUIT GROUNDS AND BUSHINGS		
CHECK NEUTRAL BUS AND CONNECTIONS		
VERIFY ALL BREAKERS AND FUSES ARE RATED PROPERLY		
INSPECT FOR BROKEN OR DAMAGED EQUIPMENT		
INSPECT ALIGNMENT OF PANEL AND DOOR		
VERIFY REMOVAL OF ALL DEBRIS AND DUST		
VERIFY WIRE LABELS ARE INSTALLED		
VERIFY ALL WIRE TERMINATIONS		
CHECK FOR PROPER WIRE SIZES		
CHECK FOR PROPER WIRE COLOR CODES		
VERIFY ALL NAMEPLATES		
CHECK FOR PROPER CLEARANCES AND WORKING SPACE		
INSPECT ALL PAINT SURFACES		
CHECK HEATERS AND THERMOSTATS		
CHECK VENTILATION AND FILTERS		
CHECK IF DRAWINGS MATCH EQUIPMENT		
CHECK ACCURACY OF OPERATION & MAINTENANCE		

NOTES:

1) Complete checklist above. Note any items that were found out of compliance.

2) Torque all electrical connections to values defined by equipment manufacturer or per NEC 110-14.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

PANEL BOARD TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

PANEL NAME: _____ PANEL TAG #: _____

PANELBOARD NAMEPLATE DATA

UL #: _____ MANUFACTURE: _____

MAIN BREAKER RATING: _____ MODEL #: _____

PHASE: _____ VOLTAGE: _____

VERTICAL BUS RATING: _____ BUS AMPERAGE: _____

NEUTRAL BUS RATING: _____ BUS TYPE: _____

GROUND BUS RATING: _____ ENCLOSURE: _____

ENTRY LOCATION: _____ SERIES: _____

PHYSICAL INSPECTION CHECKLIST

ITEM	CHECK	NOTES
TIGHTEN ALL BOLTS AND SCREWS		
TIGHTEN ALL WIRING AND BUS CONNECTIONS		
VERIFY ALL BREAKERS AND FUSES ARE RATED PROPERLY		
CHECK BUS BRACING AND CLEARANCE		
CHECK MAIN GROUNDING CONNECTION AND SIZE		
VERIFY GROUND BUS BONDING		
VERIFY EQUIPMENT GROUNDS		
VERIFY CONDUIT GROUNDS AND BUSHINGS		
CHECK NEUTRAL BUS AND CONNECTIONS		
INSPECT FOR BROKEN OR DAMAGED EQUIPMENT		
INSPECT ALIGNMENT OF PANEL AND DOOR		
VERIFY ANCHORAGE		
VERIFY REMOVAL OF ALL DEBRIS AND DUST		
VERIFY CIRCUIT BREAKER LEGEND PER CONTRACT		
INSPECT ALL PAINT SURFACES		
VERIFY WIRE LABELS ARE INSTALLED		
VERIFY ALL WIRE TERMINATIONS		
VERIFY PANEL SCHEDULE WITH TERMINATIONS		
VERIFY PROPER WIRE SIZE		

NOTES:

1) Complete checklist above by entering a checkmark for acceptable, R for needs repair or attention

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

MOTOR CONTROL PRE-OPERATIONAL TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

MCC NAME: _____ MCC MANUFACTURE _____

MCC TYPE: _____ MCC LOCATION: _____

EQUIPMENT NAME	EQUIPMENT TAG #	CUBICLE #	LOCAL DEVICE CHECKS AND TESTS						REMOTE DEVICE CHECKS AND TESTS		
			CONTROL SWITCH	TIME RELAY SETTINGS	METERING & INDICATIONS	OVERLOAD RESET	INTERLOCKS & CONTROL	ALARM & STATUS	CONTROL SWITCH	PUSHBUTTON LOCKOUT & STOP	METERING INDICATIONS

NOTES:

1) Verify equipment powers up and operates correctly in hand.

2) Perform trip functions and verify equipment returns to normal operation with only necessary operator intervention.

3) Enter data for each piece of equipment being served from MCC or Control Panel.

4) Enter NA - for non applicable entries.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

CONTROL PANEL PRE-OPERATIONAL TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

CONTROL PANEL NAME: _____ CONTROL PANEL TAG #: _____

CONTROL PANEL MANUFACTURER: _____ CONTROL PANEL TYPE: _____

CATEGORY	EQUIPMENT TAG #	DEVICE CHECKS AND TEST								
		CONTROL SWITCHES	OPERATOR INTERFACE	PANEL METERS	PANEL LIGHTS	PANEL NAMEPLATES	PLC POWER SUPPLY	I/O CARDS		
Height										
Voltage										
Function										
CATEGORY	EQUIPMENT TAG #	POWER SUPPLY 1 (V)	POWER SUPPLY 2 (V)	POWER SUPPLY 3 (V)	UPS	PANEL LIGHTS				
Function										
Voltage										

NOTES:

1) Set configurable parameters and verify voltage input prior to applying power.

2) Verify equipment powers up and operates correctly.

3) Perform trip functions and verify equipment returns to normal operation with only necessary operator intervention.

4) Complete checklist above by entering a checkmark (CM) for acceptable, or R for needs repair or attention, or NA for not applicable

Attention Requied:

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

BREAKER DEVICE TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

PANEL NAME: _____ PANEL TAG #: _____

PANEL TYPE: _____

EQUIPMENT INFORMATION

EQUIPMENT NAME: _____ EQUIPMENT H.P.: _____

EQUIPMENT TAG#: _____ EQUIPMENT KVA: _____

BREAKER INFORMATION

MANUFACTURE: _____ VOLTAGE: _____ CHARACTER: _____

PART #: _____ INTERRUPT: _____ CURVE: _____

FRAME #: _____ RATING: _____ LOCATION: _____

BREAKER TESTS

MFGR TRIP TIME @300% MIN: _____ BREAKER RATING/ RANGE: _____

MFGR TRIP TIME @300% MAX: _____ FINAL BREAKER SETTING: _____

MFGR INST. PICKUP AMPS: _____

CONTACT RESISTANCE TESTS - OHMS / INSULATION RESISTANCE TESTS - MEGOHMS

PHASE A	PHASE B	PHASE C	A-GND	B-GND	C-GND

CURRENT TESTS
TRIP TIME IN SECONDS @ 300% AMPS / INSTANTANEOUS CURRENT TRIP TESTS
AMPS

PHASE A	PHASE B	PHASE C	PHASE A	PHASE B	PHASE C

ADDITIONAL TESTS AND SETTING AS APPLICABLE

	PICK UP		DELAY-TIME		
FUNCTION	RANGE	SETTING	RANGE	SETTING	
LONG TIME					
SHORT TIME					
GROUND FLT.					

NOTES:

1) All breakers shall be checked for proper mounting, conductor size, and feeder designation. Operate circuit breaker to ensure smooth operation. Inspect case for cracks or other defects. Check tightness of connection with torque wrench in accordance with manufacturer's recommendations.

2) Thermal magnetic breakers, 100 amps and above, shall be test pet NETA specification 7.6.1.1. Time current characteristic tests shall be performed bypassing 300% rated current through each pole separately. Trip time shall be noted. Instantaneous pickup current shall be determined by run up or pulse method. Clearing times should be within 4 cycles or less. At end of test, the thermal breakers shall be set by Contractor. Test Ground-Fault Protection per NEC 230.95.

3) Magnetic breakers (MCP), regardless of amperage rating, shall be tested. Instantaneous pickup current shall be determined by run up or pulse method. Clearing time should be within 4 cycles or less. At end of test the breaker trip setting shall be set by Contractor based on the motor locked rotor current.

4) Contact resistance shall be measured and be compared to adjacent poles and similar breaker. Deviations of more than 50% shall be reported to Engineer. Insulation resistance shall be measured and shall not be less than 50 megaohms. All trip times shall fall within NETA Table values. Instantaneous pickup current levels should be within 20% of manufacturer's published values.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

GENERATOR FIELD CHECK LIST

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

No.	Check box	Description
1		Equipment installed in suitable location?
2		Adequate clearance on all sides to allow ease of maintenance?
3		Proper construction and leveling of mounting base?
4		Anchorage installed per seismic calculations?
5		Adequate heating for equipment room?
6		Battery-powered emergency lighting installed in equipment room?
7		Adequate incoming and outgoing air (louver motors adjusted, tested and of proper voltage)?
8		Radiator duct properly sized and connected?
9		Cooling system properly filled?
10		Proper level of specified oil in crankcase?
11		Adequate fuel supply for test?
12		Flexible sections installed in cooling water lines?
13		Manually-operable fuel and cooling water valves open and ready for operation?
14		Flexible fuel lines installed between engine and fuel piping?
15		Fuel tanks and piping installed in accordance with applicable codes and standards?
16		Adequate fuel transfer tank pump lift and pump motor properly wired?
17		Proper size exhaust line and flexible connector(s)? Flexible connector(s) should not be bent.
18		Exhaust line condensate trap with drain installed?
19		Exhaust line installed with proper downward outgoing incline?
20		Proper-specified muffler installed with hangers and mounts tight?
21		Battery(ies) of proper size and voltage?
22		Battery(ies) filled with electrolyte and properly connected to charger?
23		Battery charger AC circuit properly connected and charger operational?
24		Battery(ies) properly mounted with adequate ventilation?
25		Starting cables of proper length and gauge?
26		Starting cables properly connected to battery(ies)?
27		Generator load conductors of proper ampacity, and properly connected to the correct location?
28		Load conductors, engine start leads, battery and heater power source leads installed and in correct conduits?
29		All other wiring, including customer added options, connected properly?
30		Nameplate voltage and frequency of both generator set and transfer switch matching normal/utility source ratings?
31		Has generator phase rotation been checked versus utility?
32		Transfer switch AC conductors properly connected?
33		Transfer switch switching mechanism free from binding? NOTE: Disconnect all AC sources, and operate manually to check.
34		Generator room clean of all loose material not related to Generator?
35		Exhaust stack protected from entry by rain, snow, and animals?
36		Approved heat-isolating thimble(s) installed at points where exhaust line passes through combustible wall(s) or partition(s)?
37		Exhaust system termination located to prevent entry of exhaust gases into structures?
38		Exhaust line free of excessive bends and restrictions? Back pressure under specified limit?
39		Have all manufacturers' start-up instructions been completed?

NOTES: Before start-up, the Contractor and Generator Supplier must make the following installation checks in addition to those recommended by Generator Manufacturer. Some checks may require a running generator and should be checked immediately during first generator run

This form is intended to be used as a general guide. Use the manufacturer's Operations and Maintenance manual for reference in performing each of the following checks

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

GENERATOR PERFORMANCE TEST REPORT

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

NAMEPLATE DATA

MANUFACTURER:		S/N:		KW:		KVA:	
GENERATOR MODEL		S/N:		VOLTS:		PH:	
ENGINE MODEL:		S/N:					
ALTERNATOR MODEL:		S/N:					

PRELOAD TESTS VOLTAGE MEASUREMENTS

L1 TO L2:		L1 TO N:		BLOCK HEATER VOLTAGE	
L2 TO L3:		L2 TO N:		BLOCK HEATER WATTAGE	
L3 TO L1:		L3 TO N:		BATTERY VOLTAGE	

PRELOAD TESTS AND SHUTDOWNS

PRE-ALARMS	INDICATOR LIGHT	SHUTDOWNS	INDICATOR LIGHT	SHUTDOWN FUNCTION
GENERATOR RUN LIGHT		OVERSPEED		
ALARM HORN & SILENCE		OVERCRANK		
SWITCH NOT IN AUTO		EMERGENCY STOP		
PRE LOW OIL PRESSURE		LOW OIL PRESSURE		
PRE HIGH ENGINE TEMPERATURE		HIGH ENGINE TEMPERATURE		
PRE LOW COOLANT LEVEL		LOW COOLANT LEVEL		
PRE LOW FUEL LEVEL		LOW FUEL LEVEL		
LOW COOLANT TEMP WARNING				
LOW/HIGH BATTERY VOLTAGE				
AUXILLIARY FAULT		AUXILLIARY		

PERFORMANCE TESTS / LOAD ACCEPTANCE

FULL LOAD	VOLTAGE DIP	%	FREQUENCY DIP	%	
	RECOVERY TIME	SEC	RECOVERY TIME	SEC	
WITH SPECIFIED	VOLTAGE DIP	%	FREQUENCY DIP	%	
MOTOR LOAD	RECOVERY TIME	SEC	RECOVERY TIME	SEC	

LOAD TEST @ 1.0 POWER FACTOR

TIME STAMP	LOAD	VOLTS	AMPS	HZ	KW	AMB ºF	WATER ºF	OIL PSI	ENGR HRS
WARM UP	0								
0.1	25								
0.1	50								
0.2	75								
0.2	100								
3.4	100								

NOTES:

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

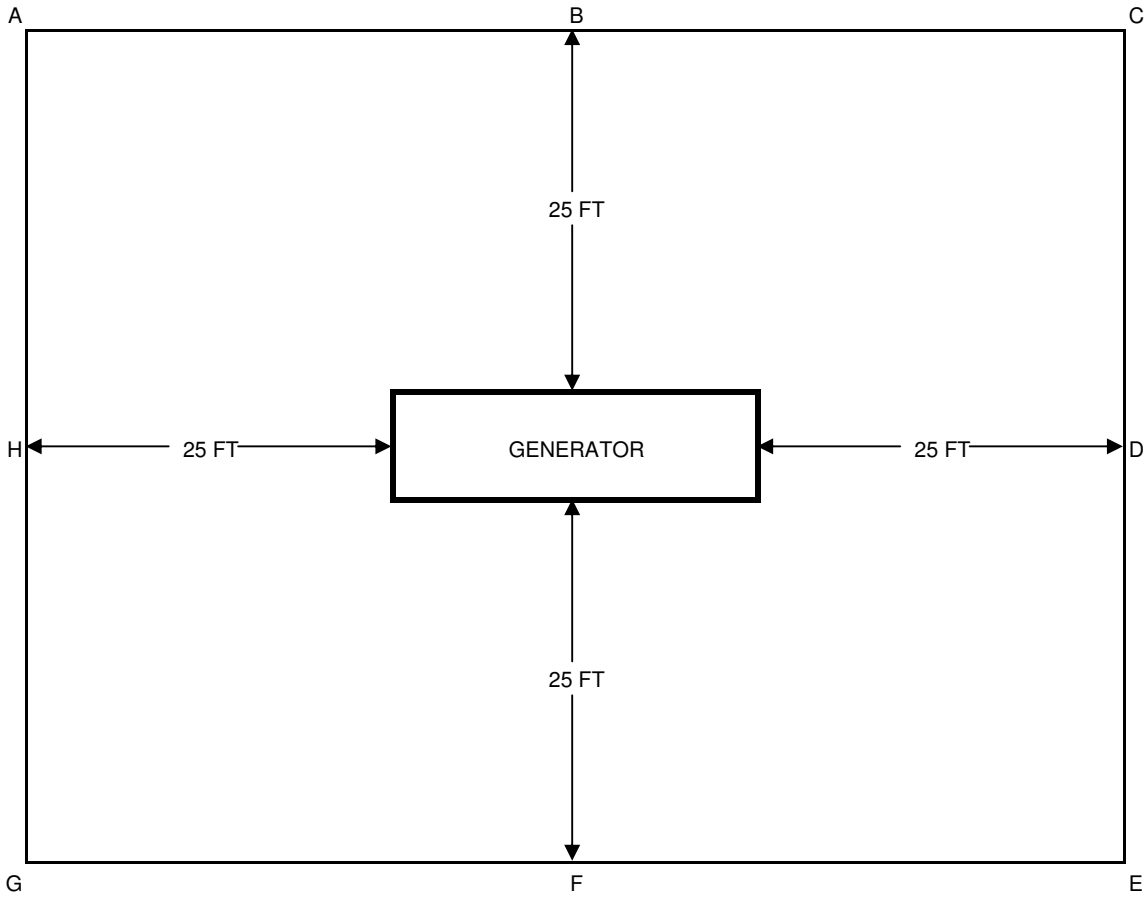
SIGNATURE COMPANY DATE

GENERATOR SOUND LEVEL DATA FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

SITE CONDITIONS



MEASURED NOISE - LOCATION									
	A	B	C	D	E	F	G	H	
NOT RUNNING									
NO LOAD									
EXPECTED MAX LOAD									
FULL LOAD									

NOTES:

1) Note permanent obstructions (within 25 FT) as they exist on site on this drawing.

2) Measure sound pressure level (dB) using acoustic sound meter on "A" setting.

3) Measure SPL background noise, generator at idle, and at full load.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

MOTOR TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

MOTOR NAME: _____ MOTOR TAG: _____

SERIAL #: _____

MOTOR NAMEPLATE DATA

MFG:		PHASE:		TYPE:		P.F:		S.F:		NEMA:	
VOLTS:		HP:		DUTY:		RPM:		CODE:		DESIGN:	
FREQ:		FLA:		MODEL:		FRAME #:		ROTATION (CW/CCW):			

INSULATION RESISTANCE TEST PHASE-TO-GROUND/PHASE-TO-PHASE

A: _____ / _____ B: _____ / _____ C: _____ / _____

CONTROL SETTINGS AND TESTS

MOTOR HEATER MEASURED AMPS:	_____ (AMPS)	MOTOR OVERLOAD SETTING:	_____ (AMPS)			
MOTOR THERMAL TRIP TEST:	_____	OVERLOAD RESET TEST:	_____ (YES/NO)			
MINIMUM SPEED (IF VFD):	_____ (HERTZ)	COIL RESISTANCE:	AB	BC	CA	

PHYSICAL MOTOR TESTS - ACTUAL MEASURED VALUES

VOLTAGE (VOLTS)		AMPERAGE (AMPS)		POWER	
AB:	_____ V	A:	_____ A	POWER FACTOR:	_____
BC:	_____ V	B:	_____ A	POWER DRAW:	_____ KW
CA:	_____ V	C:	_____ A	HORSEPOWER:	_____ HP
IMBALANCE:	_____ %	IMBALANCE:	_____ %		

NOTES:

1) Perform coil resistance measurements on motor leads with a low-resistance ohmmeter. Note measurements.

2) Perform insulation-resistance test utilizing 500 volt megger and/or accordance with manufacturer's published testing procedures. Motors 200 HP and more test duration 10 minutes, 200 HP and less test duration 1 minute.

3) Perform DC overpotential tests on motors rated 1000 HP and 4000 volts or greater in accordance with ANSI/IEEE Standard 95.

4) Verify that pump/shaft seals are lubricated and that automated lubrication systems are functional.

5) Verify that motor protection/monitoring circuits are installed and connected per contract drawings and manufacturer requirements.

6) Verify that the motor space heater is functional.

7) Perform a rotation test to insure correct shaft direction by "bumping" motor. Reverse as necessary in appropriate place. Phase taping must remain in order on terminals left-to-right once completed.

8) Measure running current and evaluate relative to load conditions and nameplate full-load amperes.

9) Record the voltage and current on all phases while operating under full-load. If voltage or current imbalance is above 2 percent, or if current is above nameplate FLA or expected level, investigate cause and report on findings. Calculate imbalance by dividing (high minus low measurement) by the average measurement of all 3 phases.

10) Vibration tests shall be conducted in cases of discernable abnormal vibration or when ordered by the Engineer (due to perceived excessive vibration). Vibration shall not exceed 0.1 in./sec as measured opposite driven end of motor. Make necessary corrections to reduce vibration below limit at all operational speeds and loads.

COMMENTS:

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

HARMONIC MEASUREMENT TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

TECHNICIAN _____ EQUIPMENT NAME: _____

POINT OF MEASUREMENT: _____

(If available, take measurements on primary side of main breaker, otherwise, on secondary side of main breaker.)

COMMENTS:

MEASURED HARMONIC VOLTAGE VALUES												
RUNNING CONDITION			TIME	VOLT	AMPS	THD(V)	THD(A)	5TH	7TH	11TH	13TH	15TH
PUMP 1 SPEED	PUMP 2 SPEED	PUMP 3 SPEED										
0	0	0										
70	0	0										
90	0	0										
100	0	0										
70	70	0										
90	90	0										
100	100	0										
70	70	70										
90	90	90										
100	100	100										

NOTES:

1) Measure the harmonics with a harmonic analyzer with each combination of pumps shown or as designated by Engineer at start-up in operation on the Utility source. Repeat test on generator (if applicable).

2) Use multiple forms and/or attach printouts of harmonic analyzer machine.

4) Expand this chart for pump stations/systems with more than 3 VFD pumps.

5) All harmonic conditioning equipment shall be on-line and operate other non-VFD loads as normal during test.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

PROGRAMMABLE LOGIC CONTROLLER I/O POINT-TO-POINT TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING CO: _____ TEST LOCATION: _____

PANEL NAME: _____ PANEL TAG #: _____

PLC NAME: _____ RACK # _____ SLOT # _____ I/O TYPE _____

I/O POINT				Scale					Digital	Operator	SCADA	Pass/Fail
I/O #	TYPE	TAG #	Description	@4mA	@8mA	@12mA	@16mA	@20mA	On/Off	Interface	Screen	CM or R
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												

NOTES:

1) Connect signal generator to each I/O point for factory testing.
2) Utilize actual instrument to generate signals for field pre-operational tests where possible.
3) Verify function and accuracy of loop by by switching the digital signal or modulating the analog signal from the connected device or instrument
4) Field verify all instruments and indicators within loop of signal.
4) Confirm polarity of signals and calibration ranges are equivalent for all components in loop.
5) Include significant digits past decimal in scale columns
6) Complete checklist above by entering a checkmark (CM) for acceptable, or R for needs repair or attention
7) Note items that need attention below

Attention Requied:

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

INSTRUMENTATION SWITCH CALIBRATION TESTS FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

INSTRUMENT NAME: _____ INSTRUMENT TAG#: _____

INSTRUMENT UNITS: _____ NAME: _____

TYPE: _____ MODEL: _____

SERIAL #: _____

MANUFACTURER	INSTRUMENT
NAME: _____	UNITS: _____
TYPE: _____	
MODEL: _____	
SERIAL #: _____	

PROCESS SETPOINT	INCREASING TRIP POINT	DECREASING TRIP POINT	DEADBAND	SETPOINT TIME DELAY	ACTUAL TIME DELAY

NOTES:

1) Field test instrumentation and associated control systems in accordance with the specifications and the manufacturer's instructions. Instrumenatation shall function as intended under actual process conditions or shall be repaired or replaced at Contractors expnse.

2) Complete a separate calibration form for each instrument provided.

3) Simulate process variable in field by applying known pressure, temperature, opening/closing measured device, raising/lowering actual level, etc. as required to confirm calibration. This step must be witnessed by inspector.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

INSTRUMENTATION TRANSMITTER CALIBRATION TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____

TESTING COMPANY: _____ TEST LOCATION: _____

INSTRUMENT NAME: _____ INSTRUMENT TAG#: _____

MANUFACTURER	INSTRUMENT
NAME:	RANGE:
TYPE:	SCALE:
MODEL:	UNITS:
SERIAL #:	TRANSMITTER OUTPUT:
REMOTE SENSOR TYPE: (If Applicable)	FACTORY SPECIFIED ACCURACY:
	REMOTE SENSOR OUTPUT: (If Applicable)

DESIGNED VALUE				ACTUAL VALUE			
INPUT SIGNAL	OUTPUT	ENG VALUE	CALCULATED TOLERANCES	INSTRUMENT DISPLAY	INSTRUMENT OUTPUT SIGNAL	PROCESS INDICATOR	LOGIC VALUE

NOTES:

1) With this form, attach and submit factory calibration forms for flowmeters and transmitters that are available from factory.

2) Field test and calibrate instrumentation and associated control systems in accordance with the specifications and the manufacturer's instructions. Instrumenatation shall meet specified accuracy or shall be repaired or replace at Contractor's expense.

3) Complete a separate calibration form for each instrument provided.

4) Simulate process variable in field by applying known pressure, temperature, pH, etc. as required to confirm calibration. This step must be witnessed by inspector.

5) Provide parameter value for each parameter changed from factory default.

CERTIFIED BY: _____ _____ _____

SIGNATURE COMPANY DATE

WITNESSED BY: _____ _____ _____

SIGNATURE COMPANY DATE

SECTION 26 79 05

CONTROL PANELS

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Provide and install Control Panels per Drawings.

B. Provide complete wired and tested panel with all devices installed per the contract Drawings and as stated herein.

C. Provide all necessary hardware, conduit, wiring, fittings, and devices to connect the control panel to equipment provided under other Sections.

1.02 REFERENCES

A. Electrical Specifications [Electrical General].

B. Electrical Specifications [Low Voltage Wire & Data Cable]

C. Electrical Specifications [PLC & OI Hardware]

D. Electrical Specifications [PLC & OI Application Programming]

E. Electrical Specifications [Instrumentation]

1.03 SUBMITTAL REQUIREMENTS

A. Provide submittals and Drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].

B. Submit shop construction Drawings for the Control Panel. The following Drawings shall be provided as a minimum:

1. Scaled drawings of the Control panel elevation, baseplan. The dimensions and locations of the cutouts shall be dimensioned from the bottom left corner of the door(s).

2. Scaled drawings of the backpan including all mounted components and wireways.

3. Wiring diagrams for AC and DC power distribution, I/O for each card in the PLC and communications block diagrams.

1.04 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Provide operating instructions as specified in Electrical Specifications [Electrical General].

PART 2: PRODUCTS

2.01 ENCLOSURE

A. The enclosure for the control panel shall be (at minimum) sized as shown in the Contract Drawings.

1. Arrangement: Where so indicated, 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.

2. Assembly: Mount all equipment on 12 ga. painted white backpan(s) that is bolted to rear (and sides) of the enclosure. Use drill and tap method for machine thread screws for all internal components on mounting panels. Provide extra mounting bolts through the rear of the structure if equipment weight exceeds backpanel mounting stud capacity.

3. Hardware: Provide door latch and accessories as detailed in the Contract Drawings or as required to meet NEMA area ratings.

a. Provide one or two single point latches for panels up to 36” height.

b. Provide 3 point latching mechanisms for panels over 36” height consisting of rotating handle with latch, extension bars with plastic wheels at ends and guide slots at top and bottom of door, or as otherwise shown on drawings.

c. Hinges, pins, bolts and screws shall be of 316 stainless steel only.

4. When physical size requirements for individual components are different than that detailed on the Control Panel backpan drawing, the wiring diagrams and specifications herein shall supersede the elevation drawing and the Contractor shall furnish additional panel width as needed to fit the electrical equipment. Deviations with sufficient evidence for the change shall be submitted for approval. The Contractor is required to provide for all equipment including spares and spaces as shown in the wiring diagrams.

2.02 CONTROL PANEL CIRCUIT BREAKERS

A. Furnish circuit breakers and accessories as required per Drawings and application.

1. Copper busbar systems, up to 480VAC, 115A, 1, 2 or 3 phase as needed for application

2. Trip rating per Drawings or as needed for protected device. Trip

curves as selected by System Integrator.

a. B curve magnetic trip point: 3 to 5 times the rated current, typically used for computers and electronic equipment with very low inrush loads (PLC wiring).

b. C curve magnetic trip point: 5 to 10 times the rated current, typically used for small transformers, pilot devices, etc.

c. D curve magnetic trip point: 10 to 20 times the rated current, typically used for transformers or loads with very high inductive loads.

3. Quantity of pins and feed in lugs as required.

4. Auxiliary contact, shunt trip as required in Drawings.

5. DIN rail mounted, 18mm width per pole, finger safe pressure plate terminals.

B. Motor applications:

1. UL489 for branch circuit protection up to 40A, 1 to 3 pole.

2. 5 kAIC interrupting capacity @ 480 VAC

3. Alltech, Eaton FAZ, or equal.

C. Control circuit transformers and other Non-motor applications:

1. UL1077 supplementary protection up to 63 amps, 1 to 2 pole, AC or DC.

2. Used where a UL489 protective device is upstream powering the circuit (from a panelboard or other source).

3. Used within control circuits for power supplies, control power transformers, relays and PLC I/O points.

4. Used in place of fuses that are applied as supplementary protection.

5. Eaton FAZ, or equal.

2.03 FUSES AND FUSE HOLDER

A. Fuses shall not be used in branch or control circuits unless specifically shown in the Drawings. Circuit breakers shall be furnished and utilized where possible.

B. Fuses used in circuits 200 VAC and above shall be time- delay, 13/32" x 1-1/2", and have an interrupting rating of 10,000 AIC at 500 VAC. Fuses shall

be Bussman type FNQ or approved equal. Fuse holders shall feature open fuse indication lights and shall be rated 30A at 600 VAC. Fuse holders shall be Bussman Optima Series OPM or equal.

C. Fuses used in 120 VAC shall be time-delay, 1/4" x 1-1/4", and have a rating of 250 VAC. Fuses shall be Bussman type MDA or approved equal. Fuse-holders shall be of the same manufacturer, series and color as the adjacent terminal blocks and have blown fuse neon indicators. Fuse holders shall be Entrelec ML 10/13.SFL, Allen Bradley 1492-H4 or equal.

D. Fuses used in signal and 24 VDC circuits shall be fast acting, 5mm x 20mm and have a rating of 250 VAC. Fuses shall be Bussman type GMA or approved equal Fuse-holders shall be of the same manufacturer, series and color as the adjacent terminal blocks and have blown fuse LED indicators. Fuse holders shall be Entrelec M 4/8.SFDT, Allen Bradley- 1492-H5 or equal

E. Fuses shall be sized in conformance with the NEC.

2.04 TERMINAL BLOCKS AND ACCESSORIES

A. General

1. Terminal blocks to be clamp type, 5 spacing, 300 volt, minimum rating of 20 amps, and mounted on DIN rail. DIN rail shall be same type as used for the relays. Install extra DIN rail on each type of terminal strip with 10% spare terminals for future additions.

   a. Provide larger terminal as necessary based on gauge of connected wiring. Those terminals with 10 gauge larger gauge wiring or more than one 12 gauge wire should be evaluated and changed.

2. Provide terminal blocks with "follower" plates that compress the wires and have wire guide tangs for ease of maintenance. Terminal blocks that compress the wires with direct screw compression are unacceptable. All power, control and instrument wires entering and leaving a compartment shall terminate on terminal blocks with wire numbers on terminals and on both ends of the wires.

3. Provide end clamps, separators, din rails, and jumpers to complete terminal block system. See example PLC I/O drawing for additional information. Engineer can provide on request if not available in plans.

4. Terminal Tags and Markers: Each terminal strip shall have a unique identifying alphanumeric code at one end (i.e.: TB1, TB2, etc.) or as shown in Drawings.

5. Plastic marking tabs shall be provided to label each terminal block. These marking tabs shall have a unique number/letter for each terminal which is identical to the "elementary" and "loop" diagram wire designation. Numbers on these marking strip shall be machine printed

and 1/8" high letters minimum.

6. Terminal blocks shall be physically separated into groups by the level of signal and voltage served an by PLC I/O card. Power and control wiring above 100 volts shall have a separate group of terminal blocks from terminal blocks for wiring below 100 volts, intermixing of these two types of wiring on the same group of terminal blocks is not allowed.

7. Terminal blocks shall be gray in color unless otherwise shown on the Drawings.

8. Provide a ground terminal or connection point for each grounding conductor.

9. Provide a separate signal, common, and/or neutral terminal for every wire and PLC or remote device connection at minimum.

B. CP – Control Panel Terminal Blocks

Description	**Model number, Allen Bradley or equal**
General Purpose Terminal Block, 20A	1492-W3
Disconnecting Terminal Block, 20A	1492-JKD3
Grounding Terminal Block	1492-JG4
PLC AI Sensor Block, 4 Level with GND	1492-WTS3
PLC Digital Output Relays, 120VAC, 6A, SPDT	700-HLT1U1

Note 1: General purpose relays are defined in ELECTRICAL – GENERAL

Note 2: Accessories are not listed such as end caps, anchors, jumpers, bridges, marking strips, or other items necessary to make up a complete terminal block layout. Furnish all parts necessary per manufacturer's intended solution.

C. MCC – Motor Starter Cubicle Terminal Blocks

1. MCC cubicle terminal blocks shall be pull apart as supplied standard by MCC manufacturer.

D. Power – Power terminal Blocks

1. Backpan mounted termination blocks shall be rated for 600V (min). The power termination blocks shall be rated to accept Copper or Aluminum cable and rated as shown on Contract one-line diagrams. Termination blocks shall be insulated with molded plastic covering and finger safe cover. Each termination block shall be provided with quantity and size of primary and secondary cable connections as required per installation. The power termination blocks shall be Erico UD, UDJ, BD, TD, or SB series or equal.

2. Unmounted termination blocks shall be constructed of aluminum and suitable for use with Aluminum and copper wire. Size and quantity of cable connections shall be as required for installation. Termination blocks shall be insulated with molded high-dielectric strength plastic covering and eliminate the need for tape insulation of electric connection. The termination block shall have removable access plugs over the wire entry and hex screw ports. Provide NSI Polaris IPL or IPLD Series terminal blocks or equal.

E. Panel Mount Receptacle

1. The panel receptacle shall include a GFI 20A receptacles on the front and rear of the unit. One Ethernet pass through port shall be included to provide a Ethernet connection on the outside of the door or panel. The entire unit shall be covered with a clear weatherproof cover. Furnish Hubbel Panel-Safe PR4X205EB or equal.

F. Panel Ground

1. Each electrical enclosure shall have a copper ground bus. Screw type fasteners shall be provided on all ground busses for connection of grounding conductors. Ground bus shall be a Challenger GB series, ILSCO CAN series or equal.

2. A 12ga. copper ground wire shall be attached between the ground bar and the panel enclosure, and between the ground bar and the mounting panels. The ground connection to the enclosure and panel shall be made by sanding the paint finish off a small area, drilling a hole for a 0.25 inch bolt and mounting a 0.25-20 bolt to the panel to serve as grounding stud. The grounding stud shall be attached with a nut and flat washers on both sides of the enclosure/panel, and with an inside tooth star lock washer next to the panel surface. The star lock washer shall be on the inside surface of the enclosure, and the front surface of the mounting panel. The grounding wire shall be secured to the stud with a nut and inside tooth star lock washer. These grounding points shall be located within 12 inches of the bottom to the grounding bar. Each terminal strip rail shall be individually grounded by means of a #12 AWG wire to the ground bus.

3. Components within the panel shall be grounded according to the manufacturer's recommendations.

2.05 POWER SUPPLIES

A. Uninterruptible Power Supply (UPS)

1. The UPS shall be installed within the control panel and power all process related 120 VAC devices and DC power supplies.

2. The UPS capacity/size shall be as shown in the contract Drawings. The battery capacity shall be such that it may provide nameplate power for

10 minutes (min) from a fully charged battery(s).

3. The UPS shall provide surge protection and filtering: 0.3% IEEE surge let-through, zero clamping response time to meet UL 1449. The inverter shall provide true sine wave output.

4. When the Utility power voltage is outside of a preset range (approx. <100 < V < 130 VAC) then the UPS shall power the load from storage batteries and a solid state inverter.

5. The power supply shall be wired into the control panel power circuit per the contract Drawings.

6. The UPS operating ambient temperature range shall be 32 deg F to 122 deg F minimum.

7. The inverter shall be self resetting and continuously on-line regardless of the Utility power existence. Configure the UPS to restart automatically upon restart of utility power without operator intervention. The rectifier/charger shall recharge and maintain float charge on the batteries automatically.

8. The UPS shall be of a readily available commercial manufacturer. Provide American Power Conversion Smart UPS, or equal.

B. DC Power Supply (PS)

1. The DC power supply shall utilize a switching power stage, rectifier and voltage regulator. The power supply case shall be DIN rail mountable.

2. The power supply shall operate on 120V AC and provide DC output voltage and current as shown in the Contract Drawings.

3. The power supply shall be wired and fused per manufacturer instructions and Contract Drawings. Power supply output shall include self resetting overcurrent protection.

4. Power supplies below 101 Watts output power shall be Class 2 rated.

5. The power supply shall provide 2% voltage regulation for a change of 10% load to 100% full load.

6. The DC power supply shall be Sola SDN-C, Phoenix Contact Quint Power, or equal.

C. DC Power Redundancy Module

1. The external redundancy module shall allow two power supplies to exist in a parallel redundant configurations. The external modules purpose is to increase the reliability by isolating the power supplies and providing a single output. If either of the power supplies was to

fail, the output would not be impacted. The redundancy module shall include monitoring contacts for each input power supply and for the output. Provide the redundancy module with capacity rating equivalent or larger than the power supply rating.

2. The DC power redundancy module shall be Sola SDN xx RED, Phoenix Contact Trio Diode, or equal.

2.06 MISCELLANEOUS COMPONENTS

A. Wireway: Manufactured from light gray rigid PVC suitable for continuous use at temperatures up to 50 deg C. Wireway shall be 2" height, width as required with 0.5" slot spacing with removable covers. Provide Panduit type "F" or equal.

B. Intrusion Switch: The intrusion switch shall have a pin plunger that is depressed when the door is closed. The form C contacts shall be rated 2A at 120 VAC. Provide Hoffman A-LFSWD, Microswitch 1AC2 or equal.

C. LED Strip Light: The LED light shall be an "under cabinet" style with multiple LED lamps and acrylic diffuser. Lamp shall be switched on/off from integral switch or PIR motion sensor. Light housing shall be capable of magnet mount to top or side of enclosure or will include mounting tabs for mounting to brackets. Lamp shall be powered from 120VAC or from 24~48 VDC or shown in the contract Drawings. LED Strip Light shall be Stego 02540, or equal.

D. Circulation Fans: The control panel temperature shall be maintained 10 deg. F below lowest internal device's temperature rating. The fans shall be 4" or 6" unless otherwise noted on Contract Drawings. The Contractor shall calculate the heat generation of all internal components and determine if the fans submitted will meet the cooling requirements of the internal components. Circulation fans shall include louver with filter and bug screen for outdoor installations.

E. Forced Air Heater: The control panel temperature shall be kept above 50 deg. F through the use of a resistive forced air heater when the panel is located outdoors. The heater shall contain a fan, heating elements, and thermostat within a single self contained unit. The wattage of the heater shall be as calculated by the supplier using the manufacturers sizing method to meet the temperature requirements. The heater shall be Hoffman D-AH series, or equal.

F. Thermostats: The air circulation fans shall be controlled by adjustable thermostat. The thermostat shall be mounted near the top of the panel and easily accessible by a technician. The thermostat shall be capable of control of a heater or cooling fan(s) by selecting the proper contact logic. The thermostat range shall be adjustable from 30 to 140 deg F. Thermostat shall be Hoffman A-TEMxx, or equal.

PART 3: EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

3.02 FABRICATION

A. Equipment Mounting:

1. Mount all equipment using manufacturers mounting tabs/holes or brackets where possible. Where not possible, construct custom brackets to panel mount or backpan mount components as shown in the Contract Drawings.

2. Equipment or laptop shelves shall be provided where shown on the Contract Drawings. Equipment shown on shelves shall not be placed on the bottom of the panel after field installation.

3. All nuts, bolts, screws, washers and hinges used in the panel shall be stainless steel. All components shall be mounted using bolts or screw fasteners only which are drilled and tapped into the backpan. Pop rivets shall not be allowed within panel except for enclosure support arms.

B. Environmental:

1. Control panel environmental accessories including fans, louvers, filters, bugscreens, air conditioners, etc. shall be provided as noted in the Drawings and as necessary for a complete environmental solution.

2. Panels environmental controls shall be designed during shop drawing submittal and fabricated to maintain temperatures 10 degrees F below lowest internal equipment maximum temperature rating.

3. Contractor shall provide [additional] fans, louvers, screens, sunshades, air conditioners, etc. as necessary to prevent equipment malfunction or premature failure. Provide associated wiring and thermostats as needed.

4. Environments:

a. NEMA 4X rated panels shall be cooled/heated with closed loop type conditioning systems to include air conditioners, internal panel circulation fans and resistive heaters.

b. NEMA 3R rated outdoor panels shall be cooled/heated with open loop type conditioning systems to include air conditioners, exhaust fans and louvers, internal panel circulation fans and resistive heaters. All exhaust fans and louvers shall include filters and bugscreens.

c. NEMA 12 or 1 rated indoor panels shall be cooled/heated with open loop type conditioning systems to include air conditioners, exhaust fans and louvers, internal panel circulation fans and resistive heaters. All exhaust fans and louvers shall include filters and bugscreens.

C. Wiring:

1. Panel Wiring: All wiring shall be installed in wireways between terminal blocks, PLC, and devices. Reference Contract Drawings for control panel power distribution diagram and control panel elementary diagrams.

3.03 INSTALLATION

A. Wiring:

1. Install all equipment per Electrical Specifications [Electrical General].

2. All internal and field wiring shall be per Electrical Specifications [Low Voltage Wire].

3. Panel Wiring: All wiring shall be installed in wireways between terminal blocks and devices. Reference Contract Drawings for Control panel power distribution diagram and control panel elementary diagrams.

4. Field Wiring: Wireways shall be provided for field wiring. Reference Contract Drawings for control panel power distribution diagram and control panel elementary diagrams.

B. Cleaning:

1. The Contractor shall clean the inside of the control panel of any dust or debris remaining at the completion of installation and testing.

2. The Contractor shall exercise care when using a vacuum cleaner or compressed air such as not to damage any component within the panel.

3. Many electrical and computer components are open for ventilation. Falling debris can penetrate the openings and cause equipment failure. Equipment with debris inside shall be removed, cleaned and/or replaced.

3.04 FIELD ASSISTANCE

A. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

3.05 WARRANTY

A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

3.06 FINAL ACCEPTANCE

A. Final Acceptance per Electrical Specifications [Electrical General].

END OF SECTION

SECTION 26 79 10

PLC & OI HARDWARE

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Providing and installing Programmable Logic Controller (PLC) and Operator Interface Hardware and all supporting hardware, wiring and devices as specified in Electrical Specifications.

1.02 REFERENCES

A. Electrical Specifications [Electrical General]
B. Electrical Specifications [Low Voltage Wire and Data Cable]
C. Electrical Specifications [PLC and OI Application Programming]

1.03 SUBMITTAL REQUIREMENTS

A. Provide submittals per Electrical Specifications [Electrical General, Submittal Requirements].

B. Submit documentation showing the number and type of I/O modules required to meet the I/O requirements specified herein. Include complete manufacturer's part and model numbers.

1. PLC I/O points are determined by the P&ID Drawings. The Contractor shall count and total the PLC I/O points per PLC controller and per type of I/O required based on the P&ID diagrams. Provide 25% spare I/O points per I/O type per PLC.

C. Submit calculations showing that the power supply meets the specified requirements and the requirements of the devices powered. Confirm PLC power supply is sufficient for all possible operable conditions.

D. Submit shop drawings showing physical backpan layout of equipment in Control Panel.

E. Submit communications block diagram including PLC, OI, motor controls, power supplies, switches, routers, radios, and any other connected components.

F. Submit hardware Operations and Maintenance Manual per Electrical Specifications [Electrical General].

PART 2: PRODUCTS

2.01 GENERAL

A. Provide PLC modules from a single family of products, using the same software and interchangeable I/O cards, that can be configured for a range of applications from small, uncomplicated sites to large, complex sites with a variety of equipment.

B. Provide a PLC that will meet the following requirements:

1. Size and provide a CPU and power supply to accommodate the CPU, I/O cards, communication devices, etc. as specified herein.

2.02 MECHANICAL

A. Provide modular PLC consisting CPU, power supply, communications, and I/O modules.

B. Provide I/O modules with removable terminal strips so that I/O modules can be removed without disconnecting field wiring.

2.03 PLC COMPONENTS

A. The following components (Schneider Automation Scadapak, no equal) shall be provided to complete the PLC(s). Only major components are listed. Multiples of some components are required- see Drawings.

B. SCADAPak 575.

1.	Main I/O and Processor	575
2.	I/O expansion	6607

2.04 ISOLATION/INTERFACE RELAYS

A. Provide output isolation relays on all digital outputs that operate devices external to the control panel and on spare outputs or as otherwise shown in the Drawings. The relay coil connection shall be on one side of the relay base and form-C output contacts on the other.

B. Relays shall be 6A SPDT, coil voltage as required, indicating, plug in style as manufactured by Allen Bradley 700-HLT1U1 or equal. Provide jumper bars for common buss connections, Allen Bradley 700-TBJ20G, or equal.

2.05 ETHERNET SWITCH

A. The unmanaged Ethernet switch shall have minimum 8 ports. Ports shall be 10/100 Base-Tx with RJ-45, 8 pin female connectors. Switch shall be suitable for power from 10 - 30 VDC. Switch shall be N-Tron 108TX, Allen Bradley Stratix 2000, or equal.

2.06 IP SERVICE ROUTER

A. Acceptable products: Netgate SG-2100.

B. Provide shelf for panel mounting of router.

C. General Specifications
   1. 2x 1 Gigabit WAN/LAN ports plus a 4 port switch provide high-speed wired connectivity
   2. PF-Sense firewall to support stateful packet filtering, firewall, and pure router capability.
   3. Supports IPsec, OpenVPN, PPTP, IPv6, NAT, BGP, RADIUS
   4. ARM v7 Cortex-A9, 2 GB DDR4L memory, M.2 expansion for SSD, or LTE.

2.07 OPERATOR INTERFACE (OI)

A. Schneider Harmony ST6, no equal.

B. Touch Screen
   1. 10 inch screen size with 1024 x 600 resolution, 65536 colors.
   2. TFT color touchscreen with LED backlight and 300nits brightness.
   3. Alarm history screen with present status and acknowledge functions.

C. Communications
   1. Modbus-TCP Ethernet communications. Provide cables for connection to PLC.
   2. Type B USB port for programming.
   3. Type A USB port for data logging and alarm history.

D. Data storage
   1. 1GB device memory
   2. 128MB User storage
   3. 32GB SDHC card for data storage.
   4. Trending for up to 16 pens (colors) with historical data access from USB RAM drive.

E. Environmental conditions:

1.	Operating Temperature:	32 to 122 degrees F
2.	Storage Temperature:	-4 to 140 degrees F
3.	Humidity Rating:	10 to 90%, non-condensing at 32° F to 86° F
4.	Rating:	NEMA 12, 13, 4X (indoor only)
5.	Power:	0.6A at 24 VDC.

PART 3: EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

3.02 INSTALLATION

A. Fabrication

1. Mount, wire and Ground PLC and OI per manufacturer's recommendations.
2. Organize equipment on control panel backpan per Backpan Layout detail in Contract Drawings.
3. Locate and install PLC(s) and OI(s) per Contract Drawings.

B. Wiring

1. Terminate status, control and analog wiring on terminal blocks.
2. Label and wire PLC to terminal blocks per Electrical Specifications [Wire, Fuses & Terminal Block] and Example I/O Wiring Diagram in the Drawings.
3. All spare I/O points shall be wired to terminal blocks.
4. Install communication cables to connect the PLC to external devices.
5. Bundle and tie down wires in a neat and orderly manner.
6. Terminate drain wire of shielded cables at backpan terminal block only.

3.03 FIELD ASSISTANCE

A. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

3.04 WARRANTY

A. Provide warranty per Electrical Specifications [Electrical General, Warranty].

B. Perform the following services during the warranty period:

1. Repair or replace damaged modules returned for service within 24 hours.
2. Determine and report the cause of failure of modules returned for service.
3. Resolve design or implementation problems discovered.

3.05 FINAL ACCEPTANCE

A. Final Acceptance per Electrical Specifications [Electrical General].

END OF SECTION

SECTION 26 79 15

PLC & OI APPLICATIONS PROGRAMMING

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Programming of the PLCs, OIs and existing SCADA to control Pump Station functions. Two pump stations are included in this scope.

1.02 REFERENCES

A. Electrical Specifications [Electrical General]
B. Project Drawings

1.03 QUALIFICATIONS

A. Services furnished under this specification shall be performed by qualified programmers meeting requirements specified in Electrical Specifications [Electrical General, Qualifications].

1.04 SECTION INCLUDES

A. Control descriptions for Programmable Logic Controller(s) (PLCs) and Operator Interface(s) (OIs).

B. SCADA system graphics, database, and configuration to support remote control of two Pump Stations. SCADA system is existing.

C. Application Programmer shall perform all PLC and OI programming requirements as defined in this section.

D. Applications Programming for Programmable Logic Controller (PLC) and Operator Interface (OI) is by Application Programmer.

E. The Application Programmer shall configure the PLC, OI, and communications equipment to facilitate testing as defined in Electrical Specifications [Factory and Field Testing]. Factory testing will take place at the System Integrator's facility.

F. The Application Programmer shall obtain the existing SCADA system program from the City. The SCADA modifications required for this project shall be incorporated in to the existing SCADA program and has all of the features described herein.

G. Related work as specified in Electrical Specifications [Electrical General].

1.05 SUBMITTAL REQUIREMENTS

A. Provide submittals per Electrical Specifications [Electrical General, Submittal Requirements].

B. Submit software operations manual including the following as a minimum.

1. Program Code

a. Program code demonstrating function in compliance with descriptions herein.

2. Setpoint listing with description

3. Program description

a. Provide written description of program operation. Description shall cover all aspects of normal operation and alarm shutdowns. Describe all alarms and their effect on operation. Describe alarms that require manual reset.

4. Register cross reference listing
   a. The listing shall be in table format and include all program constants and variable registers with their functions.
   b. The listing shall show (block and rung number) where the register is used within the program code.

5. Configuration and Set-up
   a. The configuration of the processor and hardware selections shall be summarized.
   b. The configuration of the communication ports shall be shown.

6. Data Tables

a. Print data tables with initial register values shown.

7. Special files

a. Include any special files that are particular to the manufacturer. All files pertinent to programming or configuration shall be submitted.

C. Submit software documentation demonstrating understanding of control software requirements and compliance with Portability and Maintainability requirements specified in this Section.

1. Submit OI graphic layout and PLC program listing with cross-references for approval 4 weeks prior to factory test.

2. Provide two (2) sets of SCADA and OI graphic screens and PLC applications programs on flash drives, in native file format with each software submittal and at the end of the project for as-programmed final documentation for O & M manuals. Each drive shall have a typed

label clearly stating the contents, date, filenames, and submittal (i.e., initial or as-programmed final).

3. A hard copy listings of SCADA and OI graphic screens and PLC applications programs (with comments) shall be printed with standard laser print 8½" x 11" paper and supplied with the initial submittal and for as-programmed final documentation for O&M manuals. Copy and binding method shall not cut off any parts of program logic and comments. Print shall be sized so that the complete program logic run fits on one sheet, rungs extending to multiple sheets will not be accepted and will be returned without review.

1.06 PROGRAMMING METHODS

A. Design and code programs per the following:

1. Utilize ladder logic programming language as available in the PLC manufacturer's configuration software. Other software languages such as function block, flow charts, and structured text shall not be used unless approved through RFI/submittal process.

2. Clearly comment each line of program logic code. Include module headers detailing the purpose of the module, programmer name, date of last revision, revision history, and description of sequence of events.

3. Comment for each block of code explaining purpose of program block.

4. Code shall use the P&ID device names as the prefix to the names or tagnames throughout the program logic. Reference tag formation below. If PLC does not use tagnames as data reference, then provide tagname in symbol name or in comment areas at minimum.

5. Data arrays may be used in tagname aliases for communication data transfers.

6. Provide program file for each type of program logic. The following are types that should be used, as applicable and at minimum.

a. Analog input scaling
b. Analog output scaling
c. Analog alarms
d. Digital alarms
e. PLC clock, midnight and today/yesterday control
f. Flow totalizations
g. Equipment runtimes
h. Equipment starts
i. Communications
j. Each individual piece of controlled equipment (digital control)
k. Each individual piece of controlled equipment (analog control)
l. Each individual process system (digital control)
m. Each individual process system (analog control)

n. Miscellaneous systems

B. All custom software, including diagnostic, configuration and applications programming software shall become the sole property of the Owner for their use on this and future Owner projects.

C. No software or documentation shall be labeled proprietary.

D. Provide complete hardware and original manufacturer software manuals describing how to use the configuration software.

E. Provide two (2) disks copies and two (2) hard copies of all as-installed programs at the end of the project.

F. Furnish and maintain 256MB (min) USB RAM stick on site and within control panel so that latest program files are always available and up-to-date. Upon conclusion of each downloaded program change, the USB RAM stick shall be updated.

PART 2: PRODUCTS

2.01 APPLICATIONS PROGRAMMING SOFTWARE

A. The Contractor is responsible for obtaining correct revision of PLC & OI configuration software, manuals and licensing necessary to program and configure the PLC & OI. Contractor shall coordinate the proper version of software prior to the start of PLC programming. Programming software version shall be compatible and consistent with installed base at other Owner stations.

2.02 APPLICATIONS PROGRAM CODE

A. The Application Programmer will provide, install and test (with Contractor assistance) application programming. The descriptions provided herein are not final and may have modifications made to them during construction that may change the nature of operation.

B. The descriptions are provided to give the Contractor an insight as to the level of testing effort that will be required in the later stages of the project. Minor modifications should be expected and will not constitute a change in project testing assistance scope unless those modifications cause significant additional testing time or materials by Contractor. Significant time shall be defined as 4 hours and only time or materials related to program modifications since bid may be accounted.

C. The PLC program, OI and SCADA screens shall be modeled after a similar station. Modify I/O layouts as needed and adjust programming as needed to meet requirements herein.

D. The program code shall be written without any "hard-coded" constants that would effectively require a program change to modify the value. All function

blocks shall contain variable registers only.

2.03 CONTROL STRATEGIES

A. General Requirements:

1. The following requirements (General and Specific) are intended to be used as a guideline for application programming of the PLC. They are the major functions and are not intended to be completely comprehensive of all requirements of the station operation and do not attempt to cover all necessary program routines for an operational system. Additional features, functions and registers will be required for an operational system.

2. The following general program functions shall be provided:

a. Enable/disable toggle bits and variable time delays for all alarms.

b. Analog input noise filtering -- software or firmware.

c. SCADA Auto-Off-Manual controls for all equipment controlled by the PLC. These control buttons shall also be accessible via the OI(s).

d. All equipment to have a Remote Reset feature available from SCADA and OI(s). Remote Reset signal to be held on until cleared by Reset Feedback signal.

e. Normal operations shall continue with loss of SCADA connection. The PLC code shall act on I/O connections, PLC to PLC communications, and non-SCADA communications only to control the system. Only in the event of SCADA override, shall the system not act on PLC I/O connections and non-SCADA communications. None of the program code to control the system shall reside in the SCADA system.

f. Time of day clock synchronization with SCADA system. PLC shall have registers defined for SCADA system clock write. The PLC shall have code written to recognize that the register(s) have been written to, stop the real time clock, set the clock, and restart it, with the value in the register(s). Date and time of day shall be set.

g. Resettable and non-resettable operation hour meters for all equipment and resettable starts counters for all equipment.

h. Scaling to engineering values of all variables. Minimum of 3 significant digits required.

1) Level in 1/10th Feet or Inches

2) Pressure in 1/10th PSI.
3) Flow in GPM.
4) Flow totalization
    a) Total non-resettable flow displayed in MGD with 9999999.999 presentation layout.
    b) Total resettable flow displayed in MGD with 9999999.999 presentation layout.
    c) Total yesterday flow displayed in KGAL with 99999.9 presentation layout.
    d) All registers shall roll over to zero automatically.
5) Speed in percent %.
6) Motor current in 1/10 amps.
    a) Convert current input to power (in KW) where shown on drawings. Assume voltage to be 480 and power factor to be 0.85.

i. Data register types:

1) Any register that requires precision past the decimal shall be floating point type.

2) Integer registers may be used where decimal precision is not required.

3) Boolean registers shall be used for all statuses and on/off controls.

j. All set point registers, enable/disable toggle bits and settable variable time delays shall be adjustable from the OI direct to program data table.

k. Provide communications messaging as required to share data information and interlocks between PLCs. Message structure shall be fail safe as to keep overflows or other improper operation from occurring.

l. A power fail shall reset all routines.

m. Pumps and equipment shall have backspin delays and power fail sequential re-start delay routines.

n. All powered equipment and devices shall have an assigned essential / non-essential status for purposes of generator load shedding.

o. Programming code shall have automatic error checking and proper initialization to prevent illegal operations such as negative values being placed in timer presets or mathematical out of range functions which could cause a processor fault.

p. PLC shall be programmed so that, in the event of a power interruption, the equipment controlled shall resume normal

operation upon power restoration without requiring a manual reset unless otherwise shown.

q. Set points

1) Minimum required set points for Lead / Lag pumping scenario.

a) Lead Pump start level
b) Lag Pump start level
c) Lead Pump stop level
d) Lag Pump stop level
e) Pump Start delay time
f) Pump Stop delay time
g) Backspin delay time
h) Sequential Start delay time
i) Pump rotation selection (0=auto rotate, 1=P1 Lead, 2=P2 Lead)

2) Additional minimum required set points for Lead / Lag pumping scenario when variable speed control is used.

a) Minimum Lead Pump speed to start Lag Pump
b) Minimum Lag Pump speed to stop Lag Pump
c) Maximum Pump Speed
d) Minimum Pump Speed

3. Analog Scaling:

a. All analog values shall be adjusted (if necessary) prior to scaling for required offsets due to hardware / firmware conditions.

b. All analog input values shall be scaled into real world engineering units and presented in REAL (floating point) format for use by SCADA and the OI(s).

c. All analog output values shall be scaled from real world engineering units into INT (decimal) format to control current or voltage output from an analog output device.

4. Alarms General:

a. Common alarms: Provide all applicable alarms per device based on available P&ID inputs and outputs.

1) Motor power or amperage alarms shall be disabled when the motor is not running.

2) If a device is called to start or move and the associated run status does not confirm start or move after a time

delay then post a device "Run fail" alarm. (*YNRFA).

3) All equipment (as marked on P&ID drawings) shall have a non-running alarm. (*YNRNA)

4) Not in Auto alarm: All devices (valves, gates, pumps) with auto switch monitoring shall have associated "Not in auto" alarms. (*HNAFA).

5) Moisture / Temperature alarms: All submersible pumps shall have "Moisture" and "Over temperature" alarms. (*SMFA and *SOTFA)

6) Seal Water Fail alarm: All sludge type pumps shall have "Seal water fail" alarms. (*SWFA).

7) Pressure alarm: All sludge type pumps shall have "Inlet and Outlet pressure" alarms. (*IPFA and *OPFA).

8) Temperature alarm: All sludge type pumps shall have a pump body "Over Temp" alarm. (*OTFA).

9) Differential pressure alarm: All filters shall have "Differential pressure" alarms. (*DPFA)

10) Low oil alarm: All lubricated mechanical devices (gearboxes etc.) shall have a "Low oil" alarm. *LOFA)

11) Vibration alarm: All moving mechanical devices (gearboxes, aerators, pumps etc.) shall have a "Vibration" alarm. (*VFA).

12) Over torque alarm: All geared mechanical devices (clarifiers etc.) shall have an "Over torque" alarm. (*OTQFA)

13) VFD Fault: All VFDs shall have a common fault alarm as a minimum. Further breakdown of alarms shall be provided based on data available from the VFD. All VFDs shall have a manual reset available from the OI(s) and SCADA. (*UAFA).

14) Flow, level, pressure, analytical and other analog alarms: All analog values will have at a minimum an associated alarm structure as defined in section 2.03.A.4.b.5 below.

15) All digital alarm values will have at a minimum an associated alarm structure as defined in section 2.03.A.4.c.3 below.

b. Analog Alarms:

1) If an analog value is above/below the associated set point, and the associated time delay has exceeded the time delay set point, then the alarm shall be generated / annunciated.

2) Transducer out of range alarms. If the scaled value of the analog input exceeds 21 mA or falls below 3.5 mA, an out of range alarm shall be triggered for that input.

3) The alarm shall automatically reset unless a latch is required to keep the process from resuming and re-creating the alarm. A latching alarm requires either a reset set point for hysteresis or a manual reset.

4) The low flow alarms (and pressure alarms if applicable) shall only be enabled when the associated pump or system is running.

a) Provide low flow alarm for pump operation where flow is expected above setpoint continuously when running. Alarm shall shutdown system and fail pump. If other pumps are available, they shall be called in its place.

5) Example analog alarm display structure (Units per alarm type). ENABLE / DISABLE shall be a toggle switch. DELAY to be editable timer base value for associated alarm delay timer. SET POINT column to contain current analog value in Transducer Fail Alarm row. Other alarm rows to contain editable alarm set point value with REAL (floating point) data type. LATCH to be either reset set point value for reset of alarm or manual reset toggle (blank if alarm is not latching).

Description	Status	En / Dis	Delay	Set Point	Latch
Transducer Fail Alarm	ALARM	Enable	10 sec.	28.4 GPM	Reset
High Alarm	OK	Enable	5 Sec.	xxx.x GPM	OK
High Warning	ALARM	Enable	5 Sec.	xxx.x GPM	
Low Warning	OK	Enable	5 Sec.	xxx.x GPM	xxx.x GPM
Low Alarm	OK	Disable	5 Sec.	xxx.x GPM	xxx.x GPM

c. Digital Alarms:

1) If the digital alarm state is TRUE and the associated

time delay timer has exceeded the time delay set point, then the alarm shall be generated / annunciated.

2) The alarm shall automatically reset unless it is designated as "latch". A latching alarm requires a manual reset.

3) Example digital alarm Structure. ENABLE / DISABLE to be a toggle switch. DELAY to be editable timer base value for associated alarm delay timer. LATCH to be a manual reset toggle (blank if alarm is not latching).

Description	Status	En / Dis	Delay	Latch
Generic Digital Alarm 1	OK	Disable	10 sec.	
Generic Digital Alarm 2	ALARM	Enable	10 sec.	Reset

d. Communications Alarm:

1) The SCADA and connected PLC(s) shall monitor for communications between controllers and they shall post an alarm if any PLC fails to respond to message queries.

5. Totalization:

a. Flow totalization (Example):

1) If an analog flow input value (Fxxxx) is positive, then increment the flow totalizers (FxxxxNRTOT, FxxxxRTOT and FxxxxTTOT) for each 1000 gallons of accumulated flow.

2) If internal flow reset status (FxxxxRST) is set, then set resettable flow totalizer (FxxxxRTOT) to zero and reset FxxxxRST.

3) Similar for all flowmeters / totalizers.

b. Hour Meters (Example):

1) If Generic Pump #1 running (PxxxxYNR) is set, then start hour timers PxxxxHRS, PxxxxRHRS and PxxxxTHRS.

2) If internal run time hours reset status (PxxxxRHRSRST) is set, then set resettable run time hours (PxxxxRHRS) to zero and reset PxxxxRHRSRST.

3) Similar for all device run time hours.

c. Starts Counters (Example):

1) If Generic Pump #1 running input (PxxxxYNR) is set or Generic Pump #1 start command (PxxxxXCS) is set (if running input is not available), then increment starts counters PxxxxS, PxxxxRS and PxxxxTS.

2) If internal starts reset status (PxxxxSRST) is set, then set resettable starts counter (PxxxxRS) to zero and reset PxxxxSRST.

3) Similar for all device starts.

d. Intrusion Alarms (Example):

1) Provide intrusion alarms for panels and buildings with intrusion switches.

2) Alarm shall be generated after an adjustable time delay to SCADA.

3) If an OI or SCADA is present, then provide a way for an operator to reset and disable the intrusion alarm for a setpoint period of time.

4) After that time elapses, then the alarm shall be re-activated automatically.

5) If no SCADA or OI, then the alarm shall reset automatically once the condition is returned to normal state.

B. SPECIFIC REQUIREMENTS – Booster Pump Station

1. To be further defined by Application Programmer and submitted for review. Include all operations to provide a fully functioning system.

2. Must comply with general requirements.

   a. Provide time delays and time delay setpoints for all functions.

3. Pump Interlocks:

   a. Pump control valve failure.

   b. 480 VAC power failure

   c. High discharge pressure.

   d. VFD failure.

e. Pump low flow alarm (calculated per pump, and only enabled in lead pump only operation)

4. Consists of programming function for the following:

a. Booster Pump Station (Tank Level Control)

1) Booster pump station shall maintain tank level in a remote tank with tank level information to be obtained via communications. All operating booster pumps to run at same speed. Remote tank names shown in P&IDs.

2) Utilize linear slope intercept algorithm to determine pump speed. Provide setpoints for calculating speed output at min and max speed and min and max level. Provide separate setpoints for 1 pump operation, 2 pump operation, and 3 pump operation.

3) Reduce pump speed and inhibit higher calculation of pump speed if suction pressure falls below minimum suction pressure setpoint.

4) Interlock operation with low suction pressure alarm.

5) Pump Start Control

a) Start lead pump on lead pump start level setpoint.

b) Start lag pump on lag pump start level setpoint.

c) Start lag lag pump on lag lag pump start level setpoint.

d) Stop lag lag pump on lag lag pump stop level setpoint.

e) Stop lag pump on lag pump stop level setpoint.

f) Stop lead pump on lead pump stop level setpoint.

g) Provide algorithm for 3 pumps.

b. Booster Pump Station (Local pressure Control – tank out of service.)

1) Booster pump station shall maintain discharge pressure setpoint utilizing an inverse PID algorithm to calculate pump speed. All operating booster pumps to run at same speed.

2) Reduce pump speed and inhibit higher calculation of pump speed if suction pressure falls below minimum suction pressure setpoint.

a) Start lead pump on low pressure setpoint.

b) Start lag pump on calculated pump speed output > setpoint maximum speed for setpoint time.

c) Start lag-lag pump on calculated pump speed output > setpoint maximum speed for setpoint time.

d) Stop lag-lag pump on calculated pump speed output < setpoint minimum speed for setpoint time.

e) Stop lag pump on calculated pump speed output < setpoint minimum speed for setpoint time.

f) Stop lead pump on high pressure setpoint or if tank low level alarm is active.

g) Set unique minimum and maximum speed setpoints for each of quantity of pumps operating.

h) Provide algorithm for 3 pumps.

C. SPECIFIC REQUIREMENTS – Exhaust Fan

1. Must comply with general requirements.

a. Provide time delays and time delay setpoints for all functions.

2. Consists of programming function for the following:

a. Exhaust Fan EF-XX

1) Interlock systems operation with alarms:

a) 480 VAC power fail.

b. Exhaust Fan Operation

1) In automatic mode with no interlock alarms present, the exhaust fan will operate based on room temperature and outside temperature.

a) If the outdoor air temperature is lower than desired indoor temp setpoint and is greater than

differential setpoint, then start exhaust fan and interlock HVAC control.

b) If indoor air temperature is below minimum temperature setpoint, then stop exhaust fan. Reset system once indoor temperature is above minimum temp reset setpoint. Allow exhaust fan to restart on normal start conditions described above.

c) If indoor air temperature is above indoor desired air temperature setpoint, then stop exhaust fan and enable HVAC operation.

d) if the HVAC is called to operate in SCADA manual, stop the exhaust fan.

2) In manual mode the exhaust fan will start and stop based on calls from the SCADA manual start / stop switches. These switches are to be duplicated on all local operator interfaces.

D. SPECIFIC REQUIREMENTS – HVAC-XX

1. Must comply with general requirements.

   a. Provide time delays and time delay setpoints for all functions.

2. Consists of programming function for the following:

   a. HVAC AC-XX

      1) Interlock HVAC operation with alarms:

         a) 480 VAC power fail.

         b) Room exhaust fan running.

   b. HVAC Operation

      1) In automatic mode with no interlock alarms present, the HVAC will operate based on room temperature.

         a) If the room temperature is less than the start heating setpoint for setpoint delay and the exhaust fan is not running, then start HVAC system in heating mode.

         b) If the room temperature is greater than the stop heating setpoint for setpoint delay or the exhaust fan is called to operate, then stop HVAC system heating mode.

c) If the room temperature is greater than the start cooling setpoint for setpoint delay and the exhaust fan is not running, then start the HVAC system in cooling mode.

d) If the room temperature is less than the stop cooling setpoint for setpoint delay or if the exhaust fan is called, then stop the HVAC system in cooling mode.

e) In both heating and cooling modes the HVAC system fan will be called to run whenever the heat or cool call is active and for setpoint delay time after the heating or cooling calls have ended.

2) In manual mode the HVAC system shall be enabled to operate and disable exhaust fan. Start and stop based on HVAC temperature setpoints for normal operation.

2.04 OPERATOR INTERFACE (OI) and SCADA

A. Operator Interface

1. Full manual and automatic control interface to be provided on each touchscreen OI. Group controls logically to provide intuitive navigation through display screens for operators. Utilize colors and flashing symbols to designate abnormal conditions.

a. Station Overview with current status and alarms. Model after P&ID diagrams per process.

b. Pump or equipment status, setpoints, and alarms for each pump. Use green for run, red for stop, yellow for alarm.

c. Station setpoints operation screens. Gray, white, black colors.

d. Alarm summary screens – flashing in alarm, yellow if active and acknowledged, gray if acknowledged and corrected.

2. Include all setpoints, controls selections, Alarms enable/disables, delay setpoints, status of equipment, and scaled analog values.

3. Each OI to allow full station operation and adjustment independent of SCADA.

B. SCADA

1. Provide SCADA display screens similar to existing screens for other associated facilities. Submit all new displays for review.

2. Include sufficient displays to incorporate all controls, statuses, alarms, setpoints and trends required for station operation.

3. Provide status and alarm indication of communications from SCADA to all PLC(s).

PART 3: EXECUTION

3.01 SOFTWARE DEVELOPMENT

A. The programming, setup and configuration of the PLC & OI shall be done by the Application Programmer as defined in [Electrical, General[.

B. The PLC & OI shall be ready to be placed in operation at the time of Operational Testing.

C. Do not enable or set any passwords on the PLC software or hardware for this project.

D. Additional Programmer Labor Hours

1. The Contractor shall include in his bid price an additional 32 hours of PLC/OI program configuration changes to be designated by the Engineer or Owner during testing and start-up.

3.02 MEDIUM

A. Provide PLC & OI applications programs on USB Flash Drive media with each submittal. Clearly label drive with station name and contents. Flash drive shall contain the following:

1. Application program, configuration and data tables.

2. OI software with graphics and all support files.

3. These disks and all copyrights shall become the property of the Owner, for its use on this and future projects.

B. In addition, one USB Flash drive of the application PLC & OI programs shall remain on site in the control panel. All programs and files shall be updated each time the Application Programmer modifies the PLC program.

C. Provide two (2) copies of as-installed applications programs printed with standard laser print 8 1/2" x 11" paper at end of project. Insert new print-outs into the Operations and Maintenance manuals. Provide number of copies as specified in 16010 Operations and Maintenance Instructions.

3.03 FIELD ASSISTANCE

A. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

3.04 WARRANTY

A. Troubleshoot and correct all program abnormalities, glitches and bugs uncovered during the warranty period. Provide phone and/or on-site support as required to correct problem(s).

B. Software support which shall be provided by the Application Programmer:

1. Free technical PLC / OI software and hardware configuration phone support for a period of one year. PLC / OI phone support shall be provided directly from the person(s) that configured the PLC / OI. Phone support shall be available between 8 a.m. and 4 p.m. Pacific Standard Time Monday through Friday.

2. The Application Programmer shall correct any PLC / OI software configuration error that is discovered within the warranty period, at no additional cost to Owner. Updated documentation for each "operation and maintenance" manual and new USB flash drives of updated software shall be provided for each correction.

** END OF SECTION **

SECTION 26 89 40

INSTRUMENTATION

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The major components in the instrumentation scope of work are:

1. Furnish, configure, test, commission, and warrant instrumentation as shown in the P&IDs, plans, and/or listed in specification section.

2. Include necessary piping, valves, pressure reducers, mounting brackets or flanges, supports, and anchors to complete installation.

3. Provide sunshades for instrumentation for all instruments that are exposed to direct sunlight.

B. System Integrator selection of instrumentation shall be per manufacturer's recommendation for the application and per specifications. If a manufacturer's recommendation or installation instructions are inconsistent with the Contract installation details or specifications, then the Contractor shall submit an RFI describing the inconsistency. If the inconsistency is due to substitution from the first named equipment, then the responsibility of coordination and any additional cost shall be borne by the Contractor.

C. Projects that come into contact with drinking water: (NSF-61 certification)

1. Furnish NSF/ANSI 61 certified products that have undergone testing for any device, valve, instrument, or assembly that will come into contact with drinking water.

2. The certification determines what contaminants may migrate or leach from the product into drinking water and confirms if they are below the maximum levels allowed to be considered safe.

3. Flowmeters, pressure transmitters, and chemical analyzers are a few of the products that may fall into this category requirement.

D. Provide all devices, valves, tubing, fittings, wiring, terminal blocks, calibration consumables, initial calibration equipment, accessories, sunshades and enclosures as specified herein and as shown on Contract Drawings.

E. The Contractor shall furnish all tools, calibration equipment, calibration materials, specialized parts and incidentals necessary to integrate the instrument to the application.

F. Contractor shall furnish labor for installation, verification, start-up, calibration, testing and commissioning. Contractor shall prove proper function of

instrument prior project completion.

1.02 REFERENCES

A. Electrical Specifications [Electrical General]

B. Electrical Specifications [Factory and Field Testing]

1.03 SUBMITTALS AND DRAWINGS

A. Submit shop documents and drawings for approval in accordance with this subsection and as specified in Electrical Specifications [Electrical General, Submittal Requirements].

B. Submit Operating Instructions (O&M Manuals) for each instrumentation device prior to equipment installation.

1.04 OPERATING AND MAINTENANCE INFORMATION

A. Provide operating instructions as specified in Electrical Specifications [Electrical General, Operating and Maintenance Instructions].

PART 2: PRODUCTS

2.01 QUALITY

A. Electrical Specifications [Electrical General, Quality].

B. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without requiring a manual reset.

C. Signal transmission from remote or field electric and electronic devices shall be 4-20 mA, sourced by a 24 VDC supply internal to the instrument or from a 24 VDC power supply located within the panel that is to receive the signal. Nonstandard transmission methods such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted.

D. Transmitters or devices located in Class 1, Division 1 hazardous areas shall be rated for hazardous location installations per NEC and UL. Explosion proof enclosures and raceways or current/spark limiting devices located inside or outside of the classified area shall be furnished to comply with code requirements.

E. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately converted to 4-20 mA signals for remote transmission.

2.02 INSTRUMENT IDENTIFICATION

A. All major instrumentation and equipment items or systems specified in this Division and/or on the P&IDs are identified by tag numbers. Tag field

equipment with assigned instrumentation tag number and functional description.

1. Tags shall be 1/2” stainless steel DYMO impressed tape with 3/16”(minimum) height characters.

2. Metal tape embosser shall feature a built in hole punching device and scissor cutoff tool.

B. Attach tags to equipment with a 4” long, 20-gage stainless steel wire leash for small devices, or two stainless steel screws for larger instruments; however, such permanent attachment shall not be on an ordinarily replaceable part or in an area that will be subject to unintended overuse fatigue. Make the tag plainly visible.

2.03 LEVEL COMPONENTS

A. Float Switch

1. Tilting float level switches shall be a mercury free float switch, whose specified weight is less than that of the process liquid displaced, to actuate switches as the level changes. The non-mercury snap action switch is actuated by a steel ball rolling back and forth within a switching tube in plastic float housing. The SPDT switch shall be rated 7A at 120 VAC shall be integrally mounted in the float and connected to a control box by a nitrile PVC jacketed waterproof electric cable with three finely stranded No.18 conductors. The weight shall be integrally mounted so that no metals shall contact the process liquid. Tilting type level switch shall be Anchor Scientific Eco-Float Model GSI, or equal.

B. Submersible Level Transmitter

1. The submersible level transmitter shall be 4-20 mA loop powered with integral manufacturer’s cable containing electrical conductors and breather tube. The transmitter shall include lightning protection and a desiccant air dryer for installation on the end of the breather tube.

2. Lightning protection

a. Lightning protection shall be incorporated within the level transmitter and shall be consistent with IEC 61000-4-5, Level 4 requirements.

b. Lightning protection module shall be installed in termination box and grounded per manufacturers instructions.

3. The calibration of the level transmitter and cable length shall be as shown in the instrument schedule.

4. The body of the transmitter shall be rated IP68 and constructed of

stainless steel with a ceramic diaphragm measuring cell. The transmitter shall be suspended from the electrical cable.

5. The submersible level probe shall be Endress and Hauser FMX-21 Water Pilot or approved equal.

C. Ultrasonic Level Transmitter:

1. The ultrasonic level transmitter shall utilize non-contacting ultrasonic signal reflection technology to provide level monitoring for up to 50 ft range.

2. The transmitter shall feature advanced echo processing algorithms that can be configured to ignore selected echos.

3. The transmitter shall be capable of controlling two pumps in a lead/lag configuration or using outputs for high and low level alarm outputs.

4. The transducer level element (LE) shall have the following features:

   a. Corrosion resistant plastic body, completely submergence rated.
   b. Rated for Class 1, Div. 1 hazardous atmospheres.
   c. Operating temperature of -40 to 200 deg F.
   d. Beam angle (degrees) as required for the application and to avoid obstructions.
   e. Beam range as required for the application.

5. The level indicating transmitter shall have the following features:

   a. NEMA 4X / IP65 enclosure.
   b. Ground isolated 4-20 mA output, max load of 750 ohm.
   c. Two 5 amp at 120V AC, SPDT relays.
   d. Integral 4 button keypad for configuring parameters.
   e. Integral 1.5” x 4” (min) backlit LCD display.
   f. Operating temperature range from -40 to 140 deg. F.

6. The calibration of the level transmitter and cable length shall be as shown in the instrument schedule.

7. Provide one hand held or integral programming interface with each transmitter provided.

8. The ultrasonic level/flow transmitter shall be Endress and Hauser Prosonic S FMU90, Siemens Hydroranger 200, or equal

D. Ultrasonic Level Transmitter:

1. The ultrasonic level transmitter shall utilize non-contacting ultrasonic signal reflection technology to provide level monitoring for up to 50 ft range.

2. The transmitter shall feature advanced echo processing algorithms that can be configured to ignore selected echos.

3. The transducer level element (LE/LIT) shall have the following features:

   a. NEMA 4X / IP65 enclosure.
   b. Ground isolated 4-20 mA loop powered, 24 vdc.
   c. Integral 4 button keypad for configuring parameters.
   d. Integral 1.5" x 4" (min) backlit LCD display.
   e. Operating temperature range from -40 to 140 deg. F.
   f. Rated for Class 1, Div. 2 hazardous atmospheres.
   g. Operating temperature of -40 to 200 deg F.
   h. 3 dB emitting angle: (from centerline)
      1) 5.5° for sensors up to 25 ft
      2) 4.5° for sensors up to 35 ft
      3) 3.0° for sensors up to 50ft
   i. Blocking distance: Maximum 5% of instrument range.

4. The calibration of the level transmitter and cable length shall be as shown in the instrument schedule.

5. Provide one hand held or integral programming interface with each transmitter provided.

6. The ultrasonic level transmitter shall be Endress and Hauser Prosonic M FMU4x, or equal.

2.04 PRESSURE COMPONENTS

A. Gauge, Absolute, or Differential Pressure Transmitter:

1. The pressure indicating transmitter shall be a loop powered, two wire, 4-20 mA signal transmitting device with signal derived from the applied sensor pressure. Transmitter shall be capable of driving 0 to 500 ohm loads with 24 VDC supply.

2. The transmitter shall have the following features:

   a. Programmable 4-digit Liquid Crystal Display (LCD) process indicator.

   b. HART programming with programming selections for square root extraction, output calibration, and adjustable dampening 0.0 to 36.0 seconds, minimum.

   c. Integral microprocessor based circuitry with RFI filtering and shielding.

   d. The transmitter shall have accuracy of +/- 0.1% of span over a range of minimum 10 to 1 turndown. Elevated zero setting

capable of 0-30% upper calibration limit.

e. Operating temperature range shall be -40 to 185°F (minimum). Process wetted materials shall be compatible with fluid being measured with minimum hastalloy or ceramic diaphragm and 316 stainless steel wetted parts.

f. Process connection shall be as follows:

1) Low solids content - 1/2" MNPT with calibration valve.

2) High solids content - 1-1/2” or 2” flange with flushing ring and valve.

3) And as required per installation detail.

g. The transmitter shall be scaled as shown in the instrument schedule.

3. Provide mounting bracket per mounting requirements shown in Contract drawings.

4. The gauge pressure transmitter shall be Endress and Hauser Cerabar M PMC 71, Rosemount Smart 3051, or equal.

B. Calibration Valve:

1. Calibration valve for use with gauge transmitters shall have the following features:

a. Stainless steel body with integral blocking valve and calibration valve and port.

b. Calibration port shall be 1/4” FNPT with 1/4” MNPT x 1/2” FNPT adapter.

c. Valve shall have a non-rotating stem tip and a fully backseated bonnet.

d. Process and transmitter connections shall be 1/2” MNPT. Include 1/2” stainless steel close nipple as required.

2. Calibration valve shall be Hex HB59, Anderson Greenwood, or equal.

C. Pressure Switch:

1. Each pressure switch shall be SPDT rated minimum of 15 amps @ 120VAC. Pressure switch shall consist of a pressure sensing mechanism and the switch itself enclosed in a NEMA rated housing. Pressure switch shall be diaphragm type with stainless steel wetted parts and mechanical snap action switch. Switch shall have two

setpoint adjustments (trip & reset setpoints), narrow deadband with setpoint indicator calibrated in engineering units. Pressure switch shall be UL listed. The pressure switch shall be Static-O-Ring 66 Series, Ashcroft B series; ASCO or equal.

D. Pressure Guage:

1. The pressure gauge shall be 1% accurate with C-type bourdon tube. The bourdon tube, socket and connection tube of the gauge shall be 316 stainless steel. The case and bezel ring shall be constructed of type 304 stainless steel. The dial shall be 4" in diameter with a black pointer and a white gauge face with black print. The gauge shall be filled with liquid glycerin. A bottom mount process connection shall include a snubber as a separate component. The process connection shall be 1/2" stainless steel. The pressure gauge shall be Ametek gauge model 1550, Ashcroft 1009, or equal.

2.05 FLOW COMPONENTS

A. Magnetic Flow Meter:

1. The magnetic flow meter shall consist of a flow tube FE and a converter FIT, complete with interconnecting cables.

2. The magnetic flow meter shall be of the low frequency electromagnetic induction type and shall produce a DC pulse signal directly proportional and linear to the flow rate, with the duration not less than 100 milliseconds. Complete zero stability shall be an inherent characteristic of the metering system. Meters requiring field zero adjustment will not be acceptable. The meter accuracy shall not be affected by changes in fluid pressure, temperature, viscosity, or conductivity.

3. Accuracy

a. The maximum error of the complete metering system including flow element and flow indicating transmitter shall be 0.30% of actual flowrate (in specified units) and readout over the range of full scale velocity settings from 1 to 30 feet per second. Variations in temperature, voltage, and frequency within the ranges listed herein shall not affect the overall measuring accuracy.

b. The flow meter shall not require more than three diameters of straight pipe length from the center of the meter to upstream or downstream obstructions to obtain specified accuracies.

c. Lack of straight pipe or obstructions to straight length pipe requirements shall not cause overall flowmeter inaccuracies to exceed more 0.5% of actual flowrate over the range of full scale settings from 1 to 30 feet per second.

4. Flow Element (FE)

   a. The flow element shall be based on a pipe spool with ANSI class 150 flange connections or be flangeless construction as required by mechanical drawings. Class 300 flanges shall be provided where shown or when the pressure and temperature of the process fluid exceeds the rating of a 150 lb flange. The flow element size shall be as shown in the mechanical drawings and listed in the Instrumentation Schedule. Flange type and bolt pattern shall be coordinated with the mechanical Contractor prior to submittal.

   b. The flow element shall have Hastalloy C4 coil and grounding electrodes.

   c. Stainless steel grounding rings shall be provided at both ends of the flow element for all flowmeter applications. Grounding rings shall be manufactured from stainless steel, 2 mm thickness with grounding tab for electrical wire connection, and fit within the flange bolt circle. Grounding ring shall be self centering within pipe.

   d. The flow element internal liner material shall be Teflon, polyurethane or hard rubber, unless recommended otherwise by the manufacturer for the application and approved.

   e. Nema rating as defined in the Instrumentation Schedule.

5. Flow Indicating Transmitter (FIT)

   a. The electronic flow indicating transmitter shall be mounted remotely from flow tube as shown on Contract drawings.

   b. The electronic transmitter shall be provided in a NEMA rated enclosure per the Instrumentation Schedule.

   c. The transmitter shall be interchangeable with all sizes of flow elements and shall be field replaceable (without replacing flow element) in the event of transmitter failure.

   d. The transmitter shall be microprocessor controlled, utilizing digital signal processing with automatic zero correction to provide a linear 4-20 mA signal proportional to flow rate.

   e. The transmitter shall incorporate a high impedance amplifier of 100,000 Megohms or greater, eliminating the need for electrode cleaning systems.

   f. The transmitter shall contain a self test mode to allow the operator to manually simulate the output 4-20 mA signal to any value between 0% and 100% to check out any driven devices

in the loop.

g. Rate indicator and totalizer: An alphanumeric LCD backlit display shall be provided to continuously display the flowrate and totalizer with units and all programming functions.

h. All programming configuration of the Flowmeter shall be completed through the transmitter's pushbutton interface. A communication device shall not be necessary to configure the flow transmitter.

i. PC based software shall be available and included for configuration and troubleshooting. Connection to flowmeter shall be via computer USB port and include interface cables as required.

j. The transmitter shall be designed for operation from a power source of 120 volts AC, with a power consumption of less than 20 watts. The flow element shall be powered from the transmitter.

k. The transmitter shall operate continuously without fault in an ambient temperature range from 14 to 140 °F. The flowmeter shall be suitable for operation in direct sunlight without the use of a sunshade. If a sunshade becomes required after installation for any operational reason, one shall be furnished and installed free of charge.

l. The following configurable parameters shall be provided at a minimum:

1) Field adjustable flow signal dampening.

2) Low flow cutoff (forces zero flow signal) between 0.0-5.0% of full scale rate.

3) Empty pipe detection (forces zero flow signal) if the pipe is not full.

4) Selection for forward/reverse/both flow directions.

6. Flow Indicating Transmitter (FIT) I/O Interface

a. Network Communication

1) The transmitter output(s) shall be integral to the magnetic flowmeter transmitter electronics; and must be located within the transmitter housing. Using an external signal converter is not acceptable.

2) Protocols

i Ethernet Schneider Automation Modbus TCP

ii Ethernet Allen Bradley EtherNet/IP™

3) The transmitter output selected must be supported by add-on instructions (AOI), add-on profiles (AOP), that can be imported to the Programmable Logic Controller specified in the is project. AOIs and AOPs include device drivers, instructions and pre-engineered PLC code.

b. Flow Signal: 4-20 mA signal proportional to the flow. The signal shall be field configurable for the flow calibration specified and others within the flow tube accuracy range. The flow signal shall be capable of measurement for forward and reverse flows combined by offsetting zero to mid scale (12 mA).

c. Flow Totalization Pulse: The Flowmeter shall feature a pulse output that is scaled to 1000 gallons per pulse unless otherwise shown.

1) Provide solid state interfacing relay within control panel (as required) between flow meter voltage output and PLC discrete voltage input. Provide any necessary interfacing devices to make flow meter pulse duration and output rate compatible with PLC discrete pulse input rate.

d. Meter Positive Zero Return: This contact input shall force the flow reading and output flow signal to zero flow.

e. Flow direction digital output: Open collector transistor or relay output capable of driving 24 volt interface relay up to 100 mA. Output shall be configurable for either forward or reverse flow directions.

f. Conductivity and temperature indications and signal transmission outputs as shown in the P&IDs. Accuracy on conductivity and temperature shall be 5% of range.

7. If the flow indicating transmitter (FIT) is shown in the Contract drawings to be mounted remotely from the flow element (FE), the manufacturer shall provide all cabling between flow element and flow indicating transmitter.

8. All mounting hardware and/or devices necessary to complete the installation shall be provided by the manufacturer at no additional cost to the Owner.

9. The meter shall be hydraulically calibrated at a facility located in the United States and the calibration shall be traceable to the National Bureau of Standards. A certified copy of the calibration test results

shall be submitted to the Owner prior to shipment of the meter.

10. The magnetic flowmeter shall be Endress and Hauser Promag W series with zero DN or equal.

2.06 ANALYTICAL ELEMENTS

A. Reuse existing Chlorine Analyzers.

2.07 TEMPERATURE DEVICES

A. Room Temperature Transmitter:

1. The temperature indicating transmitter shall provide display of temperature and provide linear output signal derived from the temperature of the integral or remote RTD measuring sensor.

2. Temperature Transmitter

a. Loop powered, two wire, 4-20 mA, capable of driving 0 to 500 ohm loads from 24 VDC supply.

b. 3-1/2 digit, 0.37”H, Light Emitting Diode (LED) display.

c. Zero and span adjustments for display and temperature transmitter.

d. The transmitter shall have accuracy of +/- 0.5% of span over an operating temperature range of 0 to 150°F.

e. Furnish remote RTD for outdoor temperature measurement as required per plan.

3. The wall mount transmitter shall be Devar Model D-RTTI(-R)or equal.

2.08 EVENT, STATE OR POSITION DEVICES

A. Position Switch:

1. Door switch – door intrusion switch shall have a wide gap magnetic sensor with S.P.S.T. contacts mounted in an aluminum housing with integral jacketed cable for wiring to a junction box. Switch contacts shall have 0.1A at 120VAC minimum capability. When attaching to a ferrous metal surface, space sensor components away from metal by minimum ¼” using plastic spacer in order to maintain magnetic gap. Intrusion door switches shall be Sentrol 151-6Z-12K or equal.

2. Hatch or Vault – hatch or vault intrusion switch shall include a pre-wired factory sealed 5 foot cable for wet applications. Roller level switch shall be 316 stainless steel with roller and 1.19” to 3” radius adjustable lever arm. Switch shall have two independent sets of

contacts that actuate with clockwise or counter clockwise lever movement. Tank hatch switch shall be Allen-Bradley Model 802MC-AY5 with 802MC-W2B lever or equal.

3. Valve Limit Switch – The valve mechanical position indicator shall to actuate the position limit switch(s). The limit switch shall have a rotating steel arm with end roller or plunger that can be adjusted to actuate the switch at the fully open or closed position of the valve. The switch shall have 10 amp S.P.D.T. contacts mounted in a water-tight housing. The limit switch shall be Allen Bradley 802T with 1.19" to 3" radius adjustable lever arm, or equal.

B. Amperage Switch:

1. Amperage switch shall be self powered and provide a closed contact which closes the output contact when current is measured through the integral current transformer above adjustable setpoint (1-6, 6-40, or 40-175 amps selectable). The switch shall have an accuracy of 5% and repeatability of 1/2% of full scale (minimum). Switch shall include LED for quick visual indication of contact status. Operating temperature range shall be -20 deg C to 50 deg C. Transducer shall have separate zero and span and time delay adjustments. Insulation between output and case shall be rated at 1000VAC. Amperage switch shall be as manufactured by Neilsen-Kuljian (NK technologies) ASX series or equal.

C. Smoke Detector:

1. General

a. The smoke detector shall detect smoke produced by fire and signal an alarm system. The detector shall be housed in a flame retardant plastic housing and shall be unaffected by vibration. Detector shall be sealed against dirt, insects and back pressure

b. Detector shall utilize photoelectronic sensor technology.

c. The detector/base shall be 120V, four-wire operation with built-in Form A and Form C dry contacts. Form A contact shall be rated for 2.0A at 30VAC/DC. Form C contact shall be rated for 2.0A at 30VAC/DC and 1.0A at 120VAC.

d. The detector shall have an operating temperature 32 to 120°F and an operating humidity of 10 to 93% relative humidity.

e. The detector shall have built-in test switch (magnetic proximity actuation) and 360 degree view angle of built-in alarm LEDs.

f. The detector shall be approved by UL and Factory Mutual and

meet requirements of NFPA 72.

2. The fire alarm smoke detector shall be photoelectric type. The smoke detector shall be System Sensor 100 Series model 2151 with B114LP base, Gentex 8000 Series with 120VAC base, or equal.

D. Solenoid Valve:

1. General:

a. Liquid / Air or Inert gas for general service

b. Brass Body with NPT fittings per drawings.

c. Watertight NEMA 4X (minimum) or Explosion-proof as required per area designation in drawings.

d. Replaceable operating coil operating from 120 VAC or as otherwise shown in the drawings.

2. Solenoid valve shall be ASCO 8210 series or equal.

2.09 INSTRUMENTATION SCHEDULE

A. The Instrumentation Schedule spreadsheet (located at the end of this section) is intended to be a summary of instrumentation equipment required for this project. Not all instrumentation details are shown on the schedule. Some requirements may be shown in the Instrumentation Schedule such as enclosure rating and instrument span that are not described in the specifications. Both are required for a complete specification.

B. If an instrument is shown in the P&IDs or on the site plan, then the device shall be provided whether or not it is shown on the Instrumentation Schedule.

PART 3: EXECUTION

3.01 WORKMANSHIP

A. Instrumentation work shall conform to workmanship standards specified in Electrical Specifications [Electrical General, Workmanship].

B. The Contractor shall employ personnel who are skilled and experienced in the installation and connection of equipment defined in this section. Contractor qualifications are specified in Electrical Specifications [Electrical General].

C. Verify that all equipment and materials fit properly.

D. All instrumentation configuration, programming and calibration shall be completed prior to the start of field tests.

E. Equipment without approved submittals shall not be installed.

F. All equipment shall be properly stored indoors while awaiting installation. Protect installed equipment from construction debris or mishaps. The Contractor will replace any equipment that is not in new condition at the time of installation and/or start-up.

G. Perform work to remedy non-compliant installations after inspection.

3.02 INSTALLATION

A. Install and supply all products necessary to provide an operational instrumentation system. This shall include the following:

1. Contract Drawings are intended to show the basic functional requirements of the instrumentation system. Insufficient detail does not relieve the Contractor from the responsibility to provide a complete and functioning system. If additional detail or clarification is required, the Contractor shall request such information prior to installation.

2. Provide relays, signal converters, isolators, boosters, power conditioners, circuit cards, and other miscellaneous devices as required for the compatible and functional interface.

3. Provide analog loop isolators where required to eliminate "ground loops."

4. The instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions and located as shown on the Drawings or as approved. When manufacturer's installation literature specifies a particular location or orientation in a process line due to measurement accuracy considerations, the installation shall be in conformance with the manufacturer's instructions.

B. Instrument installation methods.

1. Install instruments at the location shown on the Plans or approved. Instruments enclosures shall be NEMA rated for the installed location.

2. Install level and plumb.

3. All instruments shall be provided with floor stands or wall brackets as shown in installation details or as required for functional installation.

4. Mounting stands shall be custom manufactured of aluminum channel with base plate unless otherwise noted in installation detail.

5. Mounting channels (unistrut), and spacers shall be galvanized steel above ground outdoors and stainless steel below ground (wetwell), unless otherwise noted in installation details.

6. All screws, bolts and anchors shall be stainless steel.

C. Wiring and raceway installation methods:

1. Terminal blocks shall be provided at all instrument cable junctions and all wires shall be identified at such junctions.

2. Instrumentation wiring shall be run without splices between instruments, terminal boxes, or panels.

D. Wiring, grounding, and shielding: The following practices shall be observed unless modified by manufacturer's standards.

1. Each electronic equipment chassis shall be grounded to power ground.

2. Shielded twisted pair, shielded triad, or manufacturer supplied cables only shall be used for analog signals and communications signals.

3. Drain wire of shielded cables used for analog inputs to the PLC shall be connected at the PLC unit only. Shield shall be isolated from ground at all other termination points including transmitters.

4. Drain wire of shielded cables used for analog outputs from the PLC shall be connected at signal receiving device only. Shield shall be isolated from ground at all other termination points.

5. If electrical interference noise is imposed on DC status and alarm signals, then they shall be re-routed or wire changed to shielded twisted pair cables.

6. Each shield drain wire which is not connected to ground shall be cut off covered with a heat shrink insulating boot at cable jacket end. Shields shall be connected together at each transition from one cable to another for an effectively continuous shield circuit.

3.03 SUPPLIER SERVICES

A. The Contractor shall be responsible for each supplier of equipment to provide the following minimum services for each type of instrument supplied. Each supplier shall provide a qualified instrumentation field technician to perform services listed herein. Contractor shall supply all calibration materials necessary to commission unit and shall not use any consumable materials that are intended to be furnished for the first period of use.

1. Advise and instruct Contractor on proper installation requirements.

2. Inspect, calibrate, test, and place equipment in operation. Calibrate instruments to values as shown in the instrument index or as noted herein. If instrument spans are required to change (within instrument range) during startup for process reasons, the Contractor shall change them as directed by the Engineer.

3. Programmable devices shall be programmed and tested prior to

startup. Programming shall be adjusted or changed as directed by the Engineer at any time prior to final acceptance.

4. Perform testing in the presence of Engineer.

5. Visit the project site as often as required and spend as much time as necessary to ensure accurate and operational instrumentation.

6. Provide training as specified in FIELD ASSISTANCE.

B. The Contractor shall coordinate with each supplier of instrumentation to confirm that primary elements are provided in a timely manner, meeting critical path scheduling. The Contractor shall coordinate process connection size, equipment size, and material type when applicable and oversee the installation, calibration, and acceptance testing.

3.04 FIELD ASSISTANCE

A. The instrument supplier shall provide a minimum of one (1) hour of field training to instruct Owner's personnel in the use, operation, calibration, programming, and maintenance on each type of "field" instrument.

3.05 SPARE PARTS

A. Provide spare parts as described in each products section herein and specified in Electrical Specifications [Electrical General, Spare Parts].

B. Contractor shall supply all calibration materials necessary to commission unit and shall not use any consumable materials that are intended to be handed over to the Owner as defined in the instrument specifications.

3.06 WARRANTY

A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

3.07 FINAL ACCEPTANCE

A. Final Acceptance per Electrical Specifications [Electrical General].

END OF SECTION

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DWG # P&ID	Tag No.	DESCRIPTION	Type	Specification Section	Min. NEMA Rating	Size	SP/ Range	Units	DWG. DET. Reference	Notes
	Note:	Quantity for each of 2 stations unless noted.								
	AE 181	Sensor	CL2	Existing Reuse	-	-	0-5	mg/l	Wall Mount	Reconnect
	AIT 181	Analyzer Transmitter	CL2	Existing Reuse	-	-	-	-	Wall Mount	Reconnect
	FIT 171	Flow Indicating Transmitter	Magnetic	16940-2.05 A	4X	8"	0-1500	GPM	FM/FLG	Lake only
	FIT 171	Flow Indicating Transmitter	Magnetic	16940-2.05 A	4X	12"	0-3000	GPM	FM/FLG	Sneath only
	IS 41	Current Switch		16940-2.08 B	1		0-30	Amps		Lake Only
	LT 151	Level Transmitter	Submersible	16940-2.03 B	-	-	0-40	FT	RHD/FST	Lake Only
	LT 251	Level Transmitter	Submersible	16940-2.03 B	-	-	0-40	FT	RHD/FST	Lake Only
	LSH 151	Level Switch	Float	16940-2.03 A	-	-	-	-	RHD/FST	40 Ft. Cable
	LSL 152	Level Switch	Float	16940-2.03 A	-	-	-	-	RHD/FST	40 Ft. Cable
	LSH 251	Level Switch	Float	16940-2.03 A	-	-	-	-	RHD/FST	40 Ft. Cable
	LSL 252	Level Switch	Float	16940-2.03 A	-	-	-	-	RHD/FST	40 Ft. Cable
	PSH 161	Pressure Switch	Diaphragm	16940-2.04 C	4	-	20-200	PSI	Pipe	
	PSH 162	Pressure Switch	Diaphragm	16940-2.04 C	4	-	20-200	PSI	Pipe	
	PSH 163	Pressure Switch	Diaphragm	16940-2.04 C	4	-	20-200	PSI	Pipe	Sneath only
	PIT 165	Pressure Indicating Transmitter	Gauge	16940-2.04 A	4X	-	0-150	PSI	PT	Calibration Valve
	PIT 166	Pressure Indicating Transmitter	Gauge	16940-2.04 A	4X	-	0-150	PSI	PT	Calibration Valve
	SV 111	Solenoid Valve		16940-2.09 C	4	-	-	-	-	120 volt
	SV 121	Solenoid Valve		16940-2.09 C	4	-	-	-	-	120 volt
	SV 131	Solenoid Valve		16940-2.09 C	4	-	-	-	-	120v, Sneath only
	SS 98	Smoke Detector	photo	16940-2.08 C	1	-	-	-	Ceiling Mount	
	TIT 88	Temperature Indicating Transmitter	Room	16940-2.07 A	1	-	0-150	deg F	Wall Mount	
	TE 89	Temperature Element	Outdoor	16940-2.07 A	1	-	-	-	Wall Mount	Thru wall
	TIT 89	Temperature Indicating Transmitter	Room	16940-2.07 A	1	-	0-150	deg F	Wall Mount	Remote RTD

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DWG # P&ID	Tag No.	DESCRIPTION	Type	Specification Section	Min. NEMA Rating	Size	SP/ Range	Units	DWG. DET. Reference	Notes
	Note:	Quantity for each of 2 stations unless noted.								
	ZS 111	Valve Position Switch	Lever	16940-2.08 A	4	-	-	-	Valve Bracket	
	ZS 121	Valve Position Switch	Lever	16940-2.08 A	4	-	-	-	Valve Bracket	
	ZS 131	Valve Position Switch	Lever	16940-2.08 A	4	-	-	-	Valve Bracket	Sneath only
	ZS 191	Hatch Switch	Lever	16940-2.08 A	4	-	-	-	RHD	
	ZS 291	Hatch Switch	Lever	16940-2.08 A	4	-	-	-	RHD	
	ZS 93 A	Door Switch	magnetic	16940-2.08 A	1	-	-	-	Door	
	ZS 93 B	Door Switch	magnetic	16940-2.08 A	1	-	-	-	Door	

SECTION 31 05 03

EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes: All excavating, backfilling, filling, grading, subgrade preparation and disposing of earth materials as required. It also includes all temporary means needed to prevent discharge of sediment to watercourses from dewatering systems or erosion.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. ASTM C33, Standard Specification for Aggregate Material.
   2. ASTM D422, Method for Particle-Size Analysis of Soils.
   3. ASTM D423, Liquid Limit of Soils.
   4. ASTM D427, Shrinkage Factors of Soils.
   5. ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil.
   6. ASTM D1556, Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
   7. ASTM D2922, Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   8. ASTM D2166, unconfined compressive strength of soils.

B. Occupational Safety and Health Administration (OSHA)
   1. Title 29, Code of Federal Regulations, Part 1926

1.3 SYSTEM DESCRIPTION

A. Permits and Regulations:
   1. Perform excavation Work in compliance with applicable requirements of governing authorities having jurisdiction.
   2. Obtain all necessary permits for Work in roads, rights-of-way, railroads, etc. Also, obtain permits as required by local, state and federal agencies for discharging water from excavations, for erosion control, and for prevention of air and water pollution.

1.4 SUBMITTALS

A. Test Reports - Borrow, Backfill, and Grading: Testing laboratory shall submit copies of the following reports directly to ENGINEER:
   1. Tests on borrow material.
   2. Tests on footing subgrade.
   3. Field density tests.
   4. Optimum moisture - maximum density curve for each soil used for backfill.
   5. Reports of observations for conformance of borrow material to the Project Geotechnical Report.

6. Quality Control Plan: Names and phone numbers of independent testing companies that will be used to perform soil and asphalt concrete testing, qualifications, and proposed procedures for performing tests and providing test results to ENGINEER.

B. Submit to the ENGINEER samples of all materials, including Structural Fill backfill, General Engineered fill backfill, bedding, crushed stone, sand and topsoil. Submit samples of the proposed material at least seven days in advance of its anticipated use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
   1. All material will be tested by the laboratory and approved by the ENGINEER.
   2. No material shall be placed without the approval of the ENGINEER.

B. Filter Fabric:
   1. Filter fabric shall be Mirafi, Type 140N; Dupont, Type PAR, Style 3401, or equal and shall conform to the following requirements:
   2. Minimum grab strength of 120 lbs per ASTM D4632.
   3. Apparent open size (AOS) to be equal to or greater than the U.S. Standard Sieve No. 100 (0.210 mm) per ASTM D4751.
   4. Percent open area not to exceed about 25 percent. The percent open area is defined as the ratio of the sum of 20 or more individual open areas (times 100) to the sum of the corresponding 20 or more individual total areas.
   5. Permittivity shall not be less than 1.7 sec-1.

C. Fill Material:
   1. Classification:
      a. Fill adjacent to structures to a distance measured horizontally from the structure that is equal to the depth from the finished grade is classified as Structural Fill.
      b. Outside these limits, the fill is classified as General Engineered Fill, unless otherwise specified.
   2. General Engineered Fill:
      a. General Engineered Fill materials shall consist of soils obtained from on-site excavations or off-site sources that are uniformly mixed, contain no organic material, and have been passed through a 3-inch screen.
      b. The maximum plasticity of General Engineered Fill shall be less than 12 as determined by a Plasticity Index (PI) Test in accordance with ASTM D4318.
      c. If on-site material is unsuitable as determined by the ENGINEER, imported fill shall be used.
      d. If on-site material becomes unsuitable as a result of increased moisture content, it shall be the CONTRACTOR's responsibility to off haul the unsuitable material and imported fill shall be provided by the CONTRACTOR at no cost to the OWNER. Contract time extensions will not be approved by the OWNER for CONTRACTOR delays caused by unsuitable materials.
   3. Structural Fill:
      a. Structural Fill or backfill is material intended for support for structures and pavements.

b. Structural Fill material shall be nonplastic, free of organic or other unsuitable materials, and shall not contain rocks or unbroken masses of soil larger than 3 inches in greatest dimension.
c. The following table outlines the minimum gradation requirements for Structural Fill:

Sieve Size	**% Passing**
3-inch	100
¾-inch	70-100
No. 200	<5

D. Aggregate Base:
1. Class 2, ¾ inch maximum conforming to Section 26 of the Caltrans Standard Specifications.

E. Granular Bedding:
1. Well-graded sand and gravel materials.
2. Unfrozen, friable, and no clay balls, roots, or other organic material.
3. Clean or gravelly sand with less than 5% passing No. 200 sieve, as determined in accordance with ASTM D1140, or gravel or crushed rock within maximum particle size and other requirements as follows unless otherwise specified.
   a. Pipe 12” dia or smaller – 100% passing 1/2"
   b. Pipe greater than 12” dia – 100% passing 3/4"
   c. Low Voltage Conduit and Direct-Buried Cable:
      1) Sand, clean or clean to silty, less than 12% passing No. 200 sieve.
      2) Individual Particles: Free of sharp edges.
      3) Maximum Size Particle: Pass a No. 4 sieve.
      4) If more than 5% passes No. 200 sieve, the fraction that passes No. 40 sieve shall be non-plastic as determined in accordance with ASTM D4318.

F. Sand:
1. Natural or manufactured granular material, containing no organic material.
2. Sand will be non-plastic, when tested in accordance with ASTM D 4318, 100% passing a ½ inch screen and no more than 20% passing a No. 200 screen.

G. Crushed Stone:
1. Crushed stone will be crushed rock or gravel conforming to the requirements of ASTM C33, Size #57.

H. Pea gravel
1. Size of pea gravel must be such that 100 percent passes the 1/2-inch sieve, a minimum 90 percent passes the 3/8-inch sieve, and not more than 5 percent passes the no. 8 sieve.

I. Drain Rock (#57 Washed)
1. Drain rock shall consist of a clean/washed uniform-graded processed gravel meeting the grading requirements of coarse aggregate size #57 in accordance with ASTM C33.

J. Gravel Surfacing
   1. Gravel Surfacing will be crushed rock, angular, and well-graded.
   2. Maximum size of ¾ inch, at least 50% passing the No 4. screen, between 10 and 30% passing the No. 10 screen and no more than 15% passing the No. 40 screen.
   3. Color to be selected by OWNER.

K. Controlled Low Strength Material (CLSM):
   1. Select and proportion ingredients to obtain compressive strength between 50 and 150 psi at 7 days in accordance with ASTM D4832. Sufficient cement shall be added to meet the strength and material requirements given below and as required to provide sufficient strength for compacting overlying trench backfill. Provide certified mix design and test results in accordance with submittal requirements.
   2. Materials:
      a. Cement: ASTM C150, Type I or II, two sacks minimum per cubic yard.
      b. Aggregate: ASTM C33, maximum Size 7. The amount of material passing a No. 200 sieve shall not exceed 12%. The above No. 200 sieve material shall be well graded so as to avoid segregation. The minus #200 sieve fraction shall be nonplastic.
      c. Fly Ash (if used): ASTM C618, Class C or F.
      d. Water: Clean, potable, containing less than 500 ppm of chlorides.
   3. Mix Design:
      a. The CONTRACTOR and its suppliers shall determine the materials and proportions used to meet the requirements of these Specifications. Make daily checks of the aggregate gradation and adjust the mix design as required. Modify the CLSM mix as necessary to meet the flowability, pumpability, and set time requirements for each individual pour.
      b. At least 30 days before placing CLSM, submit to the ENGINEER a mix design for each CLSM to be used. The mix design shall include trial lab and field data, with pairs of 6-inch by 12-inch cylinder breaks performed at 7, 14, and 28 days. Molds shall be plastic or waxed cardboard. The mix design shall be performed by an independent laboratory under the direction of an engineer licensed in California.
      c. No CLSM shall be placed until the ENGINEER has approved the mix design. The ENGINEER's approval of the mix design shall be understood to indicate conditional acceptance. Final acceptance will be based on tests conducted on field samples and conformance with these Specifications.

PART 3 - EXECUTION

3.1 PREPARATION

A. Inspection:
   1. Provide ENGINEER with sufficient notice and with means to examine the areas and conditions under which excavating, filling, and grading are to be performed.
   2. ENGINEER will notify CONTRACTOR if conditions are found that may be detrimental to the proper and timely completion of the Work.
   3. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

B. "Pot-holing":

1. Excavate and backfill, in advance of the construction, test pits to determine conditions or location of the existing utilities and structures.
2. Definite the location of each existing facility involved within the area of his excavation for Work under this Contract.
3. Exercise care during such location work to avoid damaging and/or disrupting the affected facility.
4. CONTRACTOR is responsible for repairing, at his expense, damage to any structure, piping, or utility caused by his Work.

C. Temporary Fencing:
1. Furnish and install a temporary fence surrounding excavations and work area, including the stockpile and storage areas.
2. Provide fence openings only at vehicular, equipment and worker access points.

3.2 EROSION CONTROL

A. General: Implement the construction procedures outlined herein to assure minimum damage to the environment during construction. Take all additional measures required to conform to the requirements of applicable codes and regulations.
1. Whenever possible, locate and construct access and temporary roads to avoid environmental damage. Make provisions to regulate drainage, avoid erosion and minimize damage to vegetation.
2. Where areas must be cleared for storage of materials or temporary structures, provisions will be made for regulating drainage and controlling erosion, subject to the ENGINEER'S approval.
3. Remove only those shrubs and grasses that must be removed for construction. Protect the remainder to preserve their erosion-control value.

B. Control Measures: Apply measures to control erosion and to minimize the siltation of the existing waterways, and natural ponding areas. Such measures include, but are not limited to, the use of berms, baled straw silt barriers, gravel or crushed stone, mulch, slope drains and other methods.
1. Install erosion and sediment control practices where shown and according to applicable standards, codes and specifications. The practices will be maintained in effective working condition during construction and until the drainage area has been permanently stabilized.
2. Temporary measures will be coordinated with the construction of permanent drainage facilities and other Work to the extent practicable to assure economical, effective, and continuous erosion and siltation control.
3. CONTRACTOR will provide special care in areas with steep slopes. Disturbance of vegetation will be kept to a minimum to maintain stability.
4. After stabilization, remove all straw bale dikes, debris, etc., from the site.

C. Dust Control:
1. Prevent blowing and movement of dust from exposed soil surfaces and access roads to reduce on- and off-site damage and health hazards.
2. Control may be achieved by irrigation in which the site is sprinkled with water until the surface is moist.
3. Repeat the process as needed.

D. Failure to Comply: In the event CONTRACTOR repeatedly fails to satisfactorily control erosion and siltation, the OWNER reserves the right to employ outside assistance or to use its own forces to provide the corrective measures indicated. The cost of such work, plus engineering costs, will be deducted from monies due CONTRACTOR.

3.3 DEWATERING

A. General:
   1. Continuously control all water during the course of construction, including surface water and ground water, to prevent any damage to any excavation or to the construction activities occurring within those excavations.
   2. Maintain all dewatering systems full time (24-hours/day) during the entire time the excavation is open. Do not shut down dewatering systems at night, on weekends or on holidays, or any other time the excavation is open.
   3. Each excavation will be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein is inspected by the ENGINEER and backfill operations have been completed.
   4. Provide adequate alarm, monitoring and back-up systems for all dewatering systems to maintain control of all water during all times any excavation is open.

B. Surface Water:
   1. Provide and maintain adequate drainage and dewatering system to prevent surface water from entering excavations and to remove and dispose of all rainwater entering excavations, trenches, or other parts of the Work.
   2. Keep the different working areas on the site free of surface water at all times. Special care will be taken to eliminate depressions that could serve as mosquito pools.
   3. The diversion and removal of surface water will be performed in a manner that will prevent the accumulation of water behind temporary structures or at any other locations within the construction area where it may be detrimental.

C. Ground Water:
   1. Provide, operate and maintain dewatering system to permit excavation and subsequent construction activities in a dry, safe environment.
   2. System shall be of sufficient size and capacity to maintain groundwater level a minimum of 2 feet below the lowest point of excavation.
   3. Contractor shall make an assessment of the potential for dewatering induced settlement of surrounding soils and structures. Contractor shall provide all necessary equipment and facilities, including re-injection wells, cutoff walls, infiltration trenches, etc, to prevent damage to adjacent structures.

D. Disposal of water:
   1. Disposal of discharge water shall conform to any and all applicable permit requirements.

3.4 EXCAVATION SUPPORT SYSTEMS

A. Trench Support
   1. Provide, install and maintain trench shields for all trench excavations for which trench shields are required (at a minimum, as required by OSHA).
   2. Follow all OSHA guidelines and other applicable laws and ordinances.

3. Elevation of Bottom:
   a. Excavation of earth material below the bottom of a shield will not exceed the limits established by ordinances, codes, laws and regulations.

4. Moving Shield: When a shield is removed or moved ahead, extreme care will be taken to prevent the movement of pipe or structures or the disturbance of the bedding for pipe or structures. Pipe or structures that are disturbed are to be removed and reinstalled as specified.

B. Below Grade Structure Excavation Support
   1. Provide, install and maintain excavation support systems for all structural excavations where excavation support is required (at a minimum, as required by OHSA).
   2. Follow all OSHA guidelines and other applicable laws and ordinances.
   3. Prepare excavation support plan addressing the following topics:
      a. Details of shoring, bracing, sloping or other provisions for worker protection from the hazards of caving ground
      b. Design assumptions and calculations
      c. Methods and sequencing of installing excavation support
      d. Proposed locations of stockpiled excavated materials
      e. Minimum lateral distance from the crest of slopes for vehicles, equipment and materials
      f. Location of vertical and horizontal monitoring points on structures and recommended frequency of monitoring for excavation support system stability and performance
   4. Design of excavation support systems and excavation support plan shall be prepared by a civil or structural engineer registered in the state in which the system is installed.
      a. Excavation support system shall consist of h-pile and lagging, sheet piles, or other reliable method of excavation support.
      b. The use of below-ground tiebacks is allowed, however, Contractor is responsible for locating and avoiding potential conflicts with existing utilities in the area in which the tie-backs are installed. All tiebacks shall be further than 3 feet from any conflicting utility. Tiebacks shall not use existing structures for support.

C. Removal of Excavation Support
   1. Completely remove all excavation support unless ENGINEER specifically allows requested excavation support to remain in place after backfill.
   2. Remove all excavation support in a manner that will maintain support as excavation is backfilled and will not leave voids in the backfill.

3.5 EXCAVATION

A. General:
   1. Material removed: Excavations include earth, sand, clay, gravel, hardpan, boulders, rock, pavements, rubbish and all other materials within the excavation limits.
   2. Excavations for structures and pipelines will be open excavations. Provide excavation protection system(s) required by ordinances, codes, law and regulations to prevent injury to workmen and to prevent damage to new and existing structures

or pipelines. Unless shown or specified otherwise, protection system(s) will be utilized under the following conditions.

a. Excavation Less Than 5 feet deep: Excavations in stable rock or in soil conditions where there is no potential for a cave-in may be made with vertical sides. Under all other conditions, excavations will be sloped and benched, shielded, or shored and braced.
b. Excavations More Than 5 feet deep: Excavations in stable rock where there is no potential for a cave-in may be made with vertical sides. Under all other conditions, excavations will be sloped and benched, shielded or shored and braced. Slopes shall be as recommended by the project Geotechnical Report.
c. Excavation protection system(s) will be installed and maintained in accordance with the excavation plan submitted.

B. Structural Excavation:
1. The elevation of the bottom of footings shown is approximate only. ENGINEER may order such changes in dimensions, and elevations as may be required to secure a satisfactory footing.
2. Hand-trim all structure excavations to permit the placing of full widths and lengths of footings on horizontal beds. Rounded and undercut edges will not be permitted.
3. Excavations shall allow for aggregate base, forms, working space, installation of shoring or bracing or the safe sloping of banks.

C. Pipe Trench Excavation:
1. No more than 100 feet of trench may be opened in advance of pipe laying.
2. Minimize trench width to the greatest extent practical, but conform to the following:
3. Sufficient to provide room for installing, jointing and inspecting piping, but in no case wider at top of pipe than pipe barrel outside diameter plus 3 feet.
4. Enlargements at pipe joints may be made, if required, and approved by ENGINEER.
5. Sufficient for shoring and bracing, or shielding and dewatering.
6. Sufficient to allow thorough compaction of backfill adjacent to bottom half of pipe.
7. Depth of trench will be as shown. If required and approved by ENGINEER, depths may be revised.

D. Subgrades:
1. Subgrades for roadways, structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; free from mud, muck, and other soft or unsuitable materials; and remain firm and intact under all construction operations.
2. Subgrades that are otherwise solid, but which become soft or mucky on top due to construction operations, shall be reinforced with Structural fill.
3. The finished elevation of stabilized subgrades shall not be above subgrade elevations shown.

E. Material Storage: Stockpile satisfactory excavated materials in approved areas, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
1. Locate and retain soil materials away from edge of excavations.
2. Dispose of excess soil material and waste materials as specified hereinafter.

F. Unauthorized Excavation:
1. All excavation outside the lines and grades shown, and which is not approved by ENGINEER, together with the removal and disposal of the associated material is at the CONTRACTOR'S expense.

2. Unauthorized excavations shall be filled and compacted with Structural fill by the CONTRACTOR at CONTRACTOR's expense.

3.6 PLACEMENT OF FILL AND BACKFILL

A. General:
   1. Backfill excavations as promptly as Work permits, but not until completion of the following:
      a. Acceptance by the ENGINEER of construction below finish grade.
      b. Inspection, testing, approval, and recording of locations of underground piping and ductwork.
      c. Removal of concrete formwork.
      d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials.
      e. Removal of trash and debris.
   2. Remove and replace with approved fill material, as specified, fill containing organic materials or other unacceptable material.
   3. Compact all fill and backfill as specified in Subsection 3.7.

B. Structural Backfill:
   1. Constraints:
      a. Backfill water-holding basins or structures only after satisfactory leakage tests have been conducted as specified in Sections Concrete and Precast Concrete.
      b. No backfill or fill material shall be placed when free water is standing on the surface of the area.
      c. No compaction of fill will be permitted with free water on any portion of the fill to be compacted.
      d. No fill shall be placed or compacted in a frozen condition or on top of frozen material.
      e. Any fill containing organic materials or other unacceptable material previously described shall be removed and replaced with approved fill material prior to compaction.
   2. Levels of backfill against concrete walls are not to differ by more than 2 feet on either side of walls, unless walls are adequately braced or all floor framing is in place up to and including grade level slabs.
   3. Wherever a pipe passes through a structure backfill, the structure backfill shall be placed and compacted to an elevation 12 inches above the top of the pipe before the trench is excavated.

C. Backfill in Pipe Trenches:
   1. Pipeline trenches may be backfilled prior to pressure testing, but no structure shall be constructed over any pipeline until it has been tested.
   2. Unless otherwise shown, place all pipe on a minimum 6 inches thick layer of Granular Bedding. The bedding shall extend 12 inches above the top of the pipe.
   3. Install bedding as follows:
      a. Spread bedding and grade to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints.
      b. After each pipe section is placed, deposit and compact sufficient bedding material under and around each side of the pipe to hold the pipe in proper position and to maintain alignment during subsequent pipe jointing and bedding operations.

c. Bedding material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement. Then place and compact the bedding material to an elevation 12 inches above the top of pipe.

4. Above the level of bedding, place General Engineered Fill or Structural Fill, as specified elsewhere in these specifications.
5. Controlled Low Strength Material (CLSM):
   a. When CLSM pipe zone material is indicated, the pipe may be supported above the trench floor on pea gravel bags or sandbag supports. The CONTRACTOR shall demonstrate to the ENGINEER, 7 days prior to full pipeline backfill installation, placement of CLSM as described below. This demonstration shall occur on the first 300 feet of trench, The CLSM pipe zone material shall be installed as indicated.
      1) Bedding and Embedment: Place and compact CLSM pipe zone material using the following techniques:
         a) Following placement and anchoring of the pipe, remove all loose soil from trench walls and floor. Remove any unstable soil at the top of the trench which might fall into the trench during placement of the CLSM.
         b) Deliver the CLSM to the trench in ready mix trucks or traveling pug mill and utilize pumps or chutes to place the CLSM in the trench. Direct CLSM to one side of the pipe, taking care not to displace the pipe at any time. Continue placing CLSM on one side of the pipe until CLSM has gone under the pipe and up the other side to a depth of 6 inches above the pipe bottom. Use at least two handheld vibrators to continuously liquefy and move CLSM into all voids. Adjust water in mixture to maintain fluid consistency but maintain strength requirements. Continue placing CLSM on both sides of the pipe continuously using two vibrators for every 30 feet of pipe run.
         c) Maintain stability of pipe and conduit throughout CLSM placement and curing. CLSM will likely require placement in lifts to prevent pipe flotation. No movement of the pipe caused by flotation will be allowed. If any movement occurs, the CLSM material shall be removed and/or repaired in full conformance with these Contract Documents at no additional cost to the OWNER. Remove all sloughed material or other debris from top of previously placed CLSM.
         d) CLSM shall be allowed to cure a minimum of 4 hours prior to placing each lift as well as trench zone material. A smaller cure period will be allowed if it can be demonstrated to the ENGINEER that it will support the individual lift or trench zone material. The CLSM shall be sufficiently strong to support trench backfill material and the compaction effort required to achieve the specified compaction.

D. Resume backfilling operations using the techniques described above to complete the pipe zone backfill. ENGINEER will approve the pipe zone backfill prior to initiating the trench zone backfill.

E. Embankments:
   1. To the maximum extent available, use excess earth obtained from structure and trench excavations for construction of embankments. Obtain additional material

from borrow pits, if such pits are shown, otherwise obtain additional material from offsite sources as necessary.
2. Strip, scarify, level and roll the subgrade so that surface materials of the subgrade will be compact and well bonded with the first layer of the embankment.
3. Wherever a pipe is to pass through a fill or embankment, place and compact the fill or embankment material to an elevation 12 inches above the top of the pipe before the trench is excavated.

F. Crushed Stone:
1. Place where shown on the Drawings, to the limits shown.
2. Place in hand-tamped lifts, not to exceed 6 inches.

G. Replacement of Unacceptable Excavated Materials: In cases where over-excavation for the replacement of unacceptable soil materials is required, backfill the excavation to the required subgrade with Structural Fill backfill material and thoroughly compacted.

3.7 COMPACTION

A. General:
1. Compaction by inundation with water will not be permitted.
2. Provide equipment capable of discing, aerating, and mixing the soil to ensure reasonable uniformity of moisture content throughout the material and to reduce the moisture content by air drying, if necessary.
3. Perform compaction with equipment suitable for the type of fill material being placed. Select equipment that is capable of providing the minimum density required by these Specifications. Use hand-operated compacting equipment within a distance of 3 feet from the wall of any completed below grade structure. Between 3 feet and 12 feet adjacent to below grade structures, compaction may be completed with lightweight compaction equipment weighing less than 15,000 pounds. Beyond 12 feet adjacent to below grade structures, there are no equipment weight restrictions. Provide equipment that is capable of compacting in restricted areas next to structures and around piping.

B. Compaction Density Requirements: The degree of compaction required for several types of fill is listed below. Moistened or aerated material as necessary to provide the moisture content specified, or if not specified, that will facilitate obtaining the specified compaction.

MATERIAL	Required Minimum Density (ASTM D 1557)	Maximum Uncompacted Lift*
Structural Fill/Prepared Subgrade:	95%	8 inches
General Engineered Fill/Trench Backfill above pipe:		
More than 2 feet below final grade	90%	8 inches
Less than 2 feet below final grade	95%	8 inches
Aggregate Base:	95%	8 inches
Granular Bedding	90%	6 inches

Sand	90%	6 inches
Gravel Surfacing	95%	6 inches

*Where large areas of backfill allow for use of large, heavy equipment, ENGINEER may, at their option, allow uncompacted lifts up to 12 inches.

C. Moisture Content: All fill and backfill shall be prepared and thoroughly mixed to achieve optimum moisture content, ±3%, with the following exception: On site clayey soils optimum to +3%.

D. Testing: Testing will be as specified under Paragraph 3.10, "Field Quality Control".

3.8 GRADING

A. General:
   1. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas.
   2. Smooth subgrade surfaces within specified tolerances, and compact with uniform levels or slopes between points where elevations are shown or between such points and existing grades.

B. Adjacent to Structures: Grade areas adjacent to structures to drain away from structures (including masonry fences) and to prevent ponding.

C. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 1 inch above or below the required subgrade elevation.

D. Pavements: Shape surface of areas under pavement to line, and grade and cross-section with finish surface not more than ½ inch above or below the required subgrade elevation.

E. Under Building Slabs: Grade smooth and even, free of voids, compacted as specified and to required elevation. Provide final grades within a tolerance of ½ inch when tested with a 10-foot straightedge.

F. Special Areas: In turfed areas or areas covered with gravel, stone, wood chips, or other special cover, grade to within not more than 1 inch above or below the required subgrade elevations.

G. Compaction: After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

Area	**Required Minimum Density (ASTM D 1557)**
Beneath Treatment Structures and Buildings	95%
Beneath Pavement	90%
Landscaped and other areas	85%

3.9 PAVEMENT BASE COURSE

A. Shoulders:
   1. Place shoulders along edges of base course to prevent lateral movement.
   2. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each base course layer.
   3. Compact and roll at least a 12-inch width of shoulder simultaneously with compacting and rolling of each layer of base course.

B. Placing:
   1. Place base course material on prepared subgrade in layers of uniform thickness conforming to indicated cross-section and thickness.
   2. Maintain optimum moisture content for compacting base material during placement operations.

3.10 FIELD QUALITY CONTROL:

A. General: Testing by a testing laboratory of materials, testing for moisture content during placement and compaction of fill materials, and of compaction requirements for compliance with technical requirements of the Specifications.

B. The CONTRACTOR shall retain one or more independent testing agencies to perform all quality control testing required for all materials except portland cement concrete. The required testing is for soil, aggregates, imported gravel, aggregate base, asphalt concrete, and CLSM. Each independent testing agency shall perform the testing under the supervision of an engineer registered in California. Technicians performing the testing shall be certified to operate the equipment and have at least 1 full year of experience in the type of tests being performed.

C. A Quality Control Plan shall be submitted by the CONTRACTOR to the ENGINEER at least 30 days before field testing is required. It shall include the names, addresses, and phone number of the companies, the major personnel that will be involved, and resumes of the individuals that will be supervising and performing the tests. Copies of certificates held by the companies and the testing personnel shall be included.

D. CONTRACTOR's independent testing agency shall perform all field and laboratory testing as described in these Specifications, and the Statement of Special Inspections and corresponding Table of Special Inspections in the Drawings. Test shall include specific gravity, sand equivalent, durability, abrasion resistance, soundness, gradation, compaction curves, lab and field moisture contents, compressive strength, and field density. Other tests shall be performed by the CONTRACTOR's independent testing agency as may be required to meet the Specifications. Mix design testing for portland cement concrete, CLSM, and asphalt concrete shall also be performed by the CONTRACTOR. Field testing for portland cement concrete will be performed by the ENGINEER.

E. CONTRACTOR shall schedule all lab testing so that materials arriving at the site have been approved by the ENGINEER for use on the Project.

F. All lab tests shall be performed on Samples obtained from the source of actual material that will be used on the Project. No test results more than 90 days old shall be submitted for review.

G. The location of field density tests shall be determined by the ENGINEER.

H. Frequency of tests: Frequency will be not less than as follows:
   1. For trenches:
      a. In open fields: 2 locations every 1,000 linear feet, for each layer
      b. Along dirt, gravel, or paved roads or off traveled right-of-way: 2 locations every 500 linear feet, for each layer
      c. Crossing roads: 2 locations along each crossing, for each layer
   2. For structural backfill: 1 every 50 cubic yards.
   3. In embankment or fill: 1 every 200 cubic yards.
   4. Base material: 1 every 50 cubic yards.
   5. Footing Subgrade: 1 every 50 linear feet, for each layer.
   6. Paved Areas and Building Slab Subgrade: 1 every 500 square feet, but in no case less than 3 tests, for each layer.

I. The ENGINEER may modify the frequency or spacing of tests to provide for testing at specific structures or locations where the ENGINEER deems additional testing is required. The CONTRACTOR shall perform such additional testing up to 10% above the frequency and total number of tests specified at no additional cost to the OWNER.

J. Verbal and hand-written test results shall be provided to the ENGINEER and CONTRACTOR immediately following the field testing. Written test data sheets shall be provided to the ENGINEER not more than 12 hours following completion of the field test. Typed lab test results shall be provided to the ENGINEER not more than 7 calendar days following completion of the tests; however, the results must be reviewed and approved by the ENGINEER prior to placing the material in the trenches or incorporating it in the Work.

A. Any location where a failing test occurs shall be recompacted and retested until a passing test is obtained. Specified testing values are minimums and no tests shall be accepted below the specified minimums. No material shall be placed over the failing test area until the failing material is recompacted and a passing test is obtained, and the area is approved by the ENGINEER. The limits of the failing test shall be assumed to be halfway between the failing location and the nearest passing location. Additional tests may be taken to determine the limits of unsatisfactory compaction.

B. At the first of each month, the CONTRACTOR shall provide to the ENGINEER a typed summary of all tests performed for the previous month including test location by station, depth below finished grade, material tested, wet density, moisture content, dry density, maximum density curve used, and percent relative compaction. Lab test results shall also be included in the monthly report with clear description of material tested, intended use on the Project, and a statement of compliance or noncompliance with the Project Specifications.

C. Any material which does not meet the Specifications shall be removed from the site and replaced with material in compliance.

D. Material which has been softened or modified prior to placing the overlying lift shall be removed down to material which is in compliance.

3.11 DISPOSAL OF EXCAVATED MATERIALS

A. Material removed from the excavations that does not conform to the requirements for fill or is in excess of that required for backfill shall be hauled away from the Work site and disposed of by CONTRACTOR in compliance with ordinances, codes, laws and regulations at no additional cost to the OWNER.

B. A site is not available to dispose of excess material.

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SECTION 31 23 33

TRENCH EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. It is the general intent of these specifications to specify conduct of the work in such manner as to cause the general public a minimum of inconvenience, with no exposure to unsafe conditions during construction, and to provide a trench that will properly support and protect the pipe and have no settlement on improved streets and only minor settlement in other areas where such settlement will not be noticed, or compensation made for any expected settlement. The degree of compaction and type of material will vary in accordance with type of pipe and soil and surface conditions.

B. In general, it is the City's standard policy that no trenching will be allowed on a City Street until a period of five calendar years has expired from the previous time of paving. In any case, when trenching occurs on a city street, the entire affected city block will be repaved in accordance with the Special Provisions and Project Plans.

C. Excavation of all earth, regardless of character and subsurface conditions, to the required lines and grade as shown on the plans for the installation of the subsurface pipelines, utilities, conduits, etc.

D. Shoring designed for general safety, worker protection, and protection of adjacent property from the hazards of caving ground shall be required for:
   1. Trench excavations
   2. Structural excavations

E. Control of ground water.

F. Backfill from the required pipe cover depth to subgrade.

G. Compaction as shown on the plans and as specified herein.

1.2 RELATED REQUIREMENTS

A. City Standard Detail Drawing for Trenching and Backfill.

B. Section 33 10 00 - Water Utilities

1.3 REFERENCES

A. 2010 State of California Department of Transportation Standard Specifications (SS)

Section 26	Aggregate Bases

1.4 QUALITY ASSURANCE

A. All work under this section will be subject to the inspection and approval of both the engineer and an approved geotechnical engineer registered in California. Compaction testing either shall be performed by the geotechnical engineer or by a city approved independent testing laboratory under the supervision of a California registered geotechnical engineer.

B. The geotechnical engineer shall make enough visits to the site to insure ongoing familiarity with the progress and quality of the work. The geotechnical engineer shall make a sufficient number of field observations and tests to allow the forming of an opinion regarding the adequacy of the site preparation, the acceptability of the native or import fill material, and the extent to which the degree of compaction meets the specification requirements and the project needs.

C. Any fill where the site preparation, type of material, or compaction is not approved by the geotechnical engineer, shall be removed and/or recompacted until the requirements are satisfied and approved by said geotechnical engineer. As required, fill material shall be tested for pollutants and certified for suitability by the geotechnical engineer.

D. On city-funded projects, services of the geotechnical engineer and/or testing laboratory shall be retained by, and paid for by the city. On all other projects, the geotechnical engineer and/or testing laboratory shall be retained by, and paid for by the developer. For city-funded projects, testing will be paid for by the city; however, testing or retesting caused by unsatisfactory contract operations shall be paid for by the contractor.

E. The geotechnical engineer shall provide quality assurance reports as required and accepted by the engineer.

1.5 MEASUREMENT AND PAYMENT

A. Measurement and payment of trench excavation and backfill shall be included in the cost per lineal foot of the size of pipe installed or the structure constructed.

1.6 PERMIT

A. For trenches or excavations five feet (5') deep or deeper, the Contractor shall obtain a permit for such excavation from the State Department of Industrial Relations, Division of Safety and Health (DOSH). The Contractor shall submit a copy of the permit to the Engineer prior to initiating any work requiring said permit.

1.7 ENGINEER REVIEW

A. The duty of the Engineer to conduct construction review of the Contractor's performance is not intended to include a review or approval of the adequacy of the Contractor's safety supervisor, the safety program, or any safety measures taken in, on, or near the construction site.

B. The Engineer will review the submittal of the Contractor's proposed shoring system to verify the general scope of the work, to determine that qualified professional

engineering services are used and to determine that appropriate construction techniques are proposed for use. This review shall not, in any way, be construed to relieve the Contractor from sole responsibility for the design and safety of such shoring.

1.8 GUARANTEES

A. The Contractor shall guaranty his work against settlement for a minimum period of one (1) year after the Notice of Completion has been filed, and shall repair all damage caused by settlement within that time. For the purpose of these specifications, settlement will be deemed to have occurred if either of the following conditions exist:
   1. On paved streets, a depression of three-eighths of an inch (3/8") below the average of the sides of the uncut portion; or
   2. Along shoulder areas and unpaved portions of the rights-of-way, a depression of three-quarters of an inch (3/4") below the average of the sides of the uncut portion.

PART 2 - PRODUCTS

2.1 BACKFILL REQUIREMENTS – GENERAL

A. See the applicable City Standard Drawings for typical pipe trench requirements and indication of placement limits for pipe bedding, initial backfill and subsequent backfill. Unless otherwise specified, native materials shall not be used for trench backfill.

B. Crushed Rock.
   1. Manufactured, angular, crushed stone with a minimum san equivalent value of 75.
   2. Clean, hard, sound, durable, uniform in quality, and free of soft, liable, thin, elongated or laminated pieces, and disintegrated material.
   3. Have 100 percent of its particles with at least one fractured face on a weight basis, when tested for crushed particles per ASTM D 5821.
   4. Comply with the grading shown in the following table:

SIEVE SIZE	PERCENT PASSING
1” (25 mm)	100
3/4” (19 mm)	95-100
1/2” (12.5 mm)	30-60
3/8” (9.5 mm)	0-20
No. 4 (4.75 mm)	0-5
No. 8 (2.36 mm)	-

2.2 PIPE BEDDING AND BACKFILL FOR SEWER AND STORM MAINS

A. Pipe bedding and backfill for Sewer and Storm mains shall be placed in accordance with City Standard Drawing ST-06A "Trench Construction for Sewer or Storm Mains". Unless otherwise specified, pipe bedding and initial backfill for gravity sewer, force main, and storm mains shall be ¾" drain rock with the following gradation:

SIEVE SIZE	PERCENT PASSING
1" (25 mm)	100
3/4" (19 mm)	85-100
1/2" (12.5 mm)	10-50
3/8" (9.5 mm)	5-20
No. 4 (4.75 mm)	<3
No. 8 (2.36 mm)	<2
No. 30 (0.60 mm)	<2
No. 100 (0.15 mm)	<2

2.3 PIP BEDDING AND BACKFILL FOR WATER MAINS

A. Pipe bedding and backfill for Water mains shall be placed in accordance with City Standard Drawing ST-06B "Trench Construction for Water Mains".

B. Unless otherwise specified, pipe bedding and initial backfill for Water system ductile iron pipes shall be clean graded, imported sand with a minimum 95% dry-in-place density, as determined by ASTM D-1557.

C. Sand shall be tested and must have a pH equal to or greater than 4.5 and less than 9, and a resistivity greater than 5,000 ohm-centimeters.

D. The sand shall conform to the following grading when tested in accordance with ASTM C 136, "Method for Sieve Analysis of Fine and Coarse Aggregates":

SIEVE SIZE	PERCENT PASSING
½"	100
#4	75 - 100
#50	0 - 70

SIEVE SIZE	PERCENT PASSING
#100	0 - 30
#200	0 -15

2.4 PIPE BEDDING AND BACKFILL FOR ELECTRIC CABLE, ELECTRIC CONDUIT, AND GAS PIPE

A. Pipe bedding and backfill for electric cable, electric conduit, and gas pipe shall be imported sand with a minimum 95% dry-in-place density, as determined by ASTM D-1557.

2.5 SUBSEQUENT BACKFILL

A. The Contractor shall backfill with imported Class 2 Aggregate Base materials, as required and authorized. Aggregate Materials, standards, specifications, and testing shall be in accordance with State Standard Specifications (SS) Section 26- Aggregate Bases. The grading of the material shall conform to the ¾ inch, maximum, specified in SS Section 26-1.02B, "Class 2 Aggregate Base"

B. Recycled Aggregate Base manufactured from recycled materials is acceptable provided that it meets the requirements and specifications of virgin Aggregate Base.

2.6 OTHER BACKFILL MATERIALS

A. Cement slurry, drain rock and other special earth-rock backfill materials shall be provided as specified in the Special Provisions, or directed and authorized.

PART 3 - EXECUTION

3.1 GENERAL

A. Unless otherwise indicated on the plans or in the special conditions, excavation shall be by open cut. Trenching machines may be used, except where their use will result in damage to existing facilities.

B. All pipe materials and accessories shall be on site prior to excavation. Unless otherwise specifically approved by the Engineer, the length of open trench shall not exceed one hundred feet (100') ahead of pipe laying, and no more than twenty-five feet (25') of excavated trench shall remain un-backfilled at end of day. Excavations in public streets shall be coordinated so as to minimize traffic interference.

C. Trenching in paved areas shall be saw cut or scored and broken ahead of trenching operations, and shall be cut or trimmed to a neat edge after backfilling. Any pavement damaged outside of the cuts shall be saw cut and restored prior to final paving.

D. Except with specific approval of the Engineer, no more than one hundred feet (100') of open trench shall be excavated in advance of laying the pipe. Not more than twenty-

five feet (25') of excavated trench shall remain un-backfilled at the end of each day's work. The remainder of the trench shall be backfilled, initially compacted, and opened to traffic. All operations shall be carried out in an orderly fashion. Backfilling, compacting and cleanup shall be accomplished as sections of the pipe are installed. Traffic through the work area shall not be impeded or obstructed at any time.

E. Trenches shall be excavated at least six inches (6") below the barrel of the pipe and the bottom re-filled with select imported material of the type specified. See applicable City Standard Drawings, for details of trench construction.

F. Excavation shall be supported as set forth in the rules, orders, and regulations of the California Department of Industrial Relations, Division of Industrial Accidents. All shoring, sheeting, and bracing shall conform to the requirements of the State or local agents having jurisdiction over such matters. Shoring, sheeting, and bracing shall be removed in a manner that will protect the workers and prevent caving of banks and damage to the pipe, excavation, backfill or adjacent property. No sheeting will be withdrawn from below the top of the pipe after completion of backfill to that level.

G. Trenches must be kept free from water while the pipe or structures are being installed, concrete is setting, and until backfill has progressed to a sufficient height to anchor the work against possible flotation or leakage.

H. The Contractor shall do all excavation of whatever substance is encountered to the lines and grades shown on the plans. All material suitable for use as backfill shall be piled in an orderly manner at a sufficient distance from the edge of the trench to avoid overloading and to prevent sliding into the trench. The Contractor shall do such grading or work as is necessary to prevent surface water from entering the excavation. Storage of equipment or material on street right of way shall not be allowed after normal working hours.

I. Shoring shall be removed only during backfill operations, and shall be done without moving the surrounding ground, piping or structure. Shoring can be left in place with the approval of the Engineer. Un-backfilled portions of trench shall be shored and covered each evening with steel trench plates, properly shimmed, steel spiked and ramped with temporary asphalt (cutback), and with traffic control signs and devices installed in accordance with the current edition of the State Department of Transportation "Manual of Uniform Traffic Control Devices".

J. The Contractor shall obtain compaction and install base and temporary paving promptly. Contactor shall provide vehicular access to all homes each evening, install laterals promptly, all streets shall be kept clean and free of dust, mud or debris by providing daily clean up as necessary.

K. **Native material** shall <u>not</u> be used for trench backfill.

L. No backfilling shall be done until the installation to be covered has been inspected and approved for covering. Compaction of backfill shall proceed immediately after backfilling.

M. The Contractor shall immediately notify the Engineer upon encountering underground water. Accumulated water shall be prevented from flowing down through the bedding

material and later pumping out and softening of surfaces or subgrade causing pavement failure. Where water causes such problems, during either construction or the guaranty period, it shall be drained to the nearest point where flow can be acceptably relieved; using gravel encased perforated metal pipe.

N. Sanitary sewer water shall not be allowed to flow into the storm drain system.

O. Final paving over excavated area shall be in accordance with City Standard Drawings **ST-06A Trench Construction for Sewer and Storm Mains** and **ST-06B Trench Construction for Water Mains**.

3.2 TRENCH SAFTEY PLAN

A. For trenches and excavations five feet (5') or more in depth, the Contractor shall submit to the Engineer a detailed plan, and any revisions thereto, showing design of shoring, bracing, sloping, or other provisions to be made for worker protection from the hazards of caving ground.

B. Such plan shall be submitted at least ten (10) working days before the Contractor intends to begin trenching or do excavation work.

C. If such plan varies from the shoring system standards established by the Construction Safety Orders of the Division of Industry Safety, the plan shall be prepared, sealed and signed by a Civil or Structural Engineer registered in California. Signed and sealed copies of calculations necessary to qualify the system shall also be submitted.

D. Nothing herein shall be deemed to allow the use of shoring, sloping, or protective system less effective than that required by the Construction Safety Orders of the Division of Industrial Safety.

3.3 LAWNS AND CULTIVATED AREAS

A. Where trench crosses lawns, the sod shall be removed by cutting, stored and kept moist and replaced to its initial condition. Where trench crosses cultivated areas, the topsoil shall be replaced and replanted or cultivated into the same condition as existed prior to excavation.

3.4 WIDTH OF TRENCH

A. Except where otherwise specifically permitted, sides of trenches shall be vertical, shored as required, and shall be of uniform width from top to bottom. Trenches shall be of a width as shown on the detail sheets in the plans, except for small diameter laterals, which may be installed in narrow "Ditch-Witch" type of trench.

B. Unless otherwise specified or shown, the minimum width of the trench measured at the top of the pipe shall be in accordance with City Standard Drawing **ST-06B Trench Construction for Water Mains**.

C. Whenever the maximum allowable trench width is exceeded for any reason, the Contractor shall concrete embed or otherwise cradle the pipe in a manner satisfactory to the Engineer.

3.5 ASHPALT REMOVAL

A. Asphalt concrete shall be cut with a suitable tool, preferably a sawcutter, before excavation. Cutting with a jackhammer or a suitable grader-mounted wheel will be allowed provided that a neat orderly result is accomplished. Breaking of concrete or asphalt with excavation equipment will not be permitted.

B. After trench backfill and compaction, existing paving shall be saw cut vertically, with a neat, square edge just prior to final paving to a point twelve inches (12") or more wider than each side of the trench line. Edges of all asphalt concrete on streets and roadways shall be saw-cut at least six inches (6") deep or to the depth of the existing asphalt concrete pavement, whichever is lesser, with a concrete saw. Saw cuts shall be parallel or perpendicular to centerline of the trench.

C. Excess paving shall be disposed of and shall not be used as backfill material.

D. All silt, and water used in the saw cutting operation, shall be removed through the use of a vacuum machine and properly disposed of offsite. All catch basins downstream from the saw cutting operation shall be covered to prevent sediment from entering.

3.6 CONCRETE REMOVAL

A. The Contractor shall remove and dispose of all curbs and gutter, sidewalk, and driveway approach. Limits shall be marked in the field by the Contractor and inspected by the Engineer. Limits of removal shall be along straight lines and may be along existing cold joint or expansion joint, score line, or control line or as otherwise marked by the Contractor and approved by the Engineer in the field.

B. Where the limit of removal is along a location other than an existing cold joint or expansion joint, concrete shall be neatly cut to provide a straight and uniform edge. Where necessary to meet the dimensions for new subgrade for standard curb and gutter, sidewalk, driveway or curb ramp, additional material shall be excavated and removed to provide even and uniform plane.

C. Where the plans for reconstruction of existing curb and/or sidewalk, and the limits of the new work specified do not fall on a scoring line, the entire section shall be removed and the new work shall be joined to the existing at the first scoring line beyond said specified limit.

D. The Contractor shall notify the Engineer when tree roots are exposed during concrete removal. City may inspect the tree roots to determine the limits of the root cutting or pruning. The Contractor shall perform all necessary root pruning or removal to complete the work.

3.7 SHORING, SHEETING, AND BRACING

A. The Contractor shall furnish and install all shoring, sheeting, and bracing required to support adjacent earth banks and structures for the protection and safety of all personnel working in the trench. All shoring, sheeting, and bracing shall conform to the requirements of the State Department of Industrial Relations (DIR), Division of

Occupational Safety and Health (DOSH), or local agents having jurisdiction over such matters.

B. Remove shoring, sheeting, and bracing in a manner that will protect the workers and prevent caving of banks and damage to the pipe, excavation, backfill, or adjacent property.

3.8 WATER CONTROL

A. The Contractor shall be solely responsible for dewatering trenches and excavations, and subsequent control of ground water.

B. Contractor shall provide and maintain such pumps or other equipment as may be necessary to control ground water and seepage, to the satisfaction of the Engineer and in compliance with the requirements of the geotechnical report. All pumped water must be treated for sediment removal prior to discharge to City storm drains. Seepage coming from the sewer line shall be disposed of into the sanitary system.

C. Pumped water that is deemed to be contaminated shall be discharged to the sewer. City will obtain sewer discharge permit.

3.9 BACKFILL AND COMPACTION

A. Initial backfill shall be carefully packed under the haunches of the pipe and brought up simultaneously on both sides, to obviate any displacement of the pipe from its true alignment. The initial backfill shall be compacted in layers no more than eight inches (8") in thickness, in a manner that will preclude moving the pipe, to not less than ninety percent (90%) of maximum dry density as determined by the procedure set forth in ASTM D 1557, "Test Methods For Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using Ten Pound Rammer and Eighteen Inch Drop."

B. Water Jetting for compaction of backfill materials shall not be permitted.

C. Subsequent backfill shall be placed in loose lifts not exceeding twelve inches (12") in thickness before compaction, and compacted by the use of pneumatic tampers or other mechanical means approved by the geotechnical engineer. Each layer shall be watered or dried, as required, to bring the soils as close as practical to the optimum moisture content for proper compaction. Compaction equipment or methods that produce horizontal or vertical earth pressures, which may cause excessive displacement or may damage the pipeline, will not be permitted. Lifts of backfill material shall be compacted to not less than ninety percent (90%) above the pipe but not less than ninety-five percent (95%) for a minimum depth of thirty inches (30") below subgrade as determined by the procedure set forth in ASTM D 1557. Subsequent backfill for trenches in unpaved, non-traffic areas shall be compacted to not less than eighty-five percent (85%) of maximum dry density.

3.10 BASE, PAVING, AND TESTING

A. The Contractor shall compact material as work progresses, and base and temporary paving shall be installed the same day as excavated. Contractor shall test pipe within

five (5) working days of installation and shall install permanent paving within ten (10) working days of initial excavation.

3.11 TESTING

A. The City shall make all tests when advised by the Contractor that, in the Contractor's opinion, sufficient densities have been achieved. If the first tests in any area fail, the Contractor shall pay for any further testing in that area until specified densities are obtained. Engineer shall determine the number and location of tests required.

B. Contractor shall furnish a backhoe and operator upon request, at no cost to the City to assist in testing.

3.12 TRAFFIC SIGNAL FACILITIES, DETECTOR LOOPS, AND PAVEMENT MARKINGS

A. Existing signal facilities, detector loops, and pavement markings shall be protected. Any damage shall be replaced or restored at the Contractor's expense in accordance with the specifications and as approved by the Engineer.

++ END OF SECTION ++

SECTION 32 12 16

ASHPALT PAVING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work under this Section shall consist of furnishing all labor, material, equipment, tools, and services required for the placing and compacting of asphalt concrete pavement for roadways, berms, parking lots, and walkways to the lines, grades, and dimensions shown on the drawings and as specified herein.

B. Also included shall be the repair and resurfacing of existing roadway and area paving damaged or removed during construction.

C. Also included shall be application of prime coat over aggregate base surfaces and tack coat over existing asphalt concrete and concrete surfaces adjacent to the new paving.

D. Seal coats as specified.

1.2 RELATED REQUIREMENTS

Not Used.

1.3 REFERENCES

A. The Contractor shall comply with the requirements of the Bay Area Air Quality Management District concerning cutback asphalt paving materials and application.

1.4 QUALITY ASSURANCE

A. To validate that specified final elevations have been provided, the contractor shall provide to the City applicable grade certificates. No separate payment will be made for providing such certification. All cost therefore shall be included in the various work item(s) requiring certification.

1.5 MEASUREMENT AND PAYMENT

A. Unless otherwise specified in the Special Provisions, measurement and payment for paving and surfacing items of work will be as specified herein.

B. Aggregate Base. Measurement and payment will be on a ton basis with the truck load slip for each delivery presented to the inspector before unloading.
   1. All slips shall show the supplier, net weight, identification mark of carrying vehicle and time of loading.
   2. The contract price per ton of aggregate base shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in the delivery spreading, and compaction of the base aggregate, complete in place, as shown on the plans and specified in these specifications and directed by the Engineer.

C. Planing Asphalt Concrete Pavement
   1. Planed asphalt concrete pavement will be measured by the square foot or square yard per specified width. The quantity to be paid for will be the actual required area of surface planed irrespective of the number of passes required.
   2. The contract price paid per square foot or square yard for planing asphalt concrete pavement shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in planing asphalt concrete surfacing and immediately disposing of material removed, as specified in these specifications and as directed by the Engineer.

D. Heating and Scarifying
   1. Payment for this work will be included in the cost for asphalt concrete unless separately itemized in the bid schedule.
   2. If separately itemized in the bid schedule, the quantity to be paid for will be the actual surface area to be heated and scarified. Payment then will be made by the square foot or square yard and shall include full compensation for furnishing all labor, equipment, tools, material, traffic control, and cleanup, for heating and scarifying as shown on the plans and as specified in these specifications and the Special Provisions.

E. Prime Coat
   1. Payment for this work shall be included in the cost of asphalt concrete unless specifically itemized in the bid schedule.
   2. If specifically itemized in the bid schedule, measurement will be by the square foot or square yard. The quantity to be paid for will be the actual area applied. The contract price paid per ton for Prime Coat, if itemized, will include full compensation for furnishing all labor, material, tools, equipment, and incidentals, and for performing all work involved in the application of the prime coat.

F. Tack Coat
   1. Payment for this work shall be included in the cost for asphalt concrete unless specifically itemized in the bid schedule. If specifically itemized in the bid schedule, measurement shall be by the ton. The quantity to be paid for will be the actual number of tons applied.
   2. The Contract price paid per ton for Tack Coat, if itemized, will include full compensation for furnishing all labor, material, tools, equipment, and incidentals, and for doing all work involved in the application of the tack coat.

G. Seal Coats (Other Than Slurry Seal)
   1. Measurement for payment will be by the ton, square foot or square yard, whichever unit is designated in the bid schedule. Provision of asphalt emulsion and water for mixing with asphaltic emulsion is included in the above prices and payments.
   2. Payment will include full compensation for furnishing all labor, material, tools, equipment, and incidentals, and for doing all work involved in the application of the seal coat, complete in place.
   3. Measurement and payment for Slurry Seal will be as specified under Section 18.

H. Fog Seal Coat (When Specified)
   1. Measurement for payment will be by the ton or by the square foot or square yard, as specified. The quantity to be paid for will be the actual area applied.

2. Payment will include full compensation for furnishing all labor, material, tools, equipment, and incidentals, and for doing all work involved in the application of the fog seal coat.

I. Asphalt Concrete
   1. Measurement and payment will be on a ton basis with the truck load slip for each delivery presented to the inspector before unloading. All slips shall show the supplier, net weight, identification mark of carrying vehicle and time of loading.
   2. The contract price per ton shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in constructing asphalt concrete, complete in place, as shown on the plans and as specified in these specifications, and as directed by the Engineer.
   3. Contractor shall control the asphalt concrete quantity so that it is to the thickness as specified on the plan. Any extra asphalt concrete placed that exceeds ten percent (10%) of the calculated quantity shall be paid by the contractor.

J. Asphalt Berm
   1. Measurement and payment will be by the linear foot of the size and type of berm constructed, and shall include full compensation for furnishing all labor, materials, tools, equipment and other incidentals, for constructing the berm, complete in place, as called for on the plans and specified in these specifications, and as directed by the Engineer.

K. Street Cleaning
   1. Payment for this item will be included in the various bid items for asphalt paving.

1.6 SUBMITTALS

A. Submit the following under the Product (Information) category.
   1. 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 the City's inspection, and no materials shall be used in the construction work until it has been approved by the Engineer.
   2. The Contractor shall submit a signed verification from each source of supply for each construction material employed on the project, indicating that the materials meet the Specification requirements.
   3. Mix design for asphalt concrete.

PART 2 - PRODUCTS

2.1 AGGREGATE BASE

A. Aggregate bases shall consist entirely of Class 2 material, as set forth in Section 26-1.02B, "Class 2 Aggregate Base," of the State Specifications.

B. Maximum aggregate size shall be three-fourths inches (3/4").

C. Contractor shall provide supplier certifications concerning the gradation and durability of the aggregate base. Compaction and other tests will be done by others. 2.02 PRIME

COAT A. Material for prime coat shall consist of MC-70 conforming to the requirements of Section 93, "Liquid Asphalts," of the State Specifications.

2.2 TACK COAT

A. Material for tack coat shall consist of SS1h or SS1, conforming to the requirements of Section 94, "Asphaltic Emulsions," of the State Specifications, or AR-1000, conforming to the requirements of Section 92, "Asphalts," of the State Specifications.

2.3 SEAL COATS (OTHER THAN SLURRY SEAL)

A. Material for seal coat shall consist of CSS1h, or SS1h conforming to the requirements of Section 94, "Asphaltic Emulsions," of the State Specifications. Aggregate cover shall consist of one of the screening gradations specified in Section 37-1.02, "Materials," of the State Specifications. Seal coat type shall be as specified in the Special Provisions.

2.4 FOG SEAL COAT

A. Material for fog seal coat shall consist of SS-1h or SS-1, conforming to the requirements of Section 94, "Asphaltic Emulsions," of the State Specifications.

2.5 ASPHALT CONCRETE

A. Material for asphalt concrete or plant mix shall be furnished and placed in strict conformance with Section 39, "Asphalt Concrete," of the State Specifications. Asphalt binder shall conform to the requirements of Section 92, "Asphalts," of the State Specifications. Aggregate shall be either Type A or Type B. However, maximum aggregate size shall be one-half inch (1/2"), unless otherwise specified. For lifts of one inch (1") or less compacted thickness, and when material is placed by extrusion, maximum aggregate size shall be three-eighths of an inch (3/8").

2.6 PORTLAND CEMENT CONCRETE

A. Concrete shall conform to Section 21, "Minor Concrete," of these Specifications.

PART 3 - EXECUTION

3.1 GENERAL

A. These specifications 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 surface shall be cut back six inches (6") beyond the damaged area.

C. Where the damaged area extends over more than fifty percent (50%) of the road width or paved area, as determined by the Engineer, the full pavement width or area shall be saw cut, excavated, removed and repaired.

D. All city owned structures such as valve boxes, manhole frames and covers and monuments within the resurfaced areas shall be adjusted to the new grade, as necessary. Spraying of liquid asphalts and coatings will not be permitted on windy days (in excess of fifteen miles per hour (15 mph).

3.2 MAINTAINING TRAFFIC AND PUBLIC SAFETY

A. During the paving operations, the Contractor shall furnish and place sufficient barricades at all cross streets to protect new surfacing from traffic until sufficiently cooled, as well as "DETOUR" signs one (1) block away from all impassable intersections. At least one (1) lane of through traffic shall remain open, and sufficient traffic cones placed between the through lane and the freshly surfaced lane to prevent traffic from using the freshly surfaced lane until sufficiently compacted and cooled.

B. Spreader and other equipment shall be moved only on truck or trailer with pneumatic tires.

C. In all cases, the Contractor shall be responsible for the complete protection of new surfacing from traffic until sufficiently compacted and cooled.

3.3 PAVEMENT CUTTING

A. After backfilling and prior to paving, proper tools and equipment shall be used in marking and breaking so that the pavement shall be cut on neat straight lines parallel to the trench or roadway centerline. The asphalt pavement shall be saw cut using a concrete saw to a minimum depth of two inches (2") or one-half (1/2) the thickness thereof, whichever is greater. The pavement shall be cut back twelve inches (12") on each side of the trench or excavation wall. 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, the affected pavement shall be neatly saw cut in straight lines and replaced after the voids have been filled.

B. All water generated from pavement cutting shall be contained and treated for sediment removal (through filtration or sedimentation) prior to discharge to the City storm drain.

3.4 PLACEMENT OF AGGREGATE BASE

A. Aggregate bases shall be placed and compacted in accordance with Section 26, "Aggregate Bases," of the State Specifications.

3.5 STREET CLEANING

A. Contractor shall clean the streets to be resurfaced prior to planning of six-foot (6') wide strips adjacent to gutters and twenty-foot (20') wide transverse conform strips. Extensive cracking, potholes, and local depressions not indicated in the drawing to be repaired by Contractor will be repaired by City forces prior to resurfacing.

B. The Contractor shall inspect the streets prior to his work and shall not proceed until they are cleaned to the City's satisfaction.

3.6 PREPARATION OF EXISTING ASPHALT CONCRETE

A. Planning Asphalt Concrete Pavement:
   1. Existing asphalt concrete shall be planed at the locations and to the dimensions shown on the plans or field marked by the engineer and in accordance with these Specifications.
   2. Planning asphalt concrete pavement shall be performed by cold planing. The cold planing machine shall have a cutter head at least thirty inches (30") wide and shall be operated so as not to produce fumes or smoke.
   3. Care shall be exercised to protect wiring of existing traffic detector loops from damage. The Contractor shall request City staff to identify existing traffic detection loops in the field. Loops damaged by the Contractor, even if not located by the City, shall be replaced per Section 20, "Traffic Signals," of these Specifications.
   4. The depth, width, and shape of the cut shall be as indicated on the typical cross sections or as directed by the Engineer. The final cut shall result in a uniform surface conforming to the typical cross sections. The outside lines of the planed area shall be neat and uniform. The road surfacing to remain in place shall not be damaged in any way.
   5. Planed widths of pavement shall be continuous except for intersections at cross streets where the planing shall be carried around the corners and through the conform lines or as shown on the plans.
   6. Planing adjacent to existing manhole or other street boxes shall be within 6" minimum of the structure. Structures that are damaged as a result of Contractor activity shall be repaired or replaced to pre-construction condition at no cost to the City.
   7. The material planed from the roadway surface, including material deposited in existing gutters or on the adjacent traveled way, shall be immediately removed from the site of the work, and hauled and stockpiled at the location designated by the Engineer. The removal crew shall follow within fifty feet (50') of the planer, unless otherwise directed by the Engineer.
   8. Heating and Scarifying. The existing street surface indicated on the plans to be heated and scarified shall be heated by a mobile surface heater with lateral and vertical controls. These controls shall be used to control the application of heat to the desired location and prevent damage to adjacent concrete gutters. Additionally, the Contractor will protect trees and other planting from heat damage.
   9. The asphalt binder shall not be charred in excess of one tenth of one percent (0.10%) and the scarified surface must show live asphalt cement as a result of the applied heat.
   10. At least fifty percent (50%) of the existing top two inches (2") of aggregate of the pavement being remixed shall be moved by spinning or tumbling, thus providing for the filling of cracks and turning over the work or dried faces which have lain upward. The asphalt paving remixer shall be adjustable from three-and-a-half feet (3-1/2') to twelve feet (12') in width, and passes shall be six inches (6") wider than the spreader following. The remixer shall also be of a type to remix depressions in the pavement to a depth of at least two inches (2"). The remixer shall be of the Therma-Bond type, Rola-Burner type, or approved equal. Immediately after the application of heat, the remixer shall pass over the heater surface and remix to a minimum depth of one-half inch (1/2").

11. The pavement remixer shall be adjustable in width and depth of application, and the remixed surface shall be uniformly and evenly spread without scattering, ridging, or breaking of the mineral aggregate.
12. Following the remixing, a tack coat of SS-1h grade of emulsion (Asphalt Institute designation) shall be applied in accordance with Sections 39, "Asphalt Concrete," and 94, "Asphaltic Emulsion," of the State Specifications at the minimum rate of one-tenth (1/10) gallon per square yard by a distributor truck meeting the State Specifications. Immediately following the tack coat and while the remixed surface is in a softened state, asphalt concrete shall be placed. No surface shall be allowed to stand after heating, remixing, and application of tack coat, for such a period of time as to prevent proper compaction and bonding of the remixed material and the new course of plant-mixed surfacing.
13. No traffic shall be allowed to run on the scarified, remixed, tack-coated, or overlayed surface, until pavement is final-rolled and cooled below 150°F.
14. Should work be stopped before placing of the plant-mixed surface due to inclement weather, unavailability of asphalt concrete material, work stoppage at the end of the working day, etc., the surface shall be reheated and remixed at the Contractor's expense.

3.7 PRIME COAT

A. Prime Coat shall be applied to all aggregate base prior to laying asphaltic surfacing. It shall be applied in accordance with Sections 39-4.02, "Prime Coat and Paint Binder," and 93-1.03, "Mixing and Applying," of the State Specifications.

3.8 TACK COAT

A. A tack coat (binder coat) shall be applied to existing asphaltic or concrete surfaces that are to receive an asphaltic overlay. Asphaltic pavement which has been exposed to the weather less than thirty (30) days need not be tack-coated. Tack coat shall be applied at a rate of two hundredths (0.02) to one tenth (0.10) gallon per square yard, in accordance with Section 39-4.02, "Prime Coat and Paint Binder," of the State Specifications.

3.9 SEAL COAT (OTHER THAN SLURRY SEAL)

A. Where called for in the plan or Special Provisions, or required by the Engineer, a seal coat shall be applied to new or older pavement. A seal coat shall be applied at the rate of fifteen-hundredths (0.15) to three-tenths (0.30) gallon per square yard immediately followed by aggregate cover. Aggregate cover shall be one-quarter inch (1/4") x No. 10 screening spread uniformly over the area. Screening shall be tightly rolled into binder with a five (5) ton steel-wheeled roller. After four (4) calendar days, excess screenings shall be removed by brooming, without disturbing screenings set in binder.

B. Preparation and placement of seal shall be in accordance with Section 37-1, "Seal Coats" of the State Specifications.

3.10 FOG SEAL COAT

A. A fog seal coat conforming to the requirements of Section 37, "Bituminous Seals" of the State Standard Specifications shall be applied to asphaltic concrete pavements

when specified in project plans and specifications. A fog coat shall be applied at a rate between five-hundredths (0.05) to one-tenth (0.10) gallon per square yard.

3.11 PLACEMENT OF ASPHALT CONCRETE

A. Spreading and compacting of asphalt concrete shall be in accordance with Section 39, "Asphalt Concrete," of the State Specifications.

B. Pavement width and location for Collector Streets (42 feet curb to curb) and Arterial Streets (greater than 42 feet curb to curb). To assure that the pavement seam is not placed in the vehicle tire path, the pavement curb to curb shall be as follows:
   1. Collector Streets – Pavement seam shall be on centerline of street. Pavement width shall be a minimum of 12 feet wide either side of centerline, i.e., four (4) pavement widths are required to pave a collector street.
   2. Arterial Street – Pavement seam shall be on centerline of street. Pavement width shall be a minimum of 12 feet wide either side of centerline. For divided streets, pavement seams shall match the new lane markings.

3.12 ASPHALT BERM

A. Asphalt berms shall be placed by using an extrusion machine. Berm dimensions shall be as indicated on the plans, and shall be laid true to line and grade, and of the required surface texture.

3.13 ADJUSTING MANHOLE, VALVE, AND SURVEY MONUMENT COVERS TO GRADE

A. The location of these structures, if shown on the plans, is approximate only. It shall be the Contractor's responsibility to suitably locate them prior to resurfacing.

B. The Contractor shall identify all utilities covered during resurfacing by dimples and curb markings.

C. All City manholes, valve covers, monument box covers, traffic signal covers, and other City service access covers shall be raised within ten (10) calendar days after resurfacing is completed. Water valves and specially designated items must be raised within five (5) working days after paving. The Contractor shall notify Pacific Gas and Electric Company, AT&T, cable television companies, and other utilities affected by the resurfacing in writing within twenty-four (24) hours after each street section (block) is paved and provide copies of the same to the Engineer.

D. The monuments themselves shall not be disturbed.

E. If the Contractor elects to raise the manhole cover castings by bricks and mortar, the casting shall be placed to new grade in compliance with these specifications, as outlined for a new casting. Special care shall be exercised not to spill mortar or grout. The inside surface of the raised manhole shall have a mortar finish.

F. Manholes shall be adjusted to grade using three inch (3") thick and six inch (6") thick reinforced concrete grade rings or a combination thereof, from Hanson Concrete Products, Inc. or approved equivalent. If the required adjustment to grade is less than

three inches (3"), brick and mortar shall be used. If the required adjustment to grade is more than three inches (3") but less than six inches (6"), a three inch (3") thick reinforced concrete grade rings complemented by bricks and mortar shall be used.

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SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Shop Drawings: Detailed information and specifications for materials, finishes, and dimensions.

B. Samples: Approximately 6 inches square, or 6 inches long of posts, rails, braces, fabric, wire, ties, and fittings.

C. Quality Control Submittals:
   1. Manufacturer's recommended installation instructions.
   2. Evidence of Supplier and installer qualifications.

1.2 SCHEDULING AND SEQUENCING

A. Complete necessary site preparation and grading before installing chain link fence and gates.

PART 2 - PRODUCTS

2.1 GENERAL

A. Match style, finish, and color of each fence component with that of other fence components.

2.2 CHAIN LINK FENCE FABRIC

A. PVC-coated galvanized fabric conforming to ASTM F668, Class 1 or 29.
   1. Color: Black.
   2. Manufacturers and Products:
      a. Colorbond Corp., Raritan, NJ; Colorbond II.
      b. Cyclone Fence, United States Steel, Chicago, IL; Cyclone Color Fence System.

B. Height: 72 inches, unless otherwise shown.

C. Wire Gauge: No. 9.

D. Pattern: 2-inch diamond-mesh.

E. Diamond Count: Manufacturer's standard and consistent for fabric furnished of same height.

F. Loops of Knuckled Selvages: Closed or nearly closed with space not exceeding diameter of wire.

G. Wires of Twisted Selvages:
   1. Twisted in a closed helix three full turns.
   2. Cut at an angle to provide sharp barbs that extend minimum 1/4-inch beyond twist.

H. Privacy Slats, if called for on Drawings:
   1. HDPE or PVC Top Lock slats sized for No. 9 gauge 2-inch mesh, approximately 1 3/32-inches wide.
   2. Length to match the fabric height minus 2 inches.
   3. Color selected by OWNER.

2.3 POSTS

A. General:
   1. Strength and Stiffness Requirements: ASTM F669, Heavy Industrial Fence, except as modified in this section.
   2. Steel Pipe: ASTM F1083.
   3. Roll-Formed Steel Shapes: Roll-formed from ASTM A570, Grade 45, steel.
   4. Protective Coatings:
      a. Zinc Coating: ASTM F1234, Type A external and internal coating.
   5. Color Coating: ASTM F1043, minimum 10 mils thickness over zinc coating to match color of chain link fabric.

B. Line Posts:
   1. Steel Pipe:
      a. Outside Diameter: 2.375-inch.
      b. Weight: 3.65 pounds per foot.
   2. Roll-Formed Steel C Shape:
      a. Outside Dimensions: 2.25-inch by 1.625-inch.
      b. Weight: 2.70 pounds per foot.
   3. Steel H-Section:
      a. Outside Dimensions: 2.25-inch by 1.70-inch.
      b. Weight: 3.26 pounds per foot.

C. End, Corner, Angle, and Pull Posts:
   1. Steel Pipe:
      a. Outside Diameter: 2.875-inch.
      b. Weight: 5.79 pounds per foot.

D. Posts for Removable Fence Panels: As specified for end, corner, angle, and pull posts.

E. Posts for Swing Gates:
   1. Material: ASTM F1043 Group IA ASTM F1083 schedule 40 pipe.
   2. Gate Post Size per ASTM F900:

For gate fabric height up to and including 6 feet	
Gate Leaf Width	Post Outside Diameter
Up to 4 feet	2.375-inch
Over 4 feet to 10 feet	2.875-inch
Over 10 feet to 18 feet	4.0-inch
For gate fabric height over 6 feet to 12 feet	
Up to 6 feet	2.875-inch

Over 6 feet to 12 feet	4.0-inch
Over 12 feet to 18 feet	6.625-inch
Over 18 feet to 24 feet	8.625-inch

a. Roll-formed steel shapes may be substituted for steel pipe posts for gate leaf widths up to 6 feet and fabric heights up to 8 feet.
   1) Outside Dimensions: 3.5-inch by 3.5-inch.
   2) Weight: 4.85 pounds per foot.

2.4 TOP RAILS AND BRACE RAILS

A. Galvanized steel pipe or roll-formed steel C shapes, color-coated.

B. Protective Coatings: As specified for posts.

C. Color Coating: ASTM F1043, minimum 10 mils thickness over zinc coating to match color of chain link fabric.

D. Strength and Stiffness Requirements: ASTM F669, Top Rail, Heavy or Light Industrial Fence.

E. Steel Pipe:
   1. ASTM F1083.
   2. Outside Diameter: 1.66-inch.
   3. Weight: 2.27 pounds per foot.

F. Roll-Formed Steel C Shapes:
   1. Roll formed from ASTM A570, Grade 45.
   2. Outside Dimensions: 1.625-inch by 1.25-inch.
   3. Weight: 1.40 pounds per foot.

2.5 FENCE FITTINGS

A. General: In conformance with ASTM F626, except as modified by this article.

B. Post and Line Caps: Designed to accommodate passage of top rail through cap, where top rail required.

C. Tension and Brace Bands: No exceptions to ASTM F626.

D. Tension Bars:
   1. One-piece.
   2. Equal in length to full height of fabric.

E. Truss Rod Assembly: 3/8-inch diameter.

F. Barb Arms: 45-degree arms for supporting three strands of barbed wire.

2.6 TENSION WIRE

A. Zinc-coated steel marcelled tension wire conforming to ASTM A824, Type II, Class 2.

2.7 GATES

A. General:
   1. Gate Operation: Opened and closed easily by one person.
   2. Welded Steel Joints: Paint with zinc-based paint.
   3. Chain Link Fabric: Attached securely to gate frame at intervals not exceeding 15 inches.

B. Swing Gates: ASTM F900.
   1. Hinges:
      a. Furnished with large bearing surfaces for clamping in position.
      b. Designed to swing either 180 degrees outward, 180 degrees inward, or 90 degrees in or out, as shown, and not twist or turn under action of gate.
   2. Latches: Plunger bar arranged to engage stop, except single gates of openings less than 10 feet wide may each have forked latch.
   3. Gate Stops: Mushroom type or flush plate with anchors, suitable for setting in concrete.
   4. Locking Device and Padlock Eyes: Integral part of latch, requiring one padlock for locking both gate leaves of double gates.
   5. Hold-Open Keepers: Designed to automatically engage gate leaf and hold it in open position until manually released.

C. Fabric Salvage: Knuckled.

D. Appurtenances and Framework: As specified.

2.8 REMOVABLE FENCE PANELS

A. Panel Length:
   1. Equal division of total length of removable fence section.
   2. Maximum 10 feet.

B. Frames: ASTM F1184, Type I.

2.9 CONCRETE

A. Provide as specified in Section 03 30 03, Cast-in-Place Concrete.

PART 3 - EXECUTION

3.1 GENERAL

A. Install chain link fences and gates in accordance with ASTM F567, except as modified in this section, and in accordance with fence manufacturer's recommendations, as approved by ENGINEER. Erect fencing in straight lines between angle points.

B. Provide all necessary hardware for a complete fence and gate installation.

3.2 PREPARATION

A. Establish locations of fence lines, gates, and terminal posts.

3.3 POST SETTING

A. Driven posts are not acceptable.

B. Post Hole Depth:
   1. Minimum 3 feet below finished grade.
   2. 2 inches deeper than post embedment depth below finish grade.

C. Backfill post holes with concrete to 2 inches above finished grade.

D. Before concrete sets, crown and finish top of concrete to readily shed water.

3.4 BRACING

A. Brace gate and corner posts diagonally to adjacent line posts to ensure stability.

3.5 TOP RAILS

A. Install top rail sleeves with springs at 105 feet maximum spacing to permit expansion in rail.

3.6 CHAIN LINK FABRIC

A. Do not install fabric until concrete has cured minimum 7 days.

B. Install fabric with twisted and barbed selvage at top.

3.7 GATES

A. Hang gates and adjust hardware so gates operate satisfactorily from open or closed position.

B. Set gate stops in concrete to engage center drop rod or plunger bar.

3.8 ELECTRICAL GROUNDING

A. Ground fences in accordance with applicable requirements of IEEE C2, National Electrical Safety Code.

3.9 FIELD QUALITY CONTROL

A. Gate Tests: Prior to acceptance of installed gates and gate operator systems, demonstrate proper operation of gates under each possible open and close condition specified.

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SECTION 33 10 00

WATER UTILITIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work may include installation of various water mains, water services, fire services, fire hydrants, tracer wire, water valves and boxes, elbows, and all related equipment, appurtenances, and fittings in accordance with the requirements of the Contract Documents.

1.2 RELATED REQUIREMENTS

A. City Standard Detail Drawings for Water System.

1.3 REFERENCES

A. American Water Works Association (AWWA)

B. American Society for Testing and Materials (ASTM)

C. State Specifications

D. National Fire Protection Association (NFPA)

E. Uniform Plumbing Code (UPC)

F. Uniform Building Code (UBC)

G. San Mateo County Ordinance Code, Title 4 Sanitation and Health

1.4 QUALITY ASSURANCE

A. All work shall be done to the satisfaction of the City.

B. Class of pipe requirements shown or called for on the plans shall be the minimum acceptable.

C. Water mains, services, and appurtenances shall be subject to hydrostatic and leakage tests.

D. Water mains, services, and appurtenances shall be disinfected by the Contractor prior to connecting to existing systems.

E. The maximum allowable deflection (out of roundness) of PVC pipe under superimposed load shall be 75% of the manufacturers recommended maximum.

F. All materials and equipment furnished under this Section shall:

1. Be of a manufacturer who has been regularly engaged in the design and manufacture of the materials and equipment for at least five (5) years meeting the standards of the American Water Works Association; and
2. Be demonstrated to the satisfaction of the Engineer that the quality is equal to the materials and equipment made by those manufacturers specifically named herein, if an alternate product manufacturer is proposed.

1.5 SUBMITTALS

A. Shop Drawings
   1. Layouts and Schematics: Contractor shall submit detailed installation drawings to the Engineer of all piping and connected equipment for pump stations, valve pits, reservoirs and tanks. The drawings shall include all pipes, fittings, valves, and other appurtenances.
   2. Layouts for all main connections after verification of field conditions and utility locations. USA (811 / Dig Alert) notifications must be submitted.

B. Shutdowns and Connections
   1. Contractor shall submit to the Engineer a list and schematics of all required water system connections and shutdowns for the project.
   2. For all shutdowns, the City must receive the water shutdown request in writing from the Contractor at least six (6) working days prior to the anticipated date of the water shutdown.
   3. The Contractor shall prepare the required number of door hanger notices supplied by the City and distribute the notices. Completed door hangers must be posted forty-eight 48-hours (minimum) prior to scheduled shutdown in order to proceed.
   4. Refer to Paragraph 3.10. Construction Procedure, Connections and Water System Shutdowns for more information.

C. Compliance
   1. Submit data and affidavits to show that each water system component conforms to the specification requirements.
   2. Submit certified test reports as required by these specifications.
   3. Disinfection Schedule and Procedures including:
      a. Disinfection schedule, including number and type of services and length of disruption of service.
      b. Procedures to be followed, including list of equipment to be used and disinfecting agent to be used.

D. Manuals
   1. The Contractor shall furnish manufacturer's installation and operation manuals, bulletins, and spare parts lists for all operating components of the water system project, including:
      a. All valves
      b. Air release valves

E. Materials
   1. Submittals shall be approved before the installation of the materials.

1.6 POTHOLING

A. Potholing is to be done by hand or vacuum type equipment.

PART 2 - PRODUCTS

2.1 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. All materials shall be properly and safely stored to protect from damage, vandalism and contamination.

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.

D. Only the products listed under the specified material for hydrants, buried iron-body gate valves or butterfly valves will be accepted.

2.2 WARNING TAPE AND WIRE

A. Warning Tape and Tracer Wire: Installation shall be in accordance with City Standard Drawing ST-06B "Trench Construction for Water Mains".

B. Warning Tape shall be 3-inch wide "Blue" color for with an overall minimum thickness of 6 mil and a solid aluminum foil core with minimum thickness of 3 mil. The solid foil core shall be encased between two clear layers of 100% virgin polypropylene or polyethylene film. Warning Tape shall be permanently printed on both sides with a repeating warning "Caution: Water Pipe Below" at maximum interval of 2 feet. Warning Tape shall be placed 1 foot above the top of pipe.

C. Tracer wire shall be 8 AWG Solid Copper conductor with a 45 mil thick, high-density, high molecular weight polyethylene (HDPE) insulation and rated for 600 volts. Insulation shall be RoHS compliant and utilize virgin grade material. Jacket shall be "Blue" color for water utilities application. Tracer wire shall be placed in the same orientation to all installed pipe, and taped to the pipe using a spacer every 8-10 feet on top of the pipe.

2.3 FIRE HYDRANTS

A. Hydrant shall be manufactured in accordance with AWWA Standard C-503. Hydrant head shall be made of gray cast iron, meeting ASTM A126 Class B specifications. It shall be capable of withstanding a hydrostatic test pressure of 4 (four) times the working water pressure without stressing the material beyond its yield point per Section 4.6.3.2 of AWWA C-503. The working parts shall be engineered to function as a unit and to give trouble-free service over 250 pounds working pressure and tested to 400 pounds hydrostatic pressure.

B. Hydrants shall be wet-barrel with independently valved ports, with one four and one-half inch (4-1/2") outlet and two (2) two and one-half inch (2-1/2") outlets. Hydrants shall have the proper color-coded caps to conform to NFPA Standard 291. **Nylon Hydrant Caps shall have Permanent Color Coding for the 4-1/4" cap** - permanent color pigments are added to the plastic resin for through color. A choice of color code is determined by hydrant flow. Hydrant caps are to be enhanced with the addition of adhesive reflective trim of same cap color for improved nighttime visibility. Caps shall be securely chained to the hydrant barrel and furnished with an inner gasket.

C. All hydrants shall be permanently marked to identify the model number of the hydrant, the manufacturer and the year in which the hydrant was manufactured.

D. Hose and pumper nozzle threads shall be in conformance with the standard for fire hose connections, NFPA 1963, unless otherwise specified.

E. Standard nut size of valve/stem and protector caps shall be of pentagonal shape and furnished with a nut of one and one-eighth inch (1 1/8") measured from point to flat of the pentagon.

F. Hydrant installation shall include "Break-off" spool and "Break-off" bolts.

G. Exterior of hydrants shall receive a primer coat and furnished with a high gloss **"Safety Yellow"** industrial enamel finish coat. Rustoleum 07400 System Alkyd Enamel.

2.4 VALVE BOXES

A. Each valve shall be equipped with a valve box, complete with cover. Boxes shall be extension type with a slide type adjustment. The word "WATER" shall be cast on the cover. The boxes shall be adapted without full extension to the depth of cover required over the pipe at the valve location. Christy #G-5 traffic valve box shall be used in streets and sidewalks ". Valve boxes and valve box lids shall be of matching brand, type and model.

B. Sleeves or tubes for all valve and valve box identifications shall be eight inch (8") PVC, Schedule 40, one piece, and shall rise to six inches (6") below street, sidewalk or finish grade.

2.5 RAISING RINGS FOR TRAFFIC VALVE BOXES

A. Adjusting rings shall not be used. Valve boxes must be raised to grade. Risers are to be replaced if and when necessary to conform with final grade.

2.6 CONCRETE FOR THRUST BLOCKS

A. Concrete for thrust blocks shall not be hand mixed.

B. Couplings shall conform to AWWA C 219, "Bolted, Sleeve-Type Couplings for Plain-end Pipe," and to AWWA C 111, "Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings".

C. Couplings shall be made of ductile iron conforming to ASTM A536. Gasket shall be of virgin compounded rubber. Couplings shall have 304 stainless steel bolts and nuts supplied by manufacturer.

D. Couplings shall be Tyler/Union Ductile Iron C153 Full Body Mechanical Joint Solid Sleeve or equal and shall incorporate an approved restraint.

E. Manufacturer: Smith Blair or approved equal.

2.7 TAPPING SLEEVE

A. Tapping sleeve shall have a stainless steel body with a flat-faced flanged outlet recessed for a standard tapping valve, conforming to AWWA C 207, "Steel Pipe Flanges for Waterworks Service" - sizes four inch (4") through one hundred forty-four inch (144"), Class D (150-175 psig). Drilling boltholes shall straddle the pipe centerline. For tap sizes, fourteen inch (14") and above, flange shall accommodate the valve requirements.

B. Sleeve shall have a 3/4" N.P.T. test plug, and a roll-resistant gasket resistant to oil, water and most hydrocarbon fluids.

C. Sleeve shall be with Type 304 stainless steel bolts and nuts.

D. Sleeves shall be Smith-Blair #663.

2.8 VALVE STEM EXTENSIONS

Stem extensions shall be steel. Minimum effective length of the three-piece extension shall be eight inches (8").

2.9 APPURTENANCES

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

3.1 TRENCH EXCAVATION AND BACKFILL

Trench excavation and backfill shall be in accordance with City Technical Specifications Section 31 23 33 "Trench Excavation and Backfill" and City Standard Drawing ST-06B "Trench Construction for Water Mains", or as noted on the contract documents and plans.

3.2 HYDROSTATIC TESTING

A. General

1. A certified Distribution System Operator must be present for all hydrostatic testing, chlorination, flushing, bacteria testing and connections to the existing system per California Department of Health Services, Operator Certification Regulations, Section 63770. The Engineer must receive the request for the certified Operators to be present for these operations in writing no less than six (6) working days prior to the anticipated date of work.
2. The Contractor shall give a minimum of six (6) working days written notice to both the Engineer and the City Water Division to schedule filling and testing of the pipeline.
3. When feasible, piping shall be hydrostatic tested prior to backfill placement.
4. Testing shall be in accordance with AWWA C604. Selected requirements of AWWA C600 are repeated below:
    a. Test pressure shall not exceed pipe or thrust-restraint design pressures.
    b. The hydrostatic test shall be of at least a 2-hour duration.
    c. Pipe with cement mortar lining should be filled 24-hours in advance to allow for saturation of the cement mortar.
    d. Test pressure shall not vary by more than +/- 5 psi for the duration of the test.
    e. No piping shall be accepted if the makeup water is greater than 10 gal per inch diameter per mile of pipe per 24 hours.
    f. Any visible leaks shall be basis for failure. Visible leaks shall be repaired regardless of the makeup water volume, and the hydrostatic test shall be restarted.
5. Valves shall not be operated in either direction at a differential pressure exceeding the rated valve working pressure. Use of a test pressure greater than the rated valve pressure can result in trapped test pressure between the gates of a double-disc gate valve.
6. The test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.

B. Before Testing
1. The interior of the pipeline shall be thoroughly cleaned, and the trench backfill, except permanent pavement, shall be completed.
2. The concrete thrust or reaction blocks shall be cured for at least seven (7) calendar days.

C. Test Equipment Set-Up
1. Contractor shall furnish hoses, pumps, pressure gauges, leakage-measuring device, connections, relief valves, other necessary apparatus, and personnel required for making the tests.
2. The pressure gauge shall register pressure in pounds per square inch gauge (psig). The range of the gauge shall be from zero to three hundred pounds per square inch gauge (0-300 psig). The gauge face shall have a five (5) psig increment inscribed. The gauge shall have been calibrated within forty-five (45) calendar days of the hydrostatic test and the calibration tag shall be affixed to the gauge.
3. The gauge assembly shall be equipped with three-quarter inch (3/4") IPT nipple and isolation valve to allow the Engineer to install a second gauge.
4. The City may test pressure gauges for accuracy.

D. Pressurization.

1. After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure with a minimum of 200 psig at the point of testing.
2. Test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section.
3. Each valve section of pipe shall be slowly filled with water.
4. Before applying the specified test pressure, air shall be expelled completely from the section of pipe under test. If permanent air vents are not located at all high points, corporation cocks shall be installed at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied.
5. Allow water to stand in the pipe for 24 hours before test pressure is applied.
6. During this period, valves and exposed connections shall be examined for leaks, and all visible leakage shall be repaired.

E. Hydrostatic Pressure and Leakage Test
1. The specified test pressure (based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge) shall be applied by means of a pump connected to the pipe.
2. Maintain the test pressure, +/- 5 psi, for a minimum of two (2) hours.
3. All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test.
4. Measured makeup water shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within +/- 5 psi of the specified test pressure during the test duration. Makeup water shall not be measured by a drop in pressure in a test section over a period of time.
5. For successful completion of the test, the measured makeup water shall not exceed 10 gal per inch diameter per mile of pipe per 24 hours.
6. An inspection for leaks along the pipeline shall be made by the Contractor while pipe is under pressure. Any leaks found shall be recorded by the Contractor and the record provided to the City.

F. Repairs and Retests
1. Repair all known leaks and retest the pipe until the hydrostatic pressure and leakage test is successfully completed.
2. Any damage to the protective lining and coating of the pipe and to the jointing material after the testing shall be repaired.
3. Repairs shall be made subject to the approval of the Engineer.
4. Excavate where required to locate and repair leaks or other defects that develop under the test.
5. Remove backfill and paving already placed.
6. After repairs, backfill and pave in same manner as initial work.

3.3 FLUSHING AND CHLORINATING

A. A certified Distribution System Operator must be present for all hydrostatic testing, chlorination, flushing, bacteria testing and connections to the existing system per California Department of Health Services, Operator Certification Regulations, Section 63770. The Engineer must receive the request for the for these operations in writing no less than six (6) working days prior to the anticipated date of work.

B. Flushing and chlorinating shall be conducted only after the successful completion of the hydrostatic pressure and leakage test. Flushing from the City's water system shall only be performed by using an approved Reduced Pressure (RP) type backflow device with current certification. No water shall be discharged to a sanitary sewer.

C. Contractor shall:
   1. Provide a minimum of six (6) working days written notice to both the Engineer and the City Water Division to schedule flushing and chlorinating operations. Schedule shall allow delivery of samples to the approved laboratory before 2:00 p.m., Monday through Friday, the same day samples are taken. All procedures shall conform to applicable requirements of NFPA 24.
   2. Make necessary piping connections.
      a. Install temporary blow-offs at locations designated by the Engineer.
      b. Temporary blow-offs shall permit adequate flushing of the main. The minimum size of blow-offs and minimum number of outlets shall be:

Main Diameter (inches)	Blow-Off Diameter (inches)	Outlets Required
2"	2"	1
4"	2"	1
6"	2"	1
8"	4"	2
12'	4"	3
16"	6"	4
20"	6"	8

      c. Use two and one-half inch (2-1/2") fire hose and dissipater on each outlet.
      d. All sample taps shall be copper to FIP smooth bore.
      e. Remove temporary flushing assemblies when test results are satisfactory to the Engineer.
   3. Flush and chlorinate the pipeline in accordance with AWWA C 651, "Disinfecting Water Mains." Only personnel certified to perform that operation shall perform chlorination.
      a. Use Sodium Hypochlorite per Section 4.1.2 of AWWA C 651. Available chlorine shall be twelve and one-half percent (12-1/2%) to thirteen percent (13%) by volume. Chlorine tablets shall not be used. Chlorine shall be of the type approved for the purpose of disinfection of potable water supply systems. Chlorine for use in swimming pools shall not be allowed.
      b. Use Continuous Feed Method of Section 4.4 of AWWA C 651, except the maximum allowable volume of water available for the preliminary flushing shall not exceed twice the volume of pipe to be flushed. Chlorine shall be fed through an approved flow regulated chlorine injection machine. The pipe shall be chlorinated to 25 mg/L. After a twenty-four (24) hour holding period, there shall be a free chlorine residual of no less than 10 mg/L. The contractor shall,

at the request of the City's Project Inspector, provide calculations showing the amount of chlorine introduced.

c. Document flushing and chlorination in a manner acceptable to the Engineer.

4. Connect to water source, convey to piping, and dispose of water during flushing without flooding, inundating or damaging any property, or harming the environment with the chlorinated water.

D. Upon completion of disinfection, the flushed section of main shall remain isolated from the existing water system and allowed to sit undisturbed for a minimum of twenty-four (24) hours prior to sampling for bacteriological contamination.

E. Water samples shall be taken by a State-certified laboratory for bacterial examination. Such samples shall be taken, examined, and reported on by a recognized laboratory accustomed to this work. Examination shall be conducted according to the latest edition of "Standard Methods for the Examination of Water and Wastewater", American Public Health Association. Test results shall conform to the latest edition of U.S. Public Health Service Drinking Water Standards, and so attested by the examining laboratory prior to acceptance of the water line. Costs for the above tests shall be included in the contract bid prices.

F. The above tests shall apply to each unit or branch of the water main and all of its services up to the curb stops.

G. The bacteriologically treated unit or batch may be put into service only after written City approval of test results.

3.4 CONSTRUCTION PROCEDURE, CONNECTIONS, AND WATER SYSTEM SHUTDOWNS

A. A certified Distribution System Operator must be present for all hydrostatic testing, chlorination, flushing, bacteria testing and connections to the existing system per California Department of Health Services, Operator Certification Regulations, Section 63770. The Engineer must receive the request for the for these operations in writing no less than six (6) working days prior to the anticipated date of work.

B. Construction involves expansion and/or modification of the existing water system with the minimum possible service interruption during construction.

C. Connections and utility changes must be programmed to provide the least possible interruption of service. Prior to any shutdown, all labor, materials, fittings, supports, equipment and tools needed for the scheduled work as well as emergency work shall be on the site.

D. The Contractor shall not cause any contamination of the existing water system.

E. Following testing and disinfection, the pipeline shall be connected to existing mains as indicated on the drawing. Each connection shall be made at a time and in a manner that will result in the least interruption of service.

F. The Contractor shall not operate any valve controlling the flow of water in the City's existing system.

G. All connections involving shutdown of City's existing facilities shall be done in the presence of the Engineer and the Certified Distribution System Operator. The Contractor shall complete the connection work without interruption.

H. Planned Shutdowns
   1. Shutdowns are subject to the following scheduling constraints:
      a. Shutdowns shall not be performed on a Monday, Friday nor on the first workday following a City holiday. (It is preferred that shutdowns also not be performed on the day preceding a City holiday, if possible.)
      b. Under special circumstances, and only upon approval by the City, shutdowns may be scheduled on a weekend or during non-working hours.
      c. No more than two shutdowns will be performed in any two consecutive workdays.
      d. All shutdowns shall be scheduled to be performed between the hours of 9:00 a.m. and 3:00 p.m., inclusive, unless prior approval for deviation from these hours has been granted by the Engineer. Shutdowns are scheduled for four (4) hour durations. Additional time may be granted on a case by case basis.
   2. Prior to the start of any construction, Contractor shall submit a schedule of all planned shutdowns required for completion of project and shall indicate anticipated date, work to be performed, and estimated duration of work. In any case, the Water Division will receive a minimum of 48 hours prior notice before a shut down.
   3. The Engineer must receive the water shutdown request in writing from the Contractor at least six (6) working days prior to the anticipated date of the water shutdown.
   4. The City will review the request to ensure that the Contractor will have all materials available, and that the request complies with all provisions of the City's procedures, including the submission of required information and scheduling requirements.
   5. Upon completion of the City's review of the shutdown request, the Contractor will prepare the required number of door hanger notices supplied by the City and distribute the notices. Completed door hangers must be posted forty-eight (48) hours prior to scheduled shutdown in order to proceed.
   6. All excavations required to make the connection must be completed and approved at least twelve (12) hours prior to the scheduled shutdown. The City will not perform the actual shutdown until the Contractor is on-site and ready to work. If the Contractor is not on-site and ready to proceed within sixty (60) minutes of the scheduled start, the shutdown will be canceled. The Contractor will be billed for the City's work on a time and materials basis.
   7. If the shutdown is canceled or cannot be performed, the Contractor will notify the Engineer at least twenty-four (24) hours in advance of the requested shutdown date. If the new date of shutdown is known and the area remains the same, notice of the new date can be given at this time followed by written confirmation by Contractor. Re-notification to the public must be performed by the Contractor per Paragraph 4 above.
   8. Upon completion and approval of the work, the Contractor shall notify the Engineer to reactivate the water system.

3.5 VALVE BOXES

A. Valve boxes in the street shall be set in a poured concrete collar, at least nine inches (9") wide by six inches (6") deep. The top of the concrete shall be covered by one and one-half inches (1-1/2") of asphalt concrete.

B. Extension tubes are to be centered over the operating nut and brought to 6 inches (6”) of final grade.

C. Set boxes to grade within five (5) working days after paving of streets. Boxes are to be set flush with the road surface.

D. Valve stem extensions shall be assembled and installed as per manufacturer's recommendation.

3.6 ABANDONMENT OF EXISTING FACILITIES

A. Valve Boxes
   1. Planted areas: Remove box and cover. Fill any hole or depression with similar type of dirt at the specific location.
   2. Sidewalk areas: Remove box. Remove full flag of affected sidewalk. Pour concrete and finish to match that of the existing sidewalk.
   3. Street areas (AC): Remove box. Neatly sawcut appropriate area that shall be determined by the Engineer in the field. Restore subgrade, base and pavement according to City specifications.

B. Two-Inch (2") and Three-Inch (3") Steel Pipes as Local Feeders/Services
   1. Remove old fittings, pipe, and saddle at main pipe or fitting.
   2. Install specified full circle clamp coupling over former tap on pipe, or install new plugs in tapped tee or cross.
   3. Restore street and/or sidewalk to its former condition or better.

C. Four-Inch (4") and Larger Connections
   1. Remove tee from existing main and replace it with same diameter ductile-iron pipe, two feet (2’) longer than existing tee. Use specified restrained sleeve type couplings.
   2. Removal may include an adjacent in-line valve, which the Contractor shall replace with a valve.
   3. Restore street and/or sidewalk to its former condition or better.

D. Fire Hydrants
   1. Remove hydrant and bury. Plug remaining pipe with concrete.
   2. Remove tee from existing main and replace it with same diameter ductile iron pipe, two feet (2’) longer than existing tee. Use specified restrained sleeve type couplings, or approved equal.

3.7 REAPIR/RESTORATION OF PROPERTY

A. Any repair or restoration work resulting from Contractor's activity shall be completed within twenty-four (24) hours. Contractor may use the sod saved from the existing lawn or use new sod/seed to match existing lawn. Any concrete or other repair shall match existing. Contractor shall maintain the new planting for a minimum thirty (30) day period.

B. All new or relocated fire hydrants shall be provided with one new finish coat of paint and a blue reflective indicator securely fastened by two-part epoxy in the center line of

the street and aligned with the hydrant for ease of Fire Department locating prior to the Contractor making a request for "punch list" preparation by the City.

3.8 PIPE ABANDONMENT

Where an existing line is to be abandoned, pipe shall be cut and pipe ends shall be plugged with concrete. If portions of the line to be abandoned are depressurized only by the closure of a valve or valves, then the line shall be capped with appropriate sized restrained Mechanical Joint caps and a thrust block shall be poured.

3.9 AS-BUILT DRAWINGS

As-built drawings for all City projects shall be updated daily and shall be made available to the Engineer upon request. Location of all valves and other water system appurtenances, as specified by the Engineer, shall be verified by a licensed surveyor and shall be incorporated into the as-builts at the expense of the Contractor. At the completion of the project, the as-built drawings shall be submitted to the Engineer together with an electronic copy of the as-builds in a form acceptable to the City of San Bruno Public Works Department, Engineering Division.

++ END OF SECTION ++

SECTION 33 31 50

TEMPORARY BYPASS PUMPING

PART 1 - GENERAL

1.1 GENERAL

A. Scope: This Section covers temporary bypass pumping requirements, required of the CONTRACTOR that shall apply during construction, including but not limited to furnishing all materials, labor, equipment, power, maintenance, etc. to implement a temporary pumping system for the purpose of potable water distribution for the duration necessary to complete the work. Only two each 8-hour shutdowns are allowable per site to offer any mechanical or electrical work that disrupts normal pumping operation; one to implement the bypass, and one to remove it and place the new infrastructure in service.

B. Bypass pump skids, temporary piping, and temporary electrical are to be disposed of at the end of the project by the CONTRACTOR. The OWNER will not take possession of any temporary pump skids or the associated infrastructure after the project.

C. The CONTRACTOR shall inform all Subcontractors and manufacturers of the requirements herein and include the required services in their costs for the work specified in these Contract Documents.

D. The design, installation and successful operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

E. The pumping system shall be suitable for use with potable water and shall have never been used with anything other than potable water.

F. Protect exposed piping by capping ends during bypass pumping.

G. Scheduling:
   1. Temporary bypass pumping is requisite to satisfactory completion of the Contract and, therefore, shall be completed within the contract time.
   2. All temporary bypass pumping activities shall be realistically accounted for and shown on the CONTRACTOR's Construction Schedule.
   3. Bypass pumping shall not commence until all mechanical and all electrical equipment necessary for a complete installation of an operational pump station system has been procured to limit the duration of the shutdown.

H. Work specified herein shall also be coordinated with Section 02 41 03 - 3.3 Sequencing of Demolition work.

1.2 REFERENCES

1. 33 10 00 – Water Utilities
2. 02 41 03 – Demolition
3. 26 00 10 – Electrical General
4. 40 05 10 – Pipe and Fittings

5. 40 05 33.02 – HDPE Pressure Pipe (HDPE2)

1.3 SUBMITTALS

A. Temporary Bypass Pumping Plan:
   1. Not less than 1 month prior to CONTRACTOR's intended start of temporary bypass pumping, the CONTRACTOR shall submit a detailed Temporary Bypass Pumping Plan to the ENGINEER for review.
   2. Temporary Bypass Pumping shall not commence without written approval of the plan from the ENGINEER.
   3. The Temporary Bypass Pumping Plan shall include:
      a. Detailed description of the Temporary Bypass Pumping Plan, including a drawing identifying suction connection, suction piping, pump, discharge piping, and discharge connection details.
      b. CONTRACTOR's emergency contact information for any/all repair, fueling, or maintenance emergencies which may arise during bypass operations.

B. Permits
   1. CONTRACTOR shall work with the manufacturer to get the appropriate permits that shall be provided as a submittal.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials in contact with water shall meet ANSI/NSF-61 requirements.

B. All bypass piping shall be fusion bonded High Density Polyethylene (HDPE) SDR 9.

C. Piping diameter: Determined according to pump size and flow calculations following manufacturer's specifications and recommendations.

D. Reducers necessary to connect temp piping to pump station piping locations designated on drawings.

E. Permanent bypass piping connections are provided in the mechanical design. This connections should be installed and implemented during the 8 hour shutdown. The connections provided in the design are 8" diameter Victaulic couplings.

2.2 SCADA MONITORING

A. The following criteria is applicable for each project site.

B. Design Criteria
   1. Re-use existing PLC control panel and instrumentation to provide temporary pump controls.
   2. Locate existing control panel near the temporary bypass pump controls.
   3. Provide communications to SCADA using existing ISP communications system.
   4. Furnish continuous power for existing control panel from temporary pump system.
      a. 120 VAC, 75W continuous

5. Reconnect and extend existing communications lines to new temporary control panel location: (lengthen cables as required for connection)
    a. Cable Modem from City Cable TV provider
    b. Serial radio antenna.
6. Connect up to 30 I/O points for each site. Minimum I/O as noted below.
    a. Digital Inputs:
        1) Pump Running for each pump
        2) Pump in auto for each pump
        3) Alarms for each pump
        4) Station Power Fail
        5) Tank low level (2) (Lake only)
        6) Intrusion alarms (2)
    b. Digital Outputs:
        1) Pump Start for each pump
    c. Analog Inputs:
        1) Station Flow
        2) Tank Levels (2) (Lake only)
        3) Suction Pressure
        4) Discharge Pressure
        5) Chlorine Residual

2.3 SNEATH PUMP STATION PORTABLE PUMP TRAILER

A. Design Criteria
    1. Design Point: 1,400 gpm at 210 psi discharge (includes the 65 psi inlet pressure)
    2. Inlet pressure: 65 psi

B. Engine with 200 gallon diesel fuel capacity

C. Mounted on GL14 trailer

D. ANSI/ NSF 61 certification or documentation of ANSI/ NSF 61 approved materials for all wetted surfaces

E. Provide noise attenuation system for pumps producing noise louder than 60 dBA at 30 feet from pump.

F. Discharge Wafer check valve

2.4 LAKE PUMP STATION PORTABLE PUMP TRAILER

A. Design Criteria
    1. Design Point: 600 gpm at 223 psi discharge (includes the 7 psi inlet pressure)
    2. Inlet pressure: 7 psi

B. Engine with 200 gallon diesel fuel capacity

C. Mounted on GL14 trailer

D. ANSI/ NSF 61 certification or documentation of ANSI/ NSF 61 approved materials for all wetted surfaces

E. Provide noise attenuation system for pumps producing noise louder than 60 dBA at 30 feet from pump.

F. Discharge Wafer check valve

2.5 MANUFACTURER

A. Provide a system manufactured by a company providing portable potable water pumping systems for at least five years.

B. Manufacturers
   1. Pac Machine Company
   2. Global Pump

PART 3 - EXECUTION

3.1 INSTALLATION AND REMOVAL

A. Provisions and requirements must be approved by OWNER before implementation.

B. OWNER shall be notified of the schedule and present during installation of Bypass Pumping system.

C. Make connections to existing pipes as indicated on ENGINEER approved Drawings. OWNER to operate valves.

D. Prior to placing the bypass system into service, all bypass piping and equipment shall be hydrostatic tested and disinfected in accordance with the requirements of Specification 33 10 00.

E. Start-up and test existing control panel with temporary system.
   1. Test each I/O point for operation.
   2. Test communication system and connection to SCADA.
   3. Confirm automatic operation.
   4. Confirm alarms are received at SCADA.

3.2 OPERATION OF THE BYPASS SYSTEM

A. CONTRACTOR shall have sole responsibility for maintenance and fueling of the bypass system. During the operation of the bypass, the fuel level shall never drop below 25% of the storage tanks capacity.

B. The OWNER shall utilize certified distribution operators to operate and monitor the bypass pumps via SCADA.

C. During operation of the bypass pumps, CONTRACTOR shall have staff on standby at all times for maintenance and repairs as necessary to ensure a fully operational system for the entire bypass duration.

D. CONTRACTOR shall supply temporary security fencing to protect the bypass pumps and infrastructure for the duration of the bypass.

3.3 REMOVAL OF THE BYPASS SYSTEM

A. Upon CONTRACTOR's completion of startup and testing of all new pump station infrastructure, and OWNER's acceptance of all testing/disinfection documentation, CONTRACTOR shall disconnect bypass system from camlock bypass connections shown on the drawings.
   1. All camlock bypass connections shall receive dust caps.

B. CONTRACTOR shall remove from the site all pump skids, temporary piping, temporary electrical, and temporary fencing; and restore the surrounding area to match existing conditions or improvements shown on the contract drawings.

++ END OF SECTION ++

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SECTION 40 05 06

PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Shop Drawings:
   1. Manufacturer's data on materials, construction, end connections, ratings, overall lengths, etc.

PART 2 - PRODUCTS

2.1 FLEXIBLE COUPLINGS (FC)

A. Features:
   1. Description: Sleeve-type flexible couplings.
   2. Pressure and Service: Same as connected piping.
   3. Sleeve and Follower material: Ductile iron or steel.
   4. Coating and Lining: End and center rings shall be epoxy lined and coated, minimum 16 mils thickness. For potable water service, lining shall be NSF-61 certified.
   5. Gasket: EPDM
   6. Bolts and Nuts: Alloy steel, corrosion-resistant, prime coated. Buried couplings shall have Type 316 stainless steel bolts and nuts.

B. Manufacturers and Products:
   1. Romac;
      a. Style 501 (2-inch through 24-inch)
      b. Style 400 (12-inch through 96-inch)
   2. Dresser Piping Specialties; Style 38
   3. Smith-Blair, Inc.; Style 411.
   4. Or Equal.

2.2 FLANGED COUPLING ADAPTERS (FCA)

A. Features:
   1. Description: Sleeve-type flexible couplings with flange on one end.
   2. Pressure and Service: Same as connected piping.
   3. Adapter body material: Ductile iron or steel.
   4. Coating and Lining: End and center rings shall be epoxy lined and coated, minimum 16 mils thickness. For potable water service, lining shall be NSF-61 certified.
   5. Gasket: EPDM
   6. Bolts and Nuts: Alloy steel, corrosion-resistant, prime coated. Buried couplings shall have Type 316 stainless steel bolts and nuts.

B. Manufacturers and Products:
   1. Romac;
      a. Style FCA 501 (3-inch through 16-inch)

2. Dresser Piping Specialties; Style 227.
3. Smith-Blair, Inc.; Style 127.
4. Or Equal.

2.3 JOINT RESTRAINT HARNESSES AND TIE RODS

A. Features:
   1. Harness Lugs:
      a. Description: Steel harness lug installed on back side of flanges to allow tie rods to span across unrestrained piping components.
      b. Materials: ASTM A36 steel for all piping except stainless steel. Stainless steel for stainless steel piping, SST grade to match pipe flange.
      c. Profile Shape: Three-hole triangular or rectangular profile shape cut with plasma arc or oxy-fuel. Holes plasma arc cut or drilled.
      d. Coating: Fusion bonded epoxy. NSF 61 certified when in contact with potable water.
      e. Flange Compatibility: Coordinate lug style with pipe flange bolt pattern.
   2. Harness Restraint Rings (for 6-inch through 144-inch pipe):
      a. Description: AWWA M11 steel harness restraint ring welded to steel or stainless steel pipe to allow tie rods to span across unrestrained piping components.
      b. Materials: ASTM A36 or A283 Grade C steel for all piping except stainless steel. Stainless steel for stainless steel piping, SST grade to match pipe flange.
      c. Ring Tolerance: 3/16 inch (on diameter) clearance between the specified pipe O.D. up through 24 inch piping, and 1/4 inch clearance for pipes larger than 24 inch.
      d. Coating: Bare, to be field coated with pipe after installation.
   3. Tie Rods and Hardware:
      a. Provide ASTM A193 Grade B7 all thread rods, in multiples of two rods per joint.
      b. Provide two ASTM A194 Grade 2H nuts at each end of tie rod.
      c. Provide ASTM A194 Grade 2H washers between nuts and harness lugs or plates.

B. Manufacturers:
   1. Romac
   2. Trumbull
   3. Or equal

2.4 FLEXIBLE EXPANSION JOINTS

A. Service: Water.

B. Features:
   1. Flexible expansion joints shall be installed in the locations indicated on the drawings and shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53. Foundry certification of material shall be readily available upon request.
   2. Each flexible expansion joint shall be pressure tested prior to shipment against it's own restraint to a minimum of 250 PSI. A minimum 2:1 safety factor, determined from the published pressure rating, shall apply.
   3. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of:

a. 25º
b. 4" - 8"; 20º
c. 10" - 12"; 15º
d. 6-inches minimum expansion.

The flexible expansion fitting shall not expand or exert an axial imparting thrust under internal water pressure. The flexible expansion fitting shall not increase or decrease the internal water volume as the unit expands or contracts.

4. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61.
5. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.
6. Polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.

C. Manufacturer and Products:
1. FLEX-TEND, manufactured by EBAA Iron, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General
1. Follow all manufacturer's directions

B. Thrust Restraint for Unrestrained Couplings:
1. Provide thrust restraint for the following coupling types, as shown on the Drawings.
a. Flexible couplings
b. Flanged coupling adapters
2. If no thrust restraint is shown on the Drawings, but pipe schedule indicates a test pressure greater than zero, notify ENGINEER to request appropriate thrust restraint detail.

C. Flexible Couplings
1. Follow all manufacturer's directions
2. No more than 1-inch gap between pipe ends
3. Center flexible coupling in joint
4. Tighten bolts in an alternating pattern to provide even tension around the coupling
5. Tighten bolts to specified torque
6. In buried installations, wrap coupling with plastic fastened to pipe to protect bolts and coupling from backfill material

D. Flanged Coupling Adapters
1. Follow all manufacturer's directions
2. No more than 1-inch gap between pipe plain end and flange face
3. Tighten flange bolts prior to tightening coupling bolts
4. Tighten bolts in an alternating pattern to provide even tension around the coupling
5. Tighten bolts to specified torque

6. In buried installations, wrap coupling with plastic fastened to pipe to protect bolts and coupling from backfill material

++ END OF SECTION ++

SECTION 40 05 07

PIPING SUPPORT SYSTEMS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Shop Drawings:
   1. Details of each pipe support type used.

PART 2 - PRODUCTS

2.1 SUPPORT SYSTEMS:

A. Channel-type support systems
   1. 304 Stainless Steel
      a. Unistrut
      b. B-Line
      c. Or Equal.
   2. Non-metallic
      a. Aikenstrut
      b. CLIC
      c. Or Equal.

B. Hanger- and Clevis-type support systems
   1. B-line
   2. Anvil
   3. Or Equal

C. Stanchion-type support systems
   1. B-Line
   2. Anvil
   3. Or Equal

D. Adjustable Pipe Saddle Support
   1. B-Line, Figure B-3092
   2. Or Equal

E. Flange Mounted Pipe Support
   1. B-Line B-3094
   2. Or Equal

F. Wall Bracket (4-inch to 6-inch pipe)
   1. B-Line Figure B-3068 Light Duty Angle Bracket
   2. Or Equal

G. Wall Bracket (8-inch to 12-inch pipe)
   1. B-Line Figure B-3066 Medium Duty Angle Bracket

2. Or Equal

H. Wall Bracket (14-inch to 24-inch pipe)
   1. B-Line Figure B-3067 Heavy Duty Angle Bracket
   2. Or Equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. In addition to the pipe supports specifically called for on the drawings, CONTRACTOR shall provide pipe supports as required to fully support all piping systems.

B. CONTRACTOR shall design, supply and install pipe support system using manufacturer's standard available pipe support hardware.

C. Pipe supports shall, at a minimum, be installed at the following locations:
   1. On both sides of each valve, piece of equipment or other appurtenance, such that allowance is made for removal of the valve, piece of equipment, or other appurtenance while leaving the pipe system fully supported. Support piping connections to equipment by pipe support and not by the equipment.
   2. Along straight runs of pipe, the maximum distance between supports shall be as listed below:

Pipe Diameter	Maximum Distance Between Supports	Minimum Hanger Rod Diameter (if Hanger Rods are used)
2" and smaller	6-feet	½"
2-1/2" to 6"	8-feet	¾"
8" to 12"	10-feet	2 @ ¾"
14" to 18"	10-feet	2 @ 1"
Over 18"	Custom Design	

   3. Directly supporting valves 8-inch in diameter and larger.
   4. At least two supports on each side of flexible couplings or flanged coupling adapters to provide that no load is applied to the flexible coupling.
   5. On the pipe within two pipe diameters of each side of elbows and each branch of tees and crosses.
   6. Where piping passes through walls, such that no load is transferred to the wall.

D. Install support systems in accordance with MSS SP 69, Pipe Hangers and Supports-Selection and Application and MSS SP 89, Pipe Hangers and Supports-Fabrication and Installation, unless shown otherwise.
   1. Support no pipe from the pipe above it.
   2. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.

E. Bracing and lateral support:
   1. Provide lateral sway bracing on 10-foot maximum centers
      a. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing.

2. Install lateral supports for seismic loads at all changes in direction.

F. Thermal expansion and thrust restraint
   1. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.

G. Support types:
   1. Horizontal Suspended Piping:
      a. Single Pipes: Adjustable swivel-ring, splint-ring or clevis hangers.
      b. Grouped Pipes: Trapeze hanger systems.
      c. For insulated piping, furnish galvanized steel protection shields, welding insulation saddles, or precut sections of rigid insulation (with vapor barrier) at all hanger locations.
   2. Horizontal Piping Supported From Walls:
      a. Single Pipes: Wall brackets or wall clips attached to wall with anchors. Clips attached to wall-mounted framing also acceptable.
      b. Stacked Piping:
         1) Wall-mounted framing system and clips acceptable for piping smaller than 3-inch minimal diameter.
         2) Piping clamps that resist axial movement of pipe through support not acceptable.
      c. Insulated piping shall have the insulation removed in the vicinity of wall brackets and piping clips to allow only direct pipe wall contact with the support system.
   3. Horizontal Piping Supported From Floors:
      a. Stanchion Type:
         1) Pedestal type; adjustable with stanchion, saddle, and anchoring flange.
         2) Use yoked saddles for piping whose centerline elevation is 18 inches or greater above the floor and for all exterior installations.
         3) Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation.
      b. Floor-Mounted Channel Supports:
         1) Use for piping smaller than 3-inch nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal pipe supports.
         2) Attach channel framing to floors with anchor bolts.
         3) Attach pipe to channel with clips or pipe clamps.
      c. Concrete Cradles:
         1) Use for piping larger than 3-inch along floor and in trenches at piping elevations lower than can be accommodated using stanchion type.
   4. Vertical Pipe:
      a. Support with wall brackets and base elbow or riser clamps on floor penetrations.
      b. Insulated piping shall have the insulation removed in the vicinity of wall brackets and riser clamps, to allow only direct wall contact with the support system.

H. Standard Attachments:
   1. To Concrete Ceilings: Concrete inserts.
   2. To Steel Beams: I-beam clamp or welded attachments.
   3. To Wooden Beams: Lag screws and angle clips to members not less than 2-1/2 inches thick.
   4. To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.

5. Existing Walls and Ceilings: Install as specified for new construction, unless shown otherwise.
6. Repair mounting surfaces to original condition after attachments are made.

I. Isolation:
1. Install elastomeric inserts designed to isolate piping from pipe supports where copper pipe is run in stainless steel supports, or where other dissimilar metals are in contact with pipe supports.

J. Materials:
1. Channel-type, hanger-type and trapeze-type support systems and pipe racks constructed of channel systems:
   a. Provide non-metallic support systems in all chemical storage and feed areas or as otherwise noted on the Drawings. Provide type 316 stainless steel fasteners.
   b. Provide type 304 stainless steel support systems and fasteners in all other areas.
2. Stanchion-type support systems
   a. Provide steel and ductile iron stanchion components
   b. Coat stanchions after assembly per specification Section 09 91 03, Painting.

++ END OF SECTION ++

SECTION 40 05 10

PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Shop Drawings:
   1. Product data sheets for each piping system.
      a. Include information on pipe, fittings and joint systems.
   2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
   3. Complete descriptions and data for all coatings and linings.
   4. Tests and inspection data for pipe and coatings/linings.
   5. Qualifications for welders and/or technicians performing joining processes that requires specialized equipment to perform the work or as specifically identified herein.

B. Operation and Maintenance Data as specified in Submittal Procedures section of these specifications.

1.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. In accordance with manufacturer's directions.

PART 2 - PRODUCTS

2.1 PIPING SYSTEM DATA SHEETS

A. Piping system data sheets (PSDS) have been attached to this Specification and are incorporated herein by reference. Provide piping systems in accordance with piping system data sheets.

2.2 THRUST RESTRAINT

A. Provide rigid or restrained joints and fittings for all piping systems specified with a test pressure in the Pipe Schedule.

B. Unless otherwise specified in the Pipe Schedule or shown on the Drawings, thrust blocks shall not be used.

PART 3 - EXECUTION

3.1 PIPE SCHEDULE

A. A Pipe Schedule is included in the Specifications and is incorporated herein by reference. Install piping systems in accordance with Pipe Schedule.

B. For pipe which is shown on the Drawings, but not referenced in the Pipe Schedule, CONTRACTOR to provide pipe material and fittings which are appropriate for the intended service and acceptable to the ENGINEER.

3.2 PREPARATION

A. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.

B. Repair any coatings or linings which were damaged during shipping and handling using manufacturer-approved coating and lining repair materials in accordance with manufacturer's instructions.

3.3 INSTALLATION

A. General:
   1. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

B. Joint Assembly:
   1. Flanged Joints (FLG):
      a. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
      b. Follow a bolt tightening pattern which produces uniform bearing pressure.
      c. Do not over-tighten bolts. Follow manufacturer's recommendation for bolt torque.
      d. Provide gasket at every flanged joint.
      e. Provide insulating flange kit where indicated on Drawings and required in this Specification.
   2. Threaded and Coupled Joints (THR):
      a. Conform to ANSI B1.20.1.
      b. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
      c. Ream pipe ends and clean chips and burrs after threading.
      d. Make connections with not more than three threads exposed.
      e. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.
      f. PVC Threaded Joints:
         1) Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
         2) Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.
      g. HDPE Threaded Joints:
         1) Joining HDPE pipe with threaded connections is not allowed unless specifically approved by the ENGINEER
      h. Provide dielectric union or insulating coupling where indicated on Drawings and required in this Specification.
   3. Grooved-End Joints (GRV):
      a. Type: Rigid, except where joints are used to correct misalignment, to provide flexibility, and where shown otherwise, in which case provide flexible type.

b. Grooved end joints are not allowed for plastic pipes unless approved by the ENGINEER.

4. Soldered Joints (SLD):
   a. Before soldering, remove stems and washers from solder joint valves.
   b. Use only solder specified for particular service.
   c. Cut pipe ends square and remove fins and burrs.
   d. Protect adjacent surfaces from damage during soldering.
      1) Protect from high temperatures due to flame
      2) Protect from damage due to dripping flux or solder
   e. After thoroughly cleaning pipe and fitting of oil and grease using solvent and emery cloth, apply noncorrosive flux to the male end only.
   f. Solder Joint
   g. Wipe excess solder from exterior of joint before hardened.
5. Solvent Welded Joints (SLV):
   a. Use only solvent cement which is rated for use in the service intended. Check compatibility of solvent cement with service, especially in pipelines which carry chemicals.
   b. Observe all manufacturer's requirements for environmental conditions for use of solvent cement.
   c. Cut pipe ends square and remove fins and burrs.
   d. Apply appropriate primer.
   e. Apply solvent cement and assemble joint.
      1) Hold in place long enough for solvent cement to set-up and hold joint, as assembled, until solvent cement has cured.
   f. Wipe excess solvent cement from exterior of joint before hardened.
6. Proprietary Restrained Mechanical Joints (PRJ):
   a. PRJ piping shall be furnished with factory-fabricated retainer weldment on spigot end.
   b. If PRJ piping is field cut, the pipe joint shall be restrained using Restrained Mechanical Joint (RMJ) Glands. Field welding of retainer weldment will not be allowed.
7. Welded Steel and Stainless Steel Joints (WLD)
   a. Field welded joints shall be in accordance with AWWA C206
   b. Welder Qualifications:
      1) All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used.
      2) Welders shall be qualified by the CONTRACTOR under the provisions of ASME BPVC for shop welds and ANSI/AWS D1.1 for field welds.
      3) Furnish all material and bear the expense of qualifying welders.
   c. Backing rings will not be permitted for 30-inch and smaller pipe. Single field-welded butt joints with outside backing rings may be used for pipe larger than 30 inches in diameter.
   d. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.
   e. Butt Straps
      1) Butt straps shall be used as closure pieces and where shown on the Drawings.
      2) Where used or required, shall be as shown on the Contract Drawings or as approved during shop drawing review.

3) When fitting up the ends of pipe to be welded or fitting butt-strap pieces, minor jacking or clamping will be allowed. Cold working the metal and sledges or localized application of heat and working the metal and sledges will not be allowed. If field displacement of joints, where butt strap joints are indicated, does not allow proper fit-up with the tolerances indicated, special closure butt straps or mitered pieces shall be shop fabricated and installed.
4) Butt straps shall be welded on both the inside and outside of the pipe and at each end of the pipe and strap to avoid stress multiplication.

f. Prior to the backfilling or beginning the welding procedure, any tack welds or joint stops used to position the pipe during laying shall be removed. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means. The weld shall then be made in accordance with ANSI/AWWA C206. Where more than one pass is required, all dirt, slag, and flux shall be removed before the succeeding bead is applied.

g. Repair of Welds: All welds that are defective shall be repaired by the CONTRACTOR to meet the requirements of this section at no additional cost to the OWNER. Defects in welds or defective welds shall be removed, and that section of the joint shall then be re-welded. Only sufficient removal of defective material that is necessary to correct the defect is required. After the repair is made, the joint shall be checked by repeating the original test procedure. Welds deficient in size shall be repaired by adding weld metal.

8. Thermally butt fused (BF) HDPE joints

a. In general, the individual performing thermal butt fusion and electrofusion and the equipment used shall meet the requirements of the Plastic Pipe Institute (PPI), Technical Note (TN) 42, Recommended Minimum Training Guidelines for PE Pipe Butt Fusion Joining Operators and the requirements of Title 49, CFR Subpart F, 192.282 and 192.285.

b. Specific requirements that apply when joining HDPE pipe using butt fusion shall be as follows:

1) Submit documentation that the fusion technician has been qualified and trained by the fusion equipment manufacturer or pipe manufacturer in the operation and procedures of the butt fusion process. All qualifications and training shall have been received within 1-year from the date of submitting the information. If acceptable documentation cannot be provided, sample joints shall be made and tested in accordance with TN-42. If pipe wall thickness is greater than 1–inch, submit an acceptable method recommended by the pipe manufacturer that will be used to test the sample joint. All costs associated with the sample joint testing and any retesting shall be borne by the CONTRACTOR.

2) Each 2” NPS and larger butt fusion joint shall be documented using a data logging device or written log that records the following minimum parameters per completed joint:

a) Date and time
b) OWNER’s project number and/or name
c) Fusion Machine model
d) Pipe size, rating and PE type code (i.e. PE4710)
e) Heater plate surface temperature (minimum 2 values for each side of the heater plate per joint)

f) Recorded drag pressure
g) Gauge pressure and associated interfacial pressure (psi)
h) Heating time
i) Transfer time between heater plate being removed from the face of the opposing pipe ends and when the pipe ends are butted together
j) Cooling time

3) Provide log records at the end of each day in hardcopy format or as agreed upon with the OWNER and/or ENGINEER. Submit one (1) copy as a minimum to the OWNER's Representative or ENGINEER.
4) At the completion of the work, submit all data log records on a compact disc that can be accessed using the data log manufacturer's software or if using written logs, all individual written daily logs are transferred into a pdf format and identified by day as a separate file.

c. All joints that are determined to be defective visually or as a result of pressure testing shall be repaired using a thermal fusion method unless otherwise approved by the OWNER's Representative or ENGINEER.
d. Install buried HDPE pipe in accordance with ASTM D2774 and the pipe manufacturer's specific recommendations.

9. Insulating Flanges, Couplings, and Dielectric Unions:
   a. Applications: Provide insulating flange, coupling or di-electric union for all joints at the following locations:
      1) Dissimilar metal piping connections.
      2) Cathodically protected piping penetration to buildings.
      3) Submerged to unsubmerged metallic piping connections.
      4) Where required for electrically insulated connection.
   b. Installation:
      1) Insulating joints connecting immersed piping to non-immersed piping shall be installed above maximum water surface elevation.
      2) Align and install insulating joints according to manufacturer's recommendations to avoid damaging insulating materials.

C. Exposed Piping Installation:
   1. Piping Runs:
      a. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
      b. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.
   2. Supports: As specified in Piping Support Systems section of these specifications.
   3. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.
   4. Provide unions or flanges at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.
   5. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection;
   6. Install piping to allow for contraction and expansion without stressing pipe, joints, or connected equipment.
   7. Piping clearance, unless otherwise shown:
      a. Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.

b. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet 0 inch, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
c. From Adjacent Work: Minimum 1 inch from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
d. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
e. Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
f. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.
g. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

D. Buried Pipe Installation:
1. Pipe Placement:
a. Keep trench dry until pipe laying and joining are completed.
b. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
c. Prevent foreign material from entering pipe during placement.
1) Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.
d. Lay pipe upgrade with bell ends pointing in direction of laying.
e. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. Utilize a maximum of 75 percent of manufacturer's recommended allowable joint deflection.
1) If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
a) Shorter pipe lengths.
b) Fittings/bends.
f. Secure pipe which has been placed from movement or damage while placing the next section of pipe.
g. Prevent uplift and floating of pipe prior to backfilling.

E. Cleaning:
1. Following assembly and testing, and prior to disinfection and final acceptance, flush pipelines with water at 2.5 fps minimum flushing velocity until foreign matter is removed. At a minimum, flush for a period of time which will flush the entire pipeline volume three times.
a. If impractical to flush large diameter pipe at 2.5 fps, clean in-place from inside by brushing and sweeping, then flush line at lower velocity. If lower velocity is used, flush the entire pipeline volume five times.
2. Provide temporary means of removing flushing water from pipeline during flushing.
3. Provide means for removal/screening of debris from the flushing water, disposal of debris and disposal of flushing water.

3.4 TESTING

A. Pressure test piping in accordance with the Pipe Schedule, Testing of Pressure Piping Systems section of these specifications.

3.5 SUPPLEMENTS

A. The following supplements are attached to this Specification section and incorporated herein by reference:
   1. 40 05 24.03 – Piping System Data Sheet - Welded Steel Pipe (WSP)
   2. 40 05 31.03 – Piping System Data Sheet - PVC Drain, Waste and Vent Pipe (PVC)
   3. 40 05 31.05 – Piping System Data Sheet – PVC Perforated Pipe
   4. 40 05 31.21 – Piping System Data Sheet – LLDPE Tubing and Conduit (LLDPE)
   5. 40 05 33.02 – Piping System Data Sheet – HDPE Pressure Pipe (HDPE)

++ END OF SECTION ++

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SECTION 40 05 10.01

PIPE SCHEDULE

1.1 DESCRIPTION

A. General:
   1. This schedule is provided for the convenience of the CONTRACTOR. Some flow streams may be shown on the drawings, but not listed here.

B. Flow Stream IDs:
   1. BP – Temporary Bypass Piping
   2. D – Drain
   3. W – Potable Water
   4. WD - Wall Drain

C. Pipe Materials:
   1. Welded Steel Pipe (WSP)
   2. PVC Drain, Waste and Vent Pipe (PVC)
   3. PVC Perforated Pipe
   4. HDPE Pressure Pipe (HDPE)
   5. Low Density Polyethylene and Conduit (LLDPE)

D. Joint Types:
   1. FLG – Flanged
   2. GRV – Grooved End
   3. MJ – Mechanical Joint
   4. PO – Push On
   5. PRJ – Proprietary Restrained Mechanical Joint
   6. RMJ – Restrained Mechanical Joint
   7. S – Swagelok stainless steel compression type
   8. SLV – Solvent Welded Socket
   9. SLD – Soldered Socket
   10. THR – Threaded
   11. WLD – Butt Welded

E. Lining Systems:
   1. CM – Cement Mortar
   2. FBE – Fusion Bonded Epoxy

F. Coating Systems:
   1. System numbers as described in Section 09 91 03, Painting.
   2. CM – Cement Mortar
   3. FBE – Fusion Bonded Epoxy

1.2 PIPE SCHEDULE

Contractor shall install piping systems in accordance with the following pipe schedule:

SERVICE	DESCRIPTION	EXPOSURE	SIZE RANGE	MATERIAL	JOINT TYPE	TEST PRESSURE	LINING	COATING SYSTEM/ COLOR	NOTES
BP	Temp Bypass Piping	Exposed	All	HDPE	FL	250 psi	None	None	
D	Drain	Buried/Inside	All	PVC	SLV	None	None	None	
		Exposed		PVC	SLV	None	None	No. 301/ Light Blue	
W	Potable Water	Exposed	All	WSP	WLD/FL	250 psi	CM	FBE /No. 300/ Light Blue	
		Buried	All	WSP	WLD/FL	250 psi	CM	CM	
WD	Wall Drain	Buried	All	PVC Perforated	PO	None	None	None	
SA	CL2 Sample Line	Exposed	All	LLDPE w/ Conduit	S	100 psi	None	No. 301 / Light Blue	

++ END OF SECTION ++

SECTION 40 05 24.03

PIPING SYSTEM DATA SHEET – WELDED STEEL PIPE (WSP)

ITEM	DESCRIPTION
Pipe	Carbon steel ASTM A283/A283M Rev A Grade C or ASTM A285/A285M Grade C, sheet or coil, fabricated in accordance with AWWA C200, straight or spiral seam, thickness designed for 66 percent of minimum yield stress at hydrostatic test pressure, minimum thickness 1/4-inch, sizes are to be nominal outside diameters conforming to ASME B36.10M.
Linings/Coatings	Lining: Factory Applied Cement-Mortar per AWWA C205 Coating: • Exposed- Fusion Bonded Epoxy per AWWA C-213, 16 mil thickness. 3M Scotchkote 206N, or equal. Final coating per Specification Section 09 91 03 • Buried- Factory Applied Cement-Mortar Coating per AWWA C205
Joints	Full penetration butt-welded, flanged, butt strap
Fittings	Fabricated: Carbon steel fabricated from pipe in accordance with AWWA C208; elbows to have a 22.5-degree maximum miter section angle and a radius of 2.5 times the diameter, unless shown otherwise; wyes, tees, crosses, and outlets to be reinforced in accordance with AWWA M-11.
Flanges	Flat-faced, pressure class to exceed test pressure. Raised-face flanges only allowed when mating to equipment with raised-face flanges. Raised-face flanges are not allowed to mate with flat-faced flanges. AWWA C207 ring or hub, Class F minimum. Or ANSI B16.5 slip-on or weld neck, Class 250 minimum.
Bolting	• Bolts - Carbon steel ASTM A193, Grade B7 hex head bolts • Nuts - ASTM A194 hex head nuts • Washers – through-hardened, equivalent to ASTM F436 All bolts shall be installed with washers, and a maximum thread projection of 1/4".

ITEM	DESCRIPTION
Gaskets	Potable Water Service: 1/8" thick SBR. Supplier shall verify gaskets are rated for pressures matching the associated flanges. Provide full-face gaskets for flat-face flanges; flat ring gaskets for raised-face flanges.
Shop Non-Destructive Testing	1. Welds: 100 percent visually examined by CWI per ASME BPVC SEC VIII, Division 1. 2. Butt-Joint Welds: 100 percent ultrasonically examine welds or spot radiographically examine pipe in accordance with ASME BPVC SEC VIII, Div 1. 3. Fillet Welds: 100 percent examine using dye penetrant or magnetic particle inspection method in accordance with ASME BPVC SEC VIII, Division 1. 4. Groove Welds: 100 percent ultrasonically examine welds or spot radiographically examine pipe in accordance with ASME BPVC SEC VIII, Div. 1.
Inspection and Testing of Field Welded Joints	1. All field butt welds shall be inspected as soon as practicable after the welding of the field joint is completed. The Contractor furnished tester shall inspect the joint by ultrasonic methods in accordance with API Standard 1104. All welds that are defective welds, or have defects, shall be removed and that section of joint shall then be re-welded. After the repair is made, the joint shall be checked by repeating the original test procedure, at no expense to the Owner. 2. Fillet welds shall be Contractor tested by method per Magnetic Particle Inspection ASME Section VIII, Div. 1, Appendix VI, or liquid dye penetrant per ASTM E165 - Method A. Defects shall be removed, re-welded, and retested. 3. Repair of Welds: All welds that are defective shall be repaired by the Contractor to meet the requirements of the applicable sections of these specifications. Defects in welds or defective welds shall be removed, and that section of the joint shall then be re-welded. Only sufficient removal of defective material that is necessary to correct the defect is required. After the repair is made, the joint shall be checked by repeating the original test procedure. Welds deficient in size shall be repaired by adding weld metal.

++ END OF SECTION ++

40 05 31.03

PIPING SYSTEM DATA SHEET – POLYVINYL CHLORIDE DRAIN, WASTE AND VENT PIPE (PVC3)

ITEM	DESCRIPTION
Pipe	PVC Drain Waste and Vent type, ASTM D1785, Type 2110, Schedule 40.
Fittings	Schedule to match pipe above, ASTM D2665 Drain, Waste and Vent Type
Joints	Solvent socket weld except where connection to threaded valves and equipment may require future disassembly.
Solvent Cement	As recommended by the pipe and fitting manufacturer conforming to ASTM D2564.
Thread Sealant	Teflon Tape.
Special Installation Instructions for DWV Piping	1. Approximate routing as shown on drawings. Provide drain waste and vent piping to produce a complete, code-compliant drain, waste and vent system. 2. Provide and install all required fittings, adapters, etc. to produce a complete system. 3. Set piping above floor slab true and plumb. 4. Set risers in CMU walls where possible, set exposed risers as close to walls as possible. 5. Where vent stacks pass through roof, fit with flashing sleeve secured to roof. 6. Extend vents minimum 1 foot above roof.

++ END OF SECTION ++

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SECTION 40 05 31.05

PIPING SYSTEM DATA SHEET – POLYVINYL CHLORIDE PERFORATED PIPE

ITEM	DESCRIPTION
Pipe	Conform to the requirements of ASTM D2729 (3 to 6-inch).
Perforations	2 rows of ½" diameter holes every 5 inches. Rows shall be parallel to the axis of the pipe and be placed 120-degrees apart.
Fittings	Schedule to match pipe above, ASTM D2466 and ASTM D2467 Drainage Type
Joints	Solvent socket weld.
Solvent Cement	As recommended by the pipe and fitting manufacturer conforming to ASTM D2564.

++ END OF SECTION ++

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SECTION 40 05 31.21

PIPING SYSTEM DATA SHEET – LLDPE TUBING AND CONDUIT (LLDPE)

<table>
<tr><th>ITEM</th><th>DESCRIPTION</th></tr>
<tr><td>General</td><td>Provide color-coded linear low-density polyethylene (LLDPE) tubing, type and color as listed in the Pipe Schedule. Install tubing in electrical conduit for ease of installation/replacement as well as non-pressure rated secondary containment. Tubing manufacturer shall confirm chemical compatibility of tubing with chemical system being served and documentation of NSF certification.</td></tr>
<tr><td>Tubing</td><td>Tubing size references on the Drawings or in the Specifications refer to inside diameter, unless noted otherwise. Provide tubing with the following corresponding outside diameter and pressure rating where inside diameter is called for:
<table>
<tr><th>INSIDE DIAMETER</th><th>OUTSIDE DIAMETER</th><th>WORKING PRESSURE AT 70 DEG. F</th></tr>
<tr><td>1/4”</td><td>3/8”</td><td>214 psi</td></tr>
<tr><td>3/8”</td><td>1/2”</td><td>153 psi</td></tr>
<tr><td>1/2”</td><td>5/8”</td><td>119 psi</td></tr>
<tr><td>5/8”</td><td>3/4”</td><td>97 psi</td></tr>
<tr><td>3/4”</td><td>1”</td><td>154 psi</td></tr>
</table>
<u>Tubing Characteristics:</u>
• Specific Gravity (ASTM D792): <0.920
• Tensile strength (ASTM D638): 2800 psi @ 73 deg. F
• Elongation (ASTM D638): 530%
• Hardness (ASTM D785): 44D Rockwell Durometer
• Heat Distortion (ASTM D648): 120 deg. F @ 66 psi
• NSF 51/61 Approved
• Color:
▪ 3/8” I.D. and smaller - red, green, blue, white, gray, yellow, orange, purple, or black
▪ Larger than 3/8” I.D. - semi-opaque or black
For all tubing runs, use continuous lengths of tubing with no splices.
Tubing Manufacturers: Hudson Extrusions, United States Plastic Corp., or equal</td></tr>
</table>

<table>
<tr><th>ITEM</th><th>DESCRIPTION</th></tr>
<tr><td>Conduit</td><td>Conduit for tubing shall be PVC electrical conduit, as specified in Division 26. Sizes shall be as listed below:
<table>
<tr><th>TUBING OUTSIDE DIAMETER</th><th>CONDUIT SIZE</th></tr>
<tr><td>3/8″</td><td>2″</td></tr>
<tr><td>1/2″</td><td>2″</td></tr>
<tr><td>5/8″</td><td>2″</td></tr>
<tr><td>3/4"</td><td>3″</td></tr>
<tr><td>1″</td><td>3″</td></tr>
</table></td></tr>
<tr><td>Fittings</td><td>Provide all necessary fittings, clamps and adapters for connection of tubing at the sample connections shown on the Drawings. Provide compression-style fittings, specifically designed for use with the tubing being provided, and compatible with the service (both with the fluid being carried in pipe and pressure rating). Fittings shall be located so that they are accessible at all times. No fittings shall be located in the carrier pipe.

All connections shall be constructed per tubing manufacturer’s recommendations to provide a connection which is equal to or greater than tubing pressure rating. All parts or fittings in contact with the fluid in the tubing shall be compatible with the chemical being carried.</td></tr>
</table>

++ END OF SECTION ++

SECTION 40 05 33.02

PIPING SYSTEM DATA SHEET – HIGH DENSITY POLYETHYLENE PRESSURE PIPE

ITEM	DESCRIPTION
Pipe	High Density Polyethylene Pipe (HDPE) shall be manufactured from a PE 4710 resin and shall have a minimum the cell classification of 445474C as determined in accordance with ASTM D3350. The PE4710 resin shall be listed in the Plastic Pipe Institute (PPI), Technical Report (TR) 4. Pipe from 4" to 63" shall be manufactured in accordance with ASTM F714. Pipe sizes less than 4" shall be manufactured in accordance with ASTM D3035. The pipe shall be SDR9.
Fittings	HDPE fittings shall be manufactured with material meeting the same requirements as the pipe. Molded fittings including molded flange adapters, shall be manufactured in accordance with ASTM D3261. Molded fittings shall have the same pressure rating as the pipe. Fabricated fittings shall be manufactured in accordance with ASTM F2206. Fabricated fittings shall have the same pressure rating as the pipe.
Joints	Thermal butt fusion joints shall be used wherever possible and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer. Bolted lap-joint style flange connections shall be used when connecting to equipment or different pipe materials and may be used where butt fusion is not practical as accepted by the ENGINEER. Flange joining shall be accomplished by using a HDPE flange adapter or stub end and a back-up ring. Molded HDPE flange adapters or stubs ends shall be made from material meeting the same requirements as the pipe and shall be manufactured in accordance with ASTM D3261. Machined flange adapters or stub ends made from thick walled pipe billets or other acceptable stock materials shall meet the requirements of ASTM F2880 and shall be made from material meeting the same requirements as the pipe. Lap-joint flange connections shall have the same pressure rating as the pipe. Tighten flange connection in accordance with the manufacturer's recommendations. As a minimum, re-tighten flange connections 24-hours after initial tightening. Ductile iron back-up rings shall be made from material meeting the

ITEM	DESCRIPTION
	designation 65/45/12 in accordance with ASTM A536. Back-up rings shall meet the requirements of Class 250 and mate with ANSI B16.5 and AWWA C207 bolt patterns. Backup rings shall have a minimum pressure rating of 160 psi or have the same rating as the pipe or whichever is greater of the two. Back-up rings shall be coated with the manufacturer's standard paint system. Electrofusion fittings shall be made from material meeting the same requirements as the pipe and may be used where accepted by the ENGINEER. Fittings shall comply with ASTM F1055. Electrofusion fittings shall have a pressure rating equal to the pipe.
Couplings	When specifically called out on the Drawings, listed below or as approved by the ENGINEER, couplings shall be manufactured specifically for use on HDPE pipe and shall provide a fully restrained pipe joint capable of withstanding the full strength capability of the pipe itself and meet the pressure rating of the pipe.
Gaskets	Gasket thickness and durometer shall be as recommended by the manufacturer. Gasket material shall be suited for the service of the pipe system in terms of chemical resistance and temperature. Bolts and nuts shall be standard hex head along with washers and shall be 316L stainless steel for buried service and galvanized A307 for exposed installations.

++ END OF SECTION ++

SECTION 40 05 51

VALVES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Shop Drawings:
   1. Product data sheets for make and model.
   2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
   3. Certificate of Compliance for: Butterfly valves; full compliance with AWWA C504.

B. Tests and inspection data.

1.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. In accordance with manufacturer's directions.

1.3 TRADE NAME ABBREVIATIONS

A. FKM: Fluorocarbon (FPM or Viton®)

B. PTFE: Polytetrafluoroethylene (Teflon®)

PART 2 - PRODUCTS

2.1 GENERAL

A. All valves shall be the same size as the pipe in which they are installed, unless specifically noted otherwise on the Drawings.

B. All valves shall include all appurtenant parts (operators, chainwheels, handwheels, valve stems, floor stands, gear boxes, operating nut, etc.) for a complete operating valve.
   1. Valve shall be, as much as practical, fully factory assembled.

C. All valves shall open by turning counter-clockwise. Maximum force required for operation shall be 80 lbs.

D. Where Lead-Free Bronze or Brass is specified, materials shall be in compliance with California Health & Safety Code Section 116875. Not more than a weighted average of 0.25 percent of the wetted surface of the valve shall be lead. Valve shall be provided with a "hang tag" or other marking that easily identifies the valve as Lead-Free.

E. Coatings and Linings:
   1. Provide factory-applied coatings as described herein.
   2. Where liquid epoxy coatings are specified, coatings shall conform to AWWA C550.

3. Field coat the exterior of all valve bodies with the same coating as is required for the adjacent pipe unless otherwise specified.

F. Nuts, Bolts and Washers
   1. Hex Bolts: ASTM A320/A320M, Type 304 stainless steel, Grade B8, Class 2
   2. Nuts: ASTM F594, Type 304 stainless steel, Grade B8, Class 2
   3. Washers: Type 304 stainless steel

2.2 BUTTERFLY VALVES

A. **BFV-01:** AWWA Butterfly Valve (3" through 144")
   1. Service: Water
   2. Features:
      a. Flanged or mechanical joint end, short body type
         1) End type as shown on the Drawings
      b. AWWA C504, Class 250B
      c. Features:
         1) Body:
            a) Cast or ductile iron
         2) Disc:
            a) Cast or ductile iron disc
            b) On valves 24-inch and larger, provide non-hollow discs
         3) Shaft:
            a) Type 304 stainless steel shaft
            b) Self-adjusting V-type or O-ring shaft seals
         4) Seat:
            a) Valves 3- to 20- inch:
               1. Buna-N or NBR rubber seat bonded or molded in body only
               2. Elastomer seats which are bonded or vulcanized to the body shall have adhesive integrity of bond between seat and body assured by testing, with minimum 75-pound pull in accordance with ASTM D429, Method B
            b) Valves 24-inch and larger:
               1. Buna-N or NBR rubber seat retained within a dovetail groove in the valve body and mechanically locked in place by use of an epoxy filler
               2. Valve to be adjustable from either side
               3. Valves using seat fasteners or retaining rings are not allowed.
            c) Provide stainless steel seating surface
         5) Coatings and Linings:
            a) Liquid epoxy, 12 mil minimum, for valve interior and exterior
            b) For potable water applications, epoxy lining shall be NSF 61 approved
      d. Valve shall be suitable for throttling operations and infrequent operation after periods of inactivity.
      e. Valve shall be bubble-tight with rated pressure applied from either side.
      f. Smooth flow stream on valve body interior
         1) No travel stops for disc on interior of body
         2) Isolate metal-to-metal thrust bearing surfaces from flow stream.
   3. Manufacturers and Products:
      a. DeZurik Water Controls
      b. Henry Pratt Company

c. Or Equal

2.3 GATE VALVES

A. **GAV-03:** Resilient-Seated Gate Valve (2" through 54")
   1. Service: Water
   2. Features:
      a. Conforms to AWWA C509 (2" and 3") or AWWA C515 (4" through 54")
      b. Iron body
      c. Resilient seat, bronze mounted
      d. Full port
      e. Valve Ends:
         1) Mechanical joint ends for buried service, unless shown otherwise on drawings or valve schedule
         2) Flanged ends for exposed service, unless shown otherwise shown on drawings or valve schedule
      f. Non-rising stem
      g. Operator for Buried Service:
         1) Stem extension, as required, to bring operating nut to within 12" of ground surface
         2) 2-inch operating nut
      h. Operator for Exposed Service:
         1) Handwheel
      i. Spur gear for valves 20" and larger installed vertically
      j. Bevel gear for valves 20" and larger installed horizontally
      k. Design working water pressure: 250 psig
      l. Coatings and Linings:
         1) Liquid epoxy, 12 mil minimum, for valve interior and exterior.
         2) For potable water applications, epoxy lining shall be NSF 61 approved.
   3. Manufacturers and Products:
      a. Mueller; Model A-2361 (4" through 54")
      b. M&H Valve
      c. Or Equal

2.4 OPERATORS

A. General:
   1. Operator force not to exceed 40 pounds under any operating condition, including initial breakaway. Gear reduction operator when force exceeds 40 pounds.
   2. Operator self-locking type or equipped with self-locking device.
   3. Provide position indicator on all valves.
   4. Worm and gear operators one-piece design worm-gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling nut type operators threaded steel reach rods with internally threaded bronze or ductile iron nut.
   5. Valve handles, wheels, etc. to be designed to accommodate a padlock.

B. Manual Operator:
   1. Galvanized and painted handwheels.
   2. Lever operators allowed on quarter-turn valves 8 inches and smaller.
   3. Cranks on gear type operators.

4. For all valves above 5’-0” above adjacent working surface (finished floor or finished grade), provide chain wheel operator with tiebacks
5. For all exposed valves below adjacent working surface (finished floor or walkway), provide extension stem, floor stands, and other accessories to permit operation from 2’-6” above adjacent working surface.
6. For all buried valves 3” and larger, provide stem extension, valve bonnet, valve box and 2” AWWA operating nut such that operating nut is within 12” of adjacent finished grade.
    a. For small-diameter buried valves, provide cross-shaped handle for operating with forked key.

2.5 ACCESSORIES

A. T-Handled Operating Wrench:
    1. One each galvanized operating wrench, 4 feet long.
    2. Manufacturers and Products:
        a. Mueller; No. A-24610.
        b. Clow No.; F-2520.
        c. Or Equal

B. Cast Iron Valve Box: Designed for traffic loads, sliding type, with minimum of 6-inch ID shaft.
    1. Box: Cast iron with minimum depth of 9 inches.
    2. Lid: Cast iron, minimum depth 3 inches, marked WATER.
    3. Extensions: Cast iron.

PART 3 - EXECUTION

3.1 VALVE SCHEDULE

A. A Valve Schedule has been attached to this Specification and is incorporated herein by reference. Provide valves in accordance with Valve Schedule.

B. For valves that are not referenced in Valve Schedule, provide the valve type called for on the Drawings.

3.2 PREPARATION

A. Cleaning:
    1. Clean all mating faces of valve (threads, flange faces, etc.) prior to assembly.
    2. Remove all debris from valve body prior to assembly.
    3. Take extra care to clean mating faces of existing pipe and fittings which may have corrosion, dirt, debris and mineral build-up which should be removed for a proper fit.

B. Apply joint compound, lubricant, etc. as recommended by valve manufacturer for proper installation prior to installation.

C. Install valves in accordance with the following schedule and as noted on the Drawings:

3.3 INSTALLATION

A. Install valves per manufacturer's recommendations.

B. Install valves so handles operate from fully open to fully closed without encountering obstructions.

C. Install valves in location and orientation for easy access for routine operation and maintenance. Access should be such that an operator can operate the valve by reaching a handle, chain, etc. at a height between 2'-6" and 5'-0" above adjacent work surface (for buried valves, this is accomplished with a t-handle wrench and the operating nut being within 12" of finished grade).

3.4 TESTS AND INSPECTION

A. Valve may be either tested while testing pipelines, or as a separate step.

B. Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions.

C. Inspect air release and vacuum valves as pipe is being filled to verify venting and seating is fully functional.

D. Count and record number of turns to open and close valve; account for any discrepancies with manufacturer's data.

E. Set, verify, and record set pressures for all relief and regulating valves.

3.5 SUPPLEMENTS

A. The following supplements are attached to this Specification section and incorporated herein by reference:
   1. 40 05 51.13, Valve Schedule

++ END OF SECTION ++

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SECTION 40 05 51.13

VALVE SCHEDULE

1.1 DESCRIPTION

A. General:
   1. This schedule is provided for the convenience of the CONTRACTOR. Some valves may be shown on the drawings, but not listed here.
   2. Valve specifications are given in Section 40 05 51, Valves.

B. Valve Tag Number:
   1. Tag numbers are as noted in the Drawings.

C. Valve Type:
   1. Valve types are as described in Section 40 05 51, Valves.
   2. Valve Ends:
   3. FLG – Flanged

D. Installation Codes
   1. Ex – Exposed
   2. Un – Underground

E. Valve Actuators, as described in Section 40 05 51, Valves.
   1. HW – Handwheel
   2. L – Lever
   3. N – 2" Nut
   4. N/A – Not Applicable

1.2 VALVE SCHEDULE

VALVE TAG NUMBER	VALVE TYPE	ENDS	DIAMETER	INSTALLATION	ACTUATOR
V10	BFV	FL	14"	Exposed	Handwheel
V11	BFV	FL	6"	Buried	Nut
V12	BFV	FL	8"	Buried	Nut
V13	BFV	FL	14"	Buried	Nut
V14	BFV	FL	8"	Exposed	Handwheel
V20	BFV	FL	14"	Buried	Nut
V21	BFV	FL	8"	Exposed	Handwheel
V23	BFV	FL	8"	Exposed	Handwheel

(a) Does not include valves in the temporary bypass system.
(b) Does not include pump control valve called out on drawing.

++ END OF SECTION ++

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APPENDIX A

Geotechnical Report
(Bound Separately – Volume 1A)

DOCUMENTS FOR THE CONSTRUCTION OF

CITY OF SAN BRUNO
SNEATH AND LAKE PUMP STATION REHABILITATION PROJECT

VOLUME 1A

APPENDIX A
(GEOTECHNICAL REPORT)

DISCLAIMER
The Owner assumes no responsibility for completeness or accuracy of geotechnical and soils investigations, records compiled therefrom, or interpretation(s) contained in the subsequent report. Geotechnical and soils investigations were performed for purposes of study and design, and there is no expressed or implied warranty that conditions indicated in the report are representative of those existing throughout the site; conditions differing substantially from those indicated may be encountered.

GEOTECHNICAL REPORT

Lake Drive & Sneath Lane Pump Stations
Improvement Project
City of San Bruno, California

Submitted To:

Ms. Cindy Bertsch, P.E.
WATER WORKS ENGINEERS
1730 S. El Camino Real, Suite 280
San Mateo, CA 94402

Prepared by:
Bajada Geosciences, Inc.

November 1, 2022
Project No. 1901.0130

BAJADA
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(530) 638-5263
DBE #46532

November 1, 2022
1901.0130

Ms. Cindy Bertsch, P.E. & Mr. Jon Roy, P.E.
WATER WORKS ENGINEERS
1730 S El Camino Real, Suite 280
San Mateo, CA 94402

Subject: **Geotechnical Report**
Lake Drive & Sneath Lane Pump Station Improvement Project
City of San Bruno, California

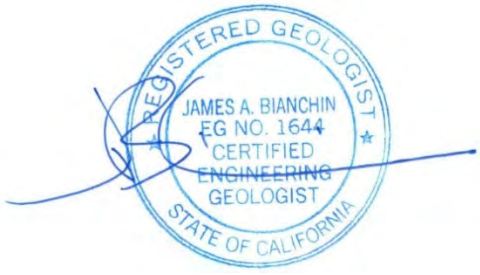
Dear Ms. Bertsch & Mr. Roy:

Bajada Geosciences, Inc., is pleased to submit this geotechnical report to Water Works Engineers for the Lake Drive and Sneath Lane Pump Station Improvement Project located in the City of San Bruno, California. This geotechnical report discusses field mapping and explorations performed, laboratory testing results, subsurface conditions encountered, and geotechnical analyses associated with the study.

We appreciate the opportunity to perform this study. If you have any questions pertaining to this report, or if we may be of further service, please contact us at (530) 638-5263 at your earliest convenience.

Sincerely,

BAJADA GEOSCIENCES, INC.



James A. Bianchin, P.G., C.E.G.
Principal Engineering Geologist



Jon Everett, P.E., G.E.
Principal Geotechnical Engineer

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Appendix B ..... Laboratory Testing
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1 GENERAL

This report presents the results of our geotechnical study for proposed improvements at the Lake Drive & Sneath Lane Pump Stations (PS), located within the City of San Bruno, California. Bajada Geosciences, Inc. (BAJADA), has prepared this report at the request of Water Works Engineers (WWE), the project civil engineer retained by the City of San Bruno (City) for design of this project. The project sites are shown on Plates 1.1 and 1.2 – Site Location Maps. The following sections present our understanding of the project, the purpose of our study, and the geotechnical findings, conclusions, and recommendations for the project. Our services were performed in general accordance with our proposal dated April 9, 2019.

1.1 PROJECT UNDERSTANDING & LOCATIONS

We understand that the project consists of the modification of two existing PS sites within the City to accommodate generators and other mechanical/electrical improvements. At the Lake Drive PS site, we understand that a new generator pad is proposed for an area north of the existing eastern tank located at that site and a building extension is proposed to the south of the existing structure, including a new retaining wall, as shown on Plate 2.1 – Proposed Project Improvements. We understand that the proposed structure will be single story and will be constructed using traditional wood framing construction and the retaining wall will be a concrete masonry unit or cast-in-place concrete wall. It is anticipated that the structure will have a slab-on-grade and will be supported using shallow foundation systems.

At the Sneath Lane PS site, we understand that the existing structure is being rehabilitated and a new generator pad and retaining wall are proposed for west of the existing structure, as shown on Plate 2.2 – Proposed Project Improvements. It is anticipated that the structure will have a slab-on-grade and will be supported using shallow foundation systems.

The Lake Drive PS site is located approximately 300 feet northeast of the southern terminus of Lake Drive, as shown on Plate 1.1. The Assessor's Parcel Number (APN) for the Lake Drive Pump Station is 017-441-290.

The Sneath Lane PS site is located about 140 feet north of the intersection of Sneath Lane and Engvall Court, as shown on Plate 1.2. The APN for this site is 017-251-020.

Latitude and longitude for the approximate center of the existing PSs are as follows:

APPROXIMATE PROJECT COORDINATES				
Pump Station:	**Lake Drive**		**Sneath Lane**	
Coordinates	**Degrees, Minutes, Seconds**	**Decimal Degrees**	**Degrees, Minutes, Seconds**	**Decimal Degrees**
Latitude	37° 37' 8.6"	37.619049°	37° 37' 47.5"	37.629865°
Longitude	-122° 26' 58.1"	-122.449479°	-122° 26' 16.7"	-122.437985°

1.2 STUDY PURPOSE

The purpose of our geotechnical study was to explore and evaluate selected site surface and subsurface conditions to provide geotechnical engineering recommendations related to the design and construction of the proposed improvements at the pump stations.

1.3 SCOPE OF SERVICES

Services performed for this study are in general conformance with the proposed scope of services presented in our April 9, 2019 proposal. Our scope of services included:

- Reconnaissance of the site surface conditions, topography, and existing drainage features;
- Review of pertinent, selected regional geological data;
- Advancement of two drill holes: one at each pump station location. Locations of those explorations are shown on Plates 3.1 and 3.2 – Geotechnical Maps, Lake Drive and Sneath Lane Pump Stations, respectively. Exploration procedures and Logs of Drill Holes are presented in Appendix A – Subsurface Exploration;
- Performance of laboratory testing on selected samples obtained during our field investigation. Laboratory test procedures and results of those tests are presented in Appendix B – Laboratory Testing;
- Slope stability analyses to estimate static and pseudostatic stability of the Lake Drive PS site. Methods used and results of the stability evaluations are presented in Appendix C – Slope Stability Evaluations;
- Preparation of this report, which includes:
    - A description of the proposed project;
    - A summary of our field exploration and laboratory testing programs;
    - A description of site surface and subsurface conditions encountered during our field investigation;
    - Seismicity data based upon 2019 California Building Code (CBC) seismic design criteria;

- A geotechnical map showing approximate field exploration locations;
- Geotechnical recommendations for:
  - Site preparation, engineered fill, site drainage, and subgrades;
  - Suitability of on-site materials for use as engineered fill;
  - Foundation and slab-on-grade design; and
  - Temporary excavations, shoring, and trench backfill.
- Appendices that present a summary of our field investigation procedures and laboratory testing programs.

1.4 PREVIOUS WORK PERFORMED & REFERENCES REVIEWED

No previous geotechnical studies are known to have been performed at or near either pump station site. A search for subsurface explorations proximal to the site was performed through the State's Geotracker and Envirostor databases (Geotracker, 2019; Envirostor, 2019), and found no reported information near the Lake Drive PS and some subsurface information near the intersection of Sneath Lane and Rollingwood Drive, about 300 feet east and downslope of the Sneath Lane PS. Other information reviewed during this study are referenced in the text and in Section 7 of this report.

2 FINDINGS

2.1 FIELD INVESTIGATION

BAJADA conducted a geotechnical field investigation to:

- Evaluate subsurface soil conditions at selected locations;
- Evaluate if relatively shallow groundwater was present; and
- Provide subsurface data for evaluation of proposed improvements.

Our field geotechnical investigation consisted of reconnaissance-level geologic mapping of the project sites and adjacent areas and subsurface exploration through advancement of two drill holes. The drill holes were advanced on November 20, 2019 using a track-mounted drill rig provided by Britton Exploration, Inc., of Los Gatos, California. The exploration locations are shown on Plates 3.1 and 3.2. Descriptions of soils encountered are presented on the drill hole logs included in Appendix A.

2.2 SITE CONDITIONS

2.2.1 Surface Conditions

2.2.1.1 Lake Drive PS

The project site is located on a pad graded on a moderately steep south-facing slope. Two tanks and a pump station are located on the pad, which is accessed by a paved access road descending from the cul-de-sac at Lake Drive. Areas of the pad not improved with infrastructure are covered with gravel or are fallow. The entire pad area is surrounded by a chain link fence. Fallow ground hosting seasonal grasses, shrubs, and trees is located outside the fenced area, except along the access road. Drainage occurs as sheetflow that is collected in drop inlets and removed from the site. The elevation at the pump station site is about 754 feet (Kier+Wright, 2019a).

2.2.1.2 Sneath Lane PS

The project site is located on a gently inclined slope that descends towards the southeast. The pump station is located on a pad that has been graded into the slope and which is accessed by a paved access extending north from Sneath Lane. The facility and access road are paved using asphaltic concrete. A retaining wall is located along the western and northwestern margin of the pad. The facility is bordered to the west and north by residences, and to the east and south by fallow lands and dense stands of mature eucalyptus trees. Drainage occurs as sheetflow to Sneath Lane. The elevation at the pump station site is about 300 to 301 feet (Kier+Wright, 2019b).

2.2.2 Subsurface Conditions

2.2.2.1 Lake Drive PS

The site is underlain by silty clay and greenstone rock materials. The silty clay ranged from firm to stiff, was moist to wet, plastic, and had varying amounts of fine sand and fine to coarse subangular gravel. Dry densities of these soils ranged from 83.4 to 110.8 pounds per cubic foot (pcf) and had moisture contents ranging from 18.8 to 27.1 percent.

The greenstone was moderately to intensely weathered, weak (rock term), poorly indurated, and highly fractured. Dry density for one tested sample was 115.0 pcf with a moisture content of 19.7 percent.

A strong petroleum odor and greenish-gray staining typical of petroleum exposure was noticed in soil and rock materials at depths extending deeper than 17 feet at the site. It is likely that the odor and staining are associated with a leaking tank or pipeline in the vicinity of the pump station. The location of the petroleum source and the chemical constituents of those contaminants are unknown and outside the scope of services contracted for this study.

2.2.2.2 Sneath Lane PS

The site is underlain by sandstone rock materials. The sandstone ranged from dry to moist, was moderately weathered, weak (rock term), poorly indurated, friable, and predominately fine grained with some thin layers of coarse sand. Dry densities of these materials ranged from 113.3 to 119.2 pcf and had moisture contents ranging from 4.6 to 12.7 percent.

2.3 GEOLOGIC CONDITIONS

2.3.1 Regional Geology

The pump station sites are located within the Coast Ranges Geomorphic/Geologic province of California. The Coast Ranges province is a northwest-trending mountain range that is about 50 miles wide and extends about 400 miles from its southern terminus in Santa Barbara County north into Shasta County and southern Oregon. It is bordered to the west by the Pacific Ocean, to the south by Transverse Ranges Province, to the east by the Great Valley province, and to the north by the Klamath Mountains Province. The province is separated into the Northern and Southern Coast Ranges at the Golden Gate (Hinds, 1952).

The Coast Ranges province is composed predominately of Cenozoic- and Mesozoic-age sedimentary rocks. Lesser amounts of Pleistocene-aged volcanic rocks occur locally within this province (such as at Clear Lake) as do granitic rocks of the Salinian Block, located west of the San Andreas fault.

The project site is located at the northern end of the Southern Coast Ranges. Specifically, the site is situated in the eastern Santa Cruz Mountains near the western border of the Santa Clara Valley (Hinds, 1952). The Santa Cruz Mountains are composed of Plio-Pleistocene-age sedimentary deposits and Mesozoic-age sedimentary and metavolcanic rocks.

2.3.2 Local Geologic Setting

2.3.2.1 Lake Drive PS

The Lake Drive PS is underlain by artificial fill materials and greenstone of the Franciscan Formation (Pampeyan, 1994), as shown on Plate 4.1 – Regional Geologic Map. The artificial fill materials consisted of silty clay soils likely derived from colluvial and/or regolithic soils associated with the greenstone on site. The artificial fill materials at the drill hole site were approximately 8 feet thick.

Directly underlying the artificial fill was the Franciscan Formation greenstone materials. Those materials were not fully penetrated by the exploration advanced for this study and are anticipated to be hundreds of feet thick. The greenstone ranged from highly weathered regolithic silty clay soils to moderately weathered, weak, poorly indurated, highly fractured rock.

2.3.2.2 Sneath Lane PS

The Sneath Lane PS is underlain by sandstone of the Merced Formation (Brabb & Pampeyan, 1983), as shown on Plate 4.2 – Regional Geologic Map. The sandstone was moderately weathered, weak (rock term), poorly indurated, friable, and predominately fine grained with some thin layer of coarse sand. The sandstone was not fully penetrated by the exploration advanced for this study but is thought to be tens to hundreds of feet thick below the site.

2.3.3 Groundwater

2.3.3.1 Lake Drive PS

Groundwater was encountered at a depth of 17 feet in the exploration advanced for this study. Upon completion of drilling, groundwater was measured and found to be at a depth of 22 feet. It should be noted that the drill hole was backfilled immediately upon completion of drilling and that the stabilized groundwater levels were not determined.

A strong petroleum odor and greenish-gray staining typical of petroleum exposure was noticed in groundwater, soil, and rock materials at depths extending deeper than 17 feet at the site. It is likely that the odor and staining are associated with a leaking tank or pipeline in the vicinity of the pump station. The location of the petroleum source and the chemical

constituents of those contaminants are unknown and outside the scope of services contracted for this study.

2.3.3.2 Sneath Lane PS

Groundwater was not encountered within the exploration advanced at the Sneath Lane PS site.

2.3.3.3 General

Groundwater elevations will fluctuate over time. The depth to groundwater can vary throughout the year and from year to year. Intense and long duration precipitation, drought conditions, modification of topography, groundwater extraction, and cultural land use changes can contribute to fluctuations in groundwater levels. Localized saturated conditions or perched groundwater conditions near the ground surface could be present during and following periods of heavy precipitation or if on-site sources contribute water. If groundwater is encountered during construction, it is the Contractor's responsibility to install mitigation measures for adverse impacts caused by groundwater encountered in excavations.

3 GEOLOGICAL HAZARDS

3.1 FAULTING & SEISMICITY

3.1.1 Regulatory Seismic Setting

The State of California designates faults as Holocene-age or Pre-Holocene-age depending on the recency of movement that can be substantiated for a fault. Fault activity is rated as follows:

FAULT ACTIVITY RATINGS		
Fault Activity Rating	**Geologic Period of Last Rupture**	**Time Interval (Years)**
Holocene-Active	Holocene	Within last 11,000 Years[1]
Pre-Holocene	Quaternary & Older	>11,000 Years[1]
Age Undetermined	Unknown	Unknown

[1] – Holocene is defined as 11,700 years before present by the International Commission on Stratigraphy. The California State Mining and Geology Board, which administers the review and application of the Alquist-Priolo Earthquake Fault Zoning Act, currently recognizes the Holocene as 11,000 years before present.

The California Geologic Survey (CGS) evaluates the activity rating of a fault in fault evaluation reports (FER). FERs compile available geologic and seismologic data and evaluate if a fault should be zoned as Holocene-active, pre-Holocene, or age undetermined. If a FER evaluates a fault as Holocene-active, then it is typically incorporated into a Special Studies Zone in accordance with the Alquist-Priolo Earthquake Fault Zoning Act (AP). AP Special Studies Zones require site-specific evaluation of fault location for structures for human occupancy and require a habitable structure setback if the fault is found traversing a project site.

The project sites are not located within Alquist-Priolo Earthquake Fault Zones and no Holocene-active faults are known to pass through either site (California Geological Survey, 2019; Jennings, 1994; Hart & Bryant, 1997). However, a number of Pre-Holocene and Holocene-active faults are located regionally to the project site, as shown on Plate 5 – Fault Location Map. The closest mapped Holocene-active fault is the San Andreas fault, located 1,500 and 3,600 feet from the Lake Drive and Sneath Lane PS sites, respectively.

The Age Undetermined Serra Fault zone is located about 200 feet east of the Sneath Lane PS site, as shown on Plate 5. That fault is considered active by many local geologists but has yet to be zoned as active by the State. The Serra fault is considered a blind thrust fault, which means the fault plane does not reach the surface. That fault plane dips to the west and as rupture along the fault occurs, the hanging wall is pushed easterly and deformed as a fault propagation fold. Thus, because the Sneath Lane PS is located on the hanging wall, it could

experience some site deformation due to folding when the Serra fault experiences rupture. The magnitude of deformation is unknown but anticipated to be relatively small due to the distance of separation between the PS site and the fault.

3.1.2 CBC Seismic Design Recommendations

We understand that the proposed project will be designed and constructed under the 2019 California Building Code (CBC) criteria. At a minimum, structures should be designed in accordance with the following seismic design criteria:

CBC SEISMIC DESIGN PARAMETERS			
California Building Code	**Parameter**	**CBC Designation**	
		Lake Dr. PS	**Sneath Ln. PS**
Site Coordinates	Latitude	37.619049°	37.629865°
	Longitude	-122.449479°	-122.437985°
Section 1613.5.3 Table 1613.5.3(1)	Site Coefficient, F_a	1.200	1.200
Section 1613.5.3 Table 1613.5.3(2)	Site Coefficient, F_v	1.400	1.938
Section 1613.5.1 Figure 1613.5	Site Class Designation	C	C
	Seismic Factor, Site Class D at 0.2 Seconds, S_s	2.446	2.419
	Seismic Factor, Site Class D at 1.0 Seconds, S_1	1.026	1.014
Section 1613.5.3	Site Specific Response Parameter for Site Class D at 0.2 Seconds, S_{MS}	2.935	2.903
	Site Specific Response Parameter for Site Class D at 1.0 Seconds, S_{M1}	1.436	1.419
Section 1613.5.4	$S_{DS}=2/3S_{MS}$	1.957	1.935
	$S_{D1}=2/3S_{M1}$	0.958	0.946
Per the 2019 CBC			

3.2 LANDSLIDES

3.2.1 Lake Drive PS

The Lake Drive PS is located on moderately inclined slopes that descend towards the east. No natural slope instabilities, either incipient, active, or dormant, were observed while on site. Stability of the developed area of the PS site, including tank surcharge loads and modeled earthquake (pseudostatic) loading, was performed and is discussed in Section 4.0.

3.2.2 Sneath Lane PS

The Sneath Lane PS site is located on gently inclined ground underlain by formational sandstone deposits. No natural slope instabilities, either incipient, active, or dormant, were observed. It is our opinion that natural slope failure has a low potential of adversely affecting this site.

3.3 LIQUEFACTION AND LATERAL SPREADING

Liquefaction is described as the sudden loss of soil shear strength due to a rapid increase of soil pore water pressures caused by cyclic loading from a seismic event. In simple terms, it means that a liquefied soil acts more like a fluid than a solid when shaken during an earthquake. For liquefaction to occur, the following are needed:

- Granular soils (sand, silty sand, sandy silt, and some gravels);
- A high groundwater table; and
- A low density in the granular soils underlying the site.

If those criteria are present, then there is a potential that the soils could liquefy during a seismic event.

The adverse effects of liquefaction include local and regional ground settlement, ground cracking and expulsion of water and sand, the partial or complete loss of bearing and confining forces used to support loads, amplification of seismic shaking, and lateral spreading. In general, the effects of liquefaction on the proposed project could include:

- Lateral spreading;
- Vertical settlement; and/or
- The soils surrounding lifelines can lose their strength and those lifelines can become damaged or severed.

Lateral spreading is defined as lateral earth movement of liquefied soils, or soil riding downslope on a liquefied soil layer toward an unsupported slope face, such as a creek bank, or an inclined slope face. In general, lateral spreading has been observed on low to moderate gradient slopes.

Both pump station locations are underlain by formational rock materials that are not subject to liquefaction. Because of this, it is our opinion that liquefaction and lateral spreading have a negligible potential to adversely impact the projects.

3.4 EXPANSION POTENTIAL

There is a direct relationship between plasticity of a soil and the potential for expansive behavior, with expansion potential generally increasing as the Plasticity Index (PI) of a soil increases, as shown in the table below (from Day, 1999). Thus, granular soils typically have a low potential to be expansive, whereas, fine-grained clay-rich soils can have a low to high expansion potential depending on various factors including the quantity and type of clay minerals present. Atterberg limit testing performed on two soil samples from the Lake Drive PS both recorded plasticity indices (PI) of 15. Soils having a PI of 15 have a low to medium expansion potential, as noted in the following table (Day, 1999).

EXPANSION POTENTIAL – PLASTICITY INDEX CORRELATION

Plasticity Index (PI)	Correlated Expansion Potential
0 – 10	Very Low
10 – 15	Low
15 – 25	Medium
25 – 35	High
35+	Very High

Taken from Day (1999)

Based on the results of our laboratory testing, it is our opinion that the on-site, near-surface fine-grained soils at the Lake Drive PS have a low to medium expansion potential.

Soils at the Sneath Lane PS were granular and nonplastic. It is our opinion that there is a very low potential for expansive soils to adversely impact the Sneath Lane PS.

3.5 SOIL CHEMISTRY

A sample of near-surface soil from each pump station site was subjected to chemical analysis for assessment of corrosion and reactivity with concrete. The samples were tested for soluble sulfates and chlorides. Testing was conducted by Sunland Analytical of Rancho Cordova and results are presented below.

SOIL CHEMISTRY RESULTS

Sample Location	Sample Depth	Sulfates (ppm)	Chlorides (ppm)	pH	Resistivity (ohms-cm)
Lake Drive PS	1' - 5'	32.1	8.2	7.03	2,680
Sneath Lane PS	1' – 5'	10.3	4.8	6.59	4,020

According to the ACI-318, a sulfate concentration below 0.10 percent by weight (1,000 ppm) is negligible. A chloride content of less than 500 ppm is generally considered non-corrosive to reinforced concrete. Based on the results of the soil chemistry tests, the sites

soils have a low potential for corrosion of concrete due to sulfates and chlorides at both pump station sites.

Minimum resistivity testing was also performed on the soil samples. A commonly accepted correlation between soil resistivity and corrosivity towards ferrous metals (NACE Corrosion Basics, 1984) is provided below:

RESISTIVITY & CORROSION CORRELATION	
Minimum Resistivity (ohm-cm)	**Corrosion Potential**
0 to 1000	Severely Corrosive
1,000 to 2,000	Corrosive
2,000 to 10,000	Moderately Corrosive
Over 10,000	Mildly Corrosive

Thus, according to the table above, the soils at Lake Drive PS and Sneath Lane PS are estimated to be mildly and moderately corrosive to ferrous metals, respectively.

4 SLOPE STABILITY

4.1 GENERAL

The following section discusses slope stability evaluations performed for this project for the Lake Drive PS site. No slope stability evaluations were performed for the Sneath Lane PS because of the relatively gentle inclination at that site. Results of the stability analyses are included in Appendix C.

4.2 DISCUSSION REGARDING FACTORS OF SAFETY

Evaluation of slope stability generally takes into consideration several soil and rock strength parameters, geologic conditions within the slope, hydrogeologic conditions, and surcharge and seismic loads that could affect the slope. Those parameters are typically modeled using limit-equilibrium methods (and less commonly using finite-element or finite-difference modeling) to estimate a slope inclination that meets or exceeds a target minimum factor of safety (FOS) against failure. The FOS is estimated by calculating the forces resisting slope failure divided by the forces causing slope failure. Thus, a FOS of greater than 1 implies a stable slope, a FOS of less than 1 implies a slope that is failing, and a FOS of 1 implies a slope that is creeping and/or on the verge of failure.

Conventional engineered cut or fill slopes typically utilize minimum FOS thresholds of 1.5 and 1.0 for static and pseudostatic (pseudo-earthquake forces) conditions, respectively, for evaluations of slope stability for acceptable maximum slope inclinations (Blake et al., 2002, CGS, 2008). In addition, temporary slopes, which in this study are defined as slopes exposed (i.e., unprotected) for less than a year and not during winter, typically utilize a minimum static FOS of 1.2. These FOS thresholds have been incorporated into this study.

4.3 SURFACE SLOPE GEOMETRY

Surface topography used in our slope stability analyses is based upon topographic information developed from open-source LIDAR data screened to obtain only ground-related points. A digital terrain model (DTM) was then prepared followed by contouring of the DTM. That topography is shown on Plate 6 – Lake Drive PS Regional Topography.

4.4 SUBSURFACE PROFILE

Subsurface geological conditions for our slope model were estimated through subsurface exploration and field mapping at the site and mapping performed by Pampayen (1994). A cross section was developed across the site that depicts anticipated subsurface conditions. The cross section location and the cross section are presented on Plate 6.

4.5 ENGINEERING PROPERTIES USED IN STABILITY ANALYSES

Soil shear strengths used in stability analyses were estimated through laboratory testing. A bulk sample of artificial fill materials obtained at the Lake Drive PS site was remolded to 90-percent relative compaction in accordance with standard test method ASTM D1557, and a direct shear test was performed on that sample. Results of the direct shear test found a cohesion (C) of 437 pounds per square foot (psf) and an angle of internal friction (Ø) of 34.3 degrees. For the stability analyses, a C=400 psf and Ø=34 degrees were conservatively used for both artificial fill and Franciscan Formation greenstone rock materials.

4.6 HYDROGEOLOGIC CONDITIONS

As noted in Section 2.3.3.1, groundwater was encountered at a depth of 17 feet in the drill hole advanced at the Lake Drive PS. Using that depth, we estimated the phreatic surface beneath the project slope and used that surface in our stability analyses, as shown on Plate 6.

4.7 SLOPE STABILITY EVALUATIONS

Limit-equilibrium analyses were performed using the computer program SLIDE 2018 (Rocscience, 2019). Static and pseudostatic analyses results are presented in Appendix C of this report.

Slope stability analyses were performed under static conditions using the strength values noted above for the cross section presented on Plate 6. In addition, we utilized a surcharge load of 1,800 psf for the existing tank at the site. Results of those analyses indicate that the existing slope with the tank surcharge with a phreatic surface as shown on Plate 6, has a static FOS in excess of 1.9. Thus, the slope conditions modeled currently exceed accepted minimum FOS values for static conditions.

Pseudostatic evaluations of the slope were modeled to estimate the effect of earthquake forces. To estimate the appropriate horizontal ground acceleration to use within our model, we used methods of Blake et al (2002) and CGS (2007). Using a probabilistic horizontal ground acceleration of 0.64g, which corresponds to a 475-year return period (10% chance of exceedance in 50 years), we reduced that value by 40 percent to obtain the pseudostatic acceleration of 0.26g used within our model. With that pseudostatic loading, we obtained FOS values in excess of 1.0, thus, exceeding currently accepted minimum FOS values.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

Recommendations presented, herein, are based upon project information provided by WWE along with stated assumptions. Changes in the configurations from those studied during this investigation may require supplemental recommendations.

5.2 GEOLOGIC HAZARDS

It is our opinion that geologic hazards should not adversely impact proposed improvements to the Lake Drive or Sneath Lane pump stations.

5.3 SITE PREPARATION AND GRADING

5.3.1 Stripping

Prior to general site grading and/or construction of planned improvements at each PS site, existing vegetation, organic topsoil, debris, and deleterious materials should be stripped and disposed of off-site or outside the construction limits. Stripping depths on the order of 2 to 3 inches should be anticipated for the projects with locally deeper stripping possible depending on the conditions encountered during grading.

5.3.2 Existing Utilities, Wells, and/or Foundations

If existing pipelines and/or subsurface improvements are located within the proposed improvement areas, they should be removed and/or rerouted beyond construction limits. Buried tanks or wells, if present, should be removed in compliance with applicable regulatory agency requirements. Existing, below-grade utility pipelines that extend beyond the limits of the proposed construction and that will be abandoned in-place should be plugged with lean concrete or grout to prevent migration of soil and/or water. All excavations resulting from removal and demolition activities should be cleaned of loose or disturbed material prior to placing any fill or backfill.

5.3.3 Keying and Benching

The proposed structure locations are generally flat and level. Keying and benching for fill placement are not anticipated to be needed for improvements associated with these projects.

5.3.4 Wet/Unstable Soil Conditions

Near-surface groundwater was not encountered in our drill holes advanced at either PS location for this project. It is unlikely that near-surface groundwater will create wet or unstable soil conditions throughout the year. However, perched groundwater and/or wet soil conditions due to precipitation of on-site water discharge and usage could hinder equipment access as well as efforts to compact site soils to a specified level of compaction.

If over optimum soil moisture content conditions are encountered during construction, disking to aerate, replacement with imported material, chemical treatment, stabilization with a geotextile fabric or grid, and/or other methods will likely be required to facilitate earthwork operations. The applicable method of stabilization is the Contractor's responsibility and will depend on the Contractor's capabilities and experience, as well as other project-related factors beyond the scope of this investigation. Therefore, if over-optimum moisture within the soil is encountered during construction, BAJADA should review these conditions (as well as the Contractor's capabilities) and, if requested, provide recommendations for their treatment.

5.3.5 Site Drainage

Grading should be performed in such a manner that provides a positive surface gradient away from all structures. The ponding of water should not be allowed adjacent to structures, retaining walls, or the top of cut or fill slopes. Surface runoff should be directed toward engineered collection systems and not allowed to flow across the site or over slopes. Discharge from structures should also be collected, conveyed, and discharged at least 20 feet away from structures.

5.3.6 Excavation Characteristics

Exploration at each PS site was performed by a drill rig using 8.25-inch diameter hollow-stem augers. Penetration of underlying soil and rock materials was performed with little to moderate difficulty. It is our opinion that these materials should be excavatable with heavy grading equipment with slight to moderate difficulty.

5.3.7 Overexcavation

Overexcavation at the Lake Drive or Sneath Lane PS sites is not anticipated to be necessary for this project unless areas of soft and yielding soils are encountered, deleterious materials are exposed in subgrade soils, or organic-laden soils are observed. If those conditions are encountered, BAJADA should be contacted to help develop recommendations to mitigate those conditions.

5.3.8 On-Site Soil Materials

It is our opinion that most of the near-surface soils encountered at the site can be used for general engineered fill provided they are free of organics, debris, oversized particles (>3") and deleterious materials. Highly plastic clayey materials (materials having a plasticity index exceeding 30 and a liquid limit more than 50) should be segregated and excluded from engineered fill, where possible. If potentially unsuitable soil is considered for use as engineered fill, BAJADA should observe, test, and provide recommendations as to the suitability of the material prior to placement as engineered fill.

5.3.9 Engineered Fill Materials and Placement

5.3.9.1 General Engineered Fill

If imported fill materials are used for this project, they should consist of soil and/or soil-aggregate mixtures generally less than 3 inches in maximum dimension, nearly free of organic or other deleterious debris, and essentially non-plastic. Typically, well-graded mixtures of gravel, sand, non-plastic silt, and minor quantities of clay are acceptable for use as imported general engineered fill. Gradation and plasticity recommendations for general engineered fill are presented in the table below.

5.3.9.2 Structural Fill

Structural fill materials are defined as those materials specifically intended for support of structures and pavements. General recommendations for structural fill are presented in the table below and should be considered minimum requirements.

All imported fill materials, whether General or Structural, should be sampled and tested prior to importation to the project site to verify that those materials meet the recommended material criteria, in accordance with applicable test procedures to verify material suitability, as shown in the following table.

IMPORTED FILL RECOMMENDATIONS				
GRADATION				
Sieve Size	**General Fill**	**Granular Fill**	**Test Procedures**	
	Percent Passing		**ASTM**	**AASHTO**
3-inch	100	100	D422	T88
¾-inch	70 – 100	70 – 100	D422	T88
No. 200	0 - 30	<5	D422	T88
PLASTICITY				
Liquid Limit	<30	NA	D4318	T89
Plasticity Index	<12	Nonplastic	D4318	T90
ORGANIC CONTENT	<1%	<1%	D2974	NA
SOIL CHEMISTRY	Chloride <500 ppm	Sulfate <1,000 ppm	Resistivity >2,000 ohm-cm	pH 6-7

5.3.10 Controlled Low Strength Material

Controlled low strength material (CLSM) can be used to backfill excavated areas or as engineered fill materials. CLSM consists of a fluid, workable mixture of aggregate, cement, and water that is of limited strength as to allow future excavation and maintenance of buried improvements yet capable of supporting the proposed improvements. If CLSM is used as engineered fill material, we recommend that it conform and be placed per specifications

presented in Section 19-3.062 of the Caltrans Standard Specifications (most current edition).

5.3.11 Placement & Compaction

Soil and/or soil-aggregate mixtures used for general engineered fill should be uniformly moisture-conditioned to within 3 percent of optimum moisture content, placed in horizontal lifts less than 8 inches in loose thickness, and compacted to at least 90 percent relative compaction in accordance with standard test method ASTM D1557[1]. All structural fill should be placed in the same manner and compacted to at least 95% relative compaction per ASTM D1557.

It is recommended that fill materials be placed and compacted uniformly in elevation around buried structures and that the vertical elevation differential of contiguous lifts diverge no more than three feet around the structure during compaction. Testing should be performed to verify that the relative compactions are being obtained as recommended herein. Compaction testing, at a minimum, should consist of one test per every 500 cubic yards of soil being placed or at every 1.5-foot vertical fill interval, whichever comes first.

In general, a "sheep's foot" or "wedge foot" compactor should be used to compact fine-grained fill materials. A vibrating smooth-drum roller could be used to compact granular fill materials and final fill surfaces.

5.4 FOUNDATIONS & SLABS

5.4.1 Transition Lots

Transitions lots are those sites where a structure foundation will be supported partially by two different geologic materials, such as artificial fill beneath one portion of the structure and undisturbed native soil beneath the remainder of the structure. Those two materials could cause structures to settle at differing rates and magnitudes. The resulting differential settlement could cause damage to the structure, structure performance, or performance of equipment within the structure.

It is not anticipated that transition lots will be present at the proposed structure locations. We anticipate that the Lake Drive PS will be supported entirely on artificial fill materials and that the Sneath Lane PS addition will be supported entirely on sandstone of the Modesto Formation. If the proposed improvement locations shown on Plates 2.1 and 2.2 are moved, then BAJADA should be given the opportunity to re-evaluate whether transitions lots are present.

[1] This test method (ASTM D1557) applies wherever relative compaction, maximum dry density, or optimum moisture content is referenced within this report.

5.4.2 Foundations

The foundations for all the buried structures should be designed by the project civil/structural engineer in accordance with the recommendations presented in this report. We recommend that BAJADA be allowed to observe foundation excavations to confirm projected site conditions.

5.4.3 Bearing Pressures

An allowable bearing pressure of 1,500 psf for isolated spread footing elements can be used for design of the Lake Drive PS building foundations. Am allowable bearing pressure of 2,000 psf for isolated footing elements can be used for design of the Sneath Lane PS building foundations. Allowable bearing pressures can be proportioned for dead loads plus probable maximum live load.

5.4.4 Sliding Resistance

For both sites, ultimate sliding resistance generated through a compacted soil/concrete interface can be computed by multiplying the total dead weight structural loads by the friction coefficient of 0.40 for native soils or imported granular engineered fill, respectively. If a membrane, such as polysheeting or PVC, is utilized between the tank foundations and/or slab, then the coefficient of friction between the foundations and/or slab and that sheeting should be established through consultation with the membrane manufacturer.

5.4.5 Passive Resistance

For both sites, ultimate passive resistance developed from lateral bearing of foundation elements against compacted soil surfaces for that portion of the foundation element extending below a depth of 1 foot below the lowest adjacent grade can be estimated using an equivalent fluid weight if 300 pcf. An appropriate factor of safety should be applied to this value.

5.4.6 Safety Factors

Sliding resistance and passive pressure may be used together in conjunction with the following recommended safety factors. A minimum factor of safety of 1.5 is recommended for foundation sliding, where sliding resistance and passive pressure are used together.

5.4.7 Frost Penetration

It should be noted that frost heave is not typically a hazard in the project area and is generally not considered in design of foundation systems. Therefore, no recommendations for frost protection have been provided for either PS.

5.4.8 Slab-on-Grade Design

All ground-supported concrete slabs should be designed by a structural or civil engineer to support the anticipated floor loading conditions. In addition to anticipated floor loads, the design considerations include, but are not limited to, concrete mix design, structural reinforcement, joint spacing, crack control, slab underlayment, moisture control and corrosion resistance. Reinforcement for slabs should meet all applicable code requirements. Reinforcement should be placed in the slab per the design requirements of the structural or civil engineer with provisions to ensure it stays in that position during construction and concrete placement.

5.4.9 Lateral Earth Pressures

It is our understanding that buried structures and retaining walls (hereafter referred to as retaining walls) might be utilized in this project. Retaining walls, including buried concrete tank walls, should be designed to resist earth pressures exerted by the retained, compacted backfill plus any additional lateral force that will be applied to the wall due to surface loads placed at or near the wall. The recommended equivalent fluid weights presented below are for static (non-earthquake) conditions.

LATERAL EARTH PRESSURES UNDER STATIC CONDITIONS		
Lateral Earth Pressure Condition	**Slope Inclination Above Structure**	**Equivalent Fluid Weight (pcf)**
		Drained
At-Rest	Flat	60
Active	Flat	40
At-Rest	2:1	85
Active	2:1	70

The resultant force of the static lateral force prism should be applied at a distance of 33 percent of the wall height above the soil elevation on the toe side of the wall.

The tabulated values are based on a soil unit weight of 125 pounds per cubic foot (pcf), and do not provide for surcharge conditions resulting from construction materials, equipment, or vehicle traffic. Loads not considered as surcharges should bear behind a 1:1 (horizontal to vertical) line projected upward from the base of the shoring. If surcharges are expected, BAJADA should be advised so that we can provide additional recommendations as needed. Surcharge loads induce additional pressures on earth retaining structures. An additional lateral load on non-yielding walls equal to 0.5 times the applied surcharge pressure should be included in the design for uniform area surcharge pressures. Lateral pressures for other surcharge loading conditions can be provided, if required.

Sliding resistance, passive pressures, and safety factors are discussed below in Section 5.5.4, 5.5.5, and 5.5.6, respectively.

5.5 RETAINING WALLS

5.5.1 Lateral Earth Pressures

If retaining walls are utilized in this project, they should be designed to resist earth pressures exerted by the retained, compacted backfill plus any additional lateral force that will be applied to the wall due to surface loads placed at or near the wall. The recommended equivalent fluid weights are presented in section 5.4.9 of this report.

The resultant force of the static lateral force prism should be applied at a distance of 33 percent of the wall height above the bottom of the foundation on the back of the wall.

The tabulated values are based on a soil unit weight of 125 pounds per cubic foot (pcf), and do not provide for surcharge conditions resulting from foundations, vehicle traffic, or compaction equipment. The drained values do not provide for hydrostatic forces (for example, standing water in the backfill materials). Foundation loads not considered as surcharges should bear behind a 1:1 (horizontal to vertical) line projected upward from the base of the wall. If conditions such as surcharge resulting from footings or hydrostatic forces are expected, BAJADA should be advised so that we can provide additional recommendations as needed.

Surcharge loads induce additional pressures on earth retaining structures. An additional lateral load on non-yielding walls equal to 0.5 times the applied surcharge pressure should be included in the design for uniform area surcharge pressures. Lateral pressures for other surcharge loading conditions can be provided, if required.

5.5.2 Drainage Measures

Drainage measures should be constructed behind the proposed retaining walls to reduce the potential for groundwater accumulation. To help reduce the potential for the buildup of hydrostatic forces behind walls, a granular free-draining backfill, at least 2 feet thick should be placed behind the wall, as shown on Plate 7 – Retaining Wall Details. The two-foot thick layer can be decreased to one foot in thickness if wrapped with a geosynthetic filter fabric; however, the structural engineer should be consulted to confirm that the retaining wall is designed to withstand potential increased stresses due to compaction closer to the wall. The free-draining backfill should consist of clean, coarse-grained material with no more than 3 percent passing the No. 200 sieve. Acceptable backfill would be:

- Pervious Backfill conforming to Item 300-3.5.2 of the *Standard Specifications for Public Works Construction* (Greenbook), most current edition;
- Permeable Material (Class 2) conforming to Item 68-1.025 of the *Caltrans Standard Specifications*, most current edition;
- Pea gravel having a nominal diameter of ¼-inch; or
- Crushed stone sized between ¼-inch and ½-inch.

In lieu of free-draining backfill materials of the types suggested above, manufactured (geosynthetic) drainage systems (for example MiraDrain manufactured by TC Mirafi, Inc., or equivalent) can be used against retaining or below-grade walls. Manufacturer recommendations for the installation and maintenance of these products should generally be followed, although they should be reviewed by BAJADA for approval. In addition, manufactured drainage systems should be attached to the retaining wall face as opposed to the excavated slope face. This requires that provisions to protect the integrity of the drainage panels will need to be made while fill materials are being placed behind the walls.

A perforated drainpipe system should be installed at the base of the wall to collect water from the free-draining material and/or geosynthetic drainage system. The drainpipe system should allow gravity drainage of the collected water away from the buried wall or, as a less preferred option, should be tied into a sump and pump system to remove the water to an acceptable outlet facility.

Finish surface grades should be sloped away from the retaining walls and designed to channel water to an acceptable collection and offsite disposal system. Provisions should be included for removal of surface runoff that may tend to collect behind the backs of walls and for drainage of water away from the fronts of walls. Also, provisions should be included to mitigate the infiltration of surface water into the below-ground, free-draining backfill/geosynthetic drainage system by placing a minimum of 18-inches of low permeability compacted soil over the top of those materials.

5.5.3 Dynamic Earth Pressures

For unrestrained walls, the increase in lateral earth pressure acting on the wall resulting from earthquake loading can be estimated using the approach of Seed and Whitman (1970). That theory assumes that sufficient wall movement occurs during seismic shaking to allow active earth pressure conditions to develop. For restrained walls, the increase in lateral earth pressure resulting from earthquake loading also can be estimated using these relations. Because that theory assumes that sufficient movement occurs so that active earth pressure conditions develop during seismic shaking, the applicability of the theory to restrained or basement walls is not direct; however, there have been studies (Nadim and Whitman, 1992) that suggest the theory can be used for such walls.

In the Seed and Whitman (1970) approach, the total dynamic pressure can be divided into static and dynamic components. The estimated dynamic lateral force increase (based on seismic loading conditions) for either unrestrained or restrained walls, could be taken as the following:

$$P_E = 3/8 * pga * \gamma_t * H^2$$

Where:

P_E	=	Seismically-induced horizontal force (lbs per lineal foot of wall)
Pga	=	Peak Ground Acceleration (g)
γ_t	=	Total unit weight of backfill (pcf)
H	=	Height of the wall below the ground surface (ft)

Peak ground acceleration (pga) values for the site are provided in Section 3.1 of this report. The centroid of the dynamic lateral force increment should be applied at a distance of 0.6*H above the base of the wall.

To estimate the total dynamic lateral force, the dynamic lateral force increase should be added to the static earth pressure force computed using recommendations for active lateral earth pressures presented above. That recommendation is based on the concept that during shaking, earth pressures recommended for permanent conditions will be reduced to those more closely approximating active conditions.

5.5.4 Sliding Resistance

Ultimate sliding resistance generated through a compacted soil/concrete interface can be computed by multiplying the total dead weight structural loads by the friction coefficient of 0.30 or 0.35 for native soils or imported granular engineered fill, respectively. A coefficient of friction of 0.40 can be used between aggregate base and the concrete tank foundations and slab on grade. If a membrane, such as polysheeting or PVC, is utilized between the tank foundations and/or slab, then the coefficient of friction between the foundations and/or slab and that sheeting should be established through consultation with the membrane manufacturer.

5.5.5 Passive Resistance

Ultimate passive resistance developed from lateral bearing of shallow foundation elements bearing against compacted soil surfaces for that portion of the foundation element extending below a depth of 1 foot below the lowest adjacent grade can be estimated using an equivalent fluid weight of 350 pcf.

5.5.6 Safety Factors

Sliding resistance and passive pressure may be used together without reduction in

conjunction with the following recommended safety factors. A minimum factor of safety of 1.5 is recommended for foundation sliding where sliding resistance and passive pressure are used together.

5.5.7 Construction Considerations

Prior to placing steel or concrete, foundation excavations should be cleaned of all debris, loose or disturbed soil, and any water. A representative of BAJADA should observe all foundation excavations prior to concrete placement.

6 REVIEW OF PLANS AND SPECIFICATIONS

We recommend BAJADA conduct a general review of final plans and specifications to evaluate that preliminary recommendations contained herein have been properly interpreted and implemented during design. If BAJADA is not retained to perform this recommended review, we will assume no responsibility for misinterpretation of our recommendations.

7 LIMITATIONS

This report has been prepared in substantial accordance with the generally accepted geotechnical engineering practice, as it existed in the site area at the time our services were rendered. No other warranty, either express or implied, is made.

Conclusions and recommendations contained in this report were based on the conditions encountered during our field investigation and are applicable only to those project features specifically addressed and described herein (see Section 1.1 – Project Understanding). Soil and rock deposits can vary in type, strength, and other geotechnical properties between points of observation and exploration. Additionally, groundwater and soil moisture conditions can also vary seasonally and for other reasons. Therefore, we do not and cannot have a complete knowledge of the subsurface conditions underlying the project site. The conclusions and recommendations presented in this report are based upon the findings at the points of exploration, and interpolation and extrapolation of information between and beyond the points of observation, and are subject to confirmation based on the conditions revealed by construction. If conditions encountered during construction differ from those described in this report, or if the scope or nature of the proposed construction changes, we should be notified immediately in order to review and, if deemed necessary, conduct additional studies and/or provide supplemental recommendations. When final site design plans (grading, foundation, retaining walls, etc.) become available, BAJADA should have the opportunity to review the plans to ensure the recommendations presented in this report remain valid and applicable to the proposed project.

Recommendations provided in this report assume that an experienced, properly licensed geotechnical engineering company will conduct an adequate program of testing and observation during the construction phase to evaluate compliance with our recommendations.

The scope of services provided by BAJADA for this project did not include the investigation and/or evaluation of toxic substances, or soil or groundwater contamination of any type. If such conditions are encountered during site development, additional studies may be required. Further, services provided by BAJADA for this project did not include the evaluation of the presence of critical environmental habitats or culturally sensitive areas. This report may be used only by our client and their agents and only for the purposes stated herein, within a reasonable time from its issuance. Land use, site conditions, and other factors may change over time that may require additional studies. In the event significant time elapses between the issuance date of this report and construction, BAJADA shall be notified of such occurrence in order to review current conditions. Depending on that review, BAJADA may require that additional studies be conducted and that an updated or revised report is issued.

Any party other than our client who wishes to use all or any portion of this report shall notify BAJADA of such intended use. Based on the intended use as well as other site-related factors, BAJADA may require that additional studies be conducted and that an updated or revised report be issued. Failure to comply with any of the requirements outlined above by the client or any other party shall release BAJADA from any liability arising from the unauthorized use of this report.



8 REFERENCES

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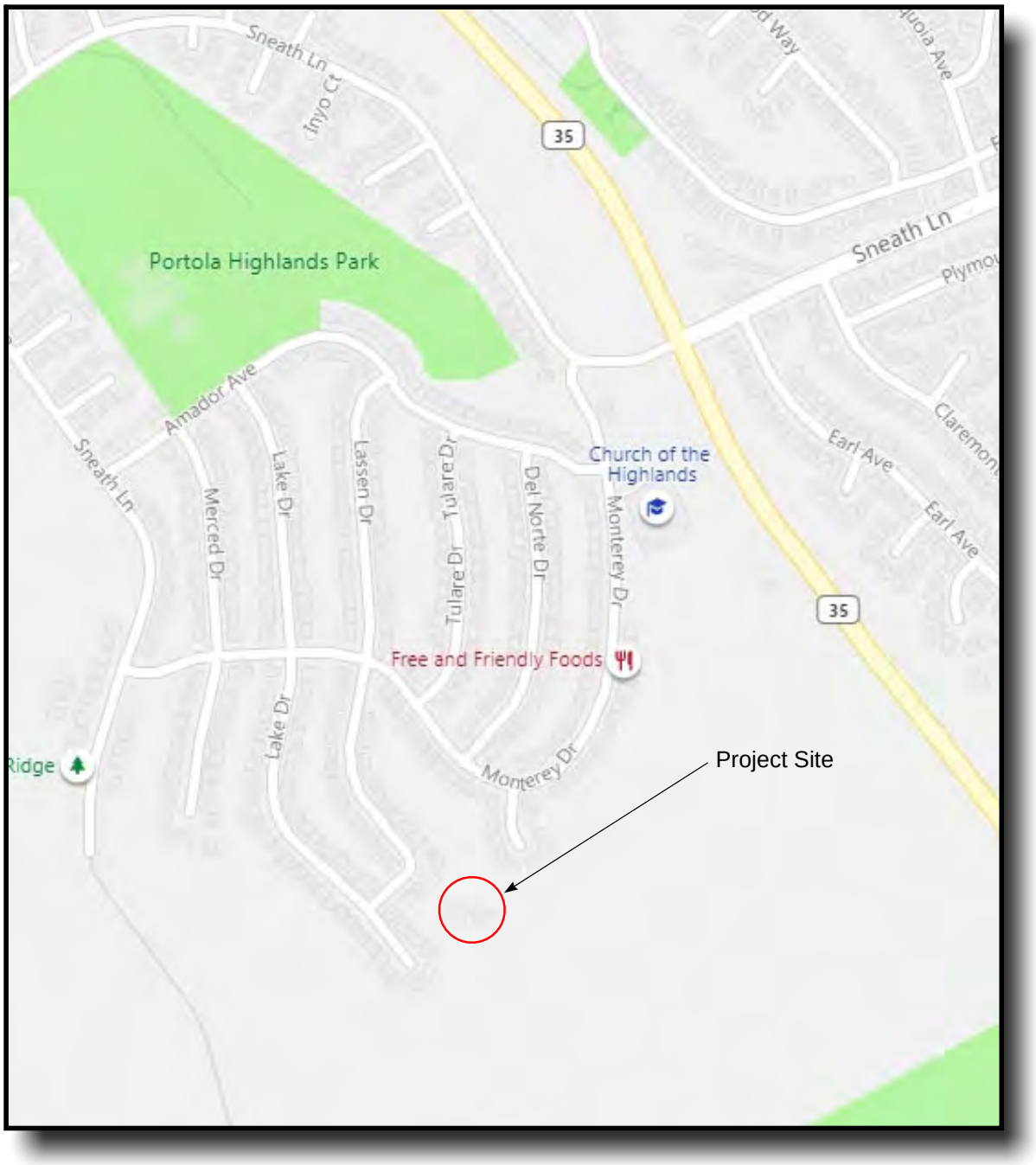
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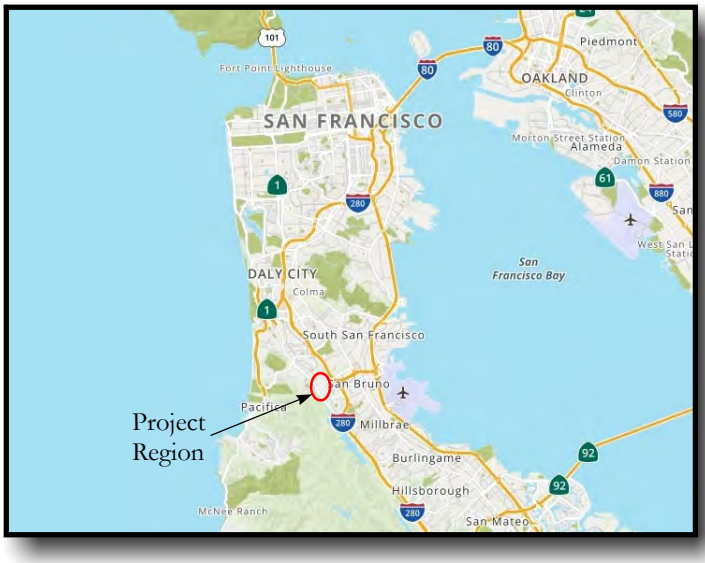
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SITE LOCATION MAP

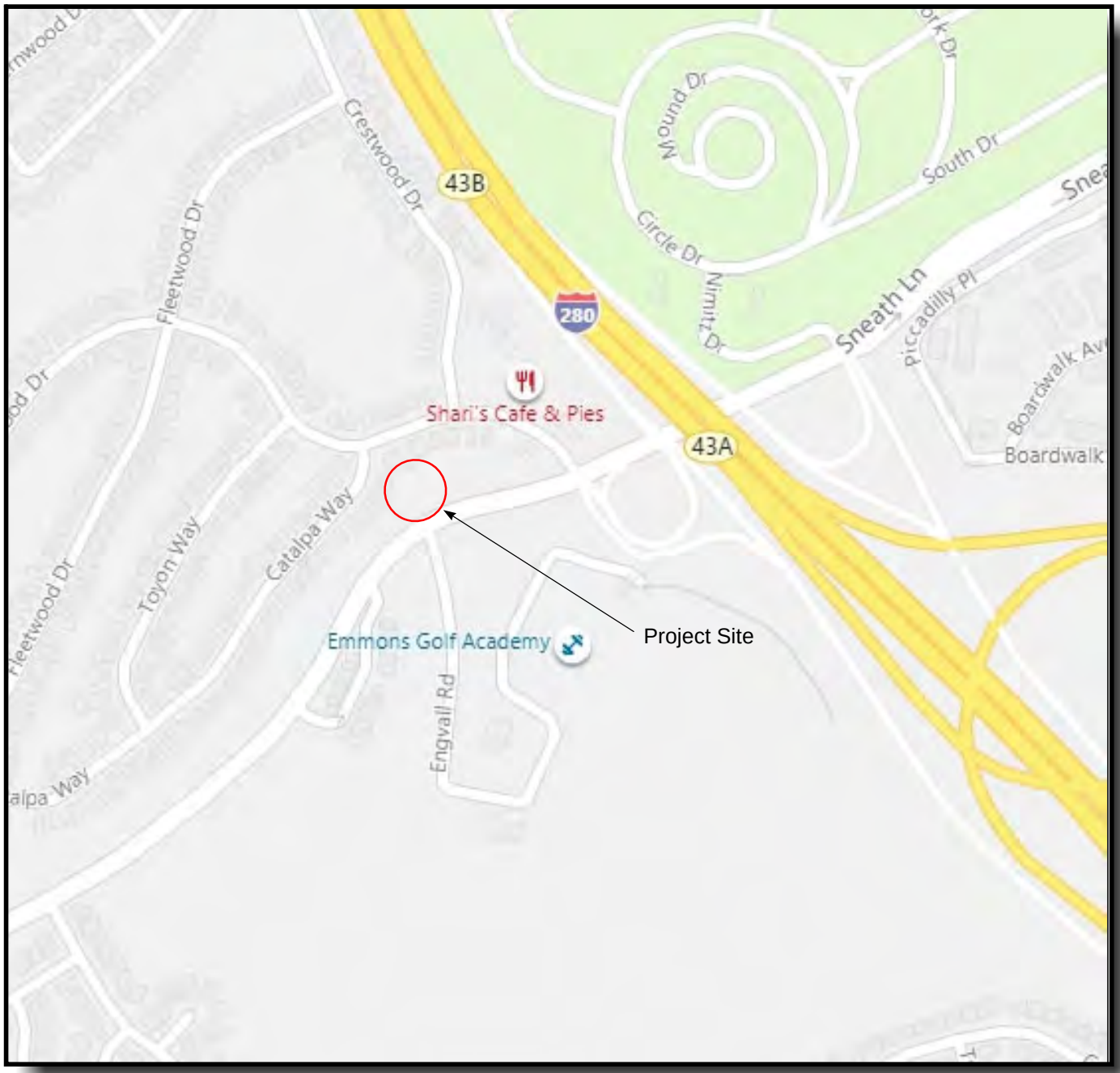
Lake Drive Pump Station
APN 017-441-290
Water Works Engineers
City of San Bruno, California

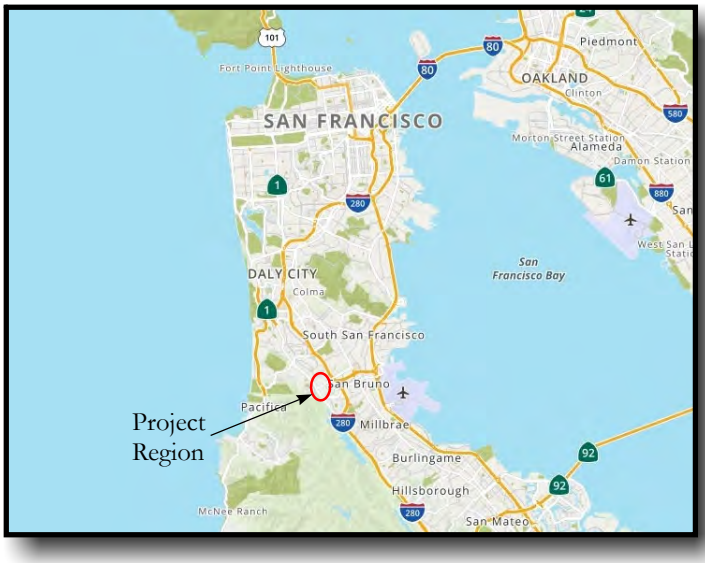
Plate No. 1.1

BAJADA Geosciences, Inc.

Project no. 1901.0130

Base maps from Mapquest & Bing Maps. Scale undetermined.





N

SITE LOCATION MAP

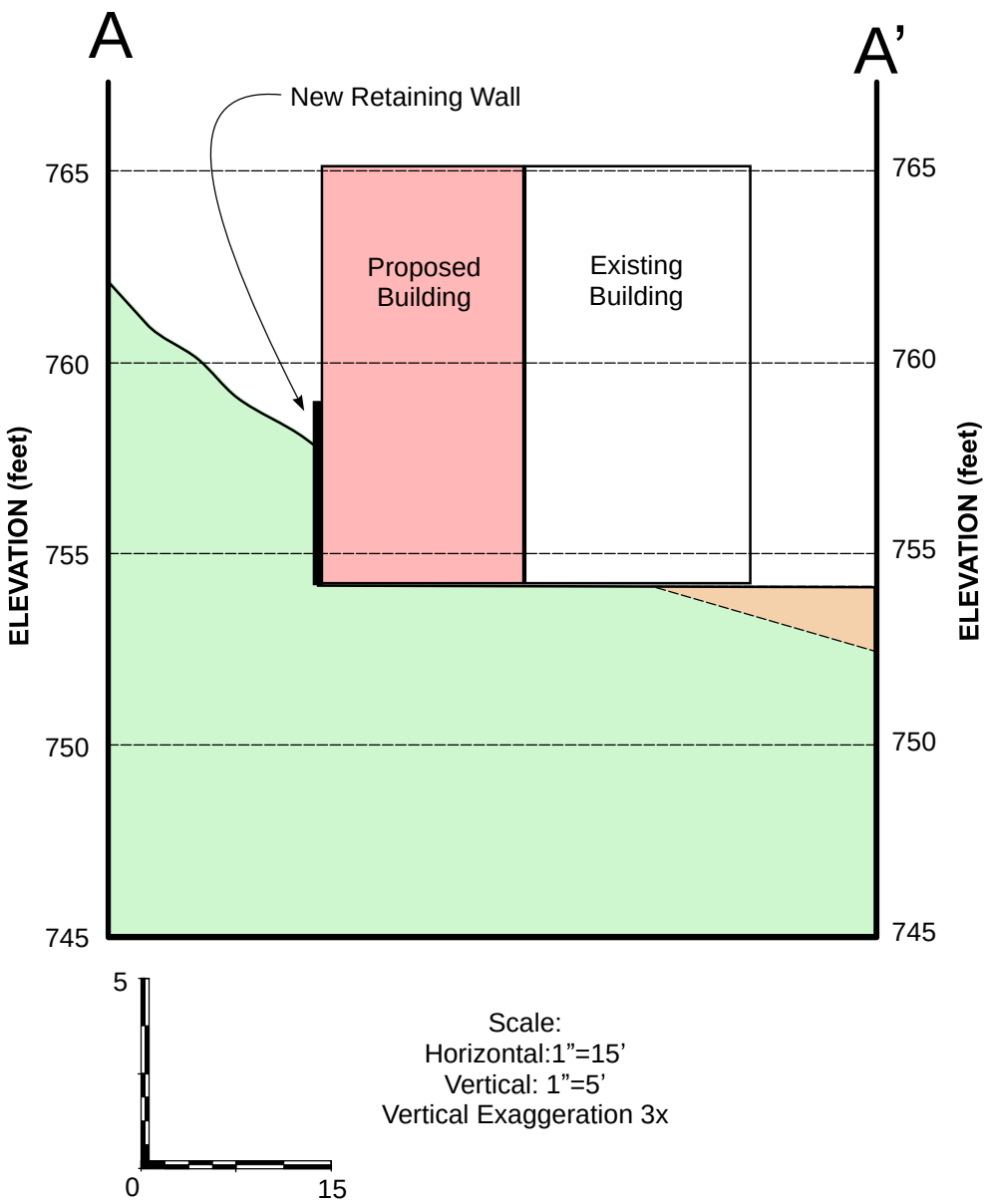
Sneath Lane Pump Station
APN 017-251-020
Water Works Engineers
City of San Bruno, California

Plate No. 1.2

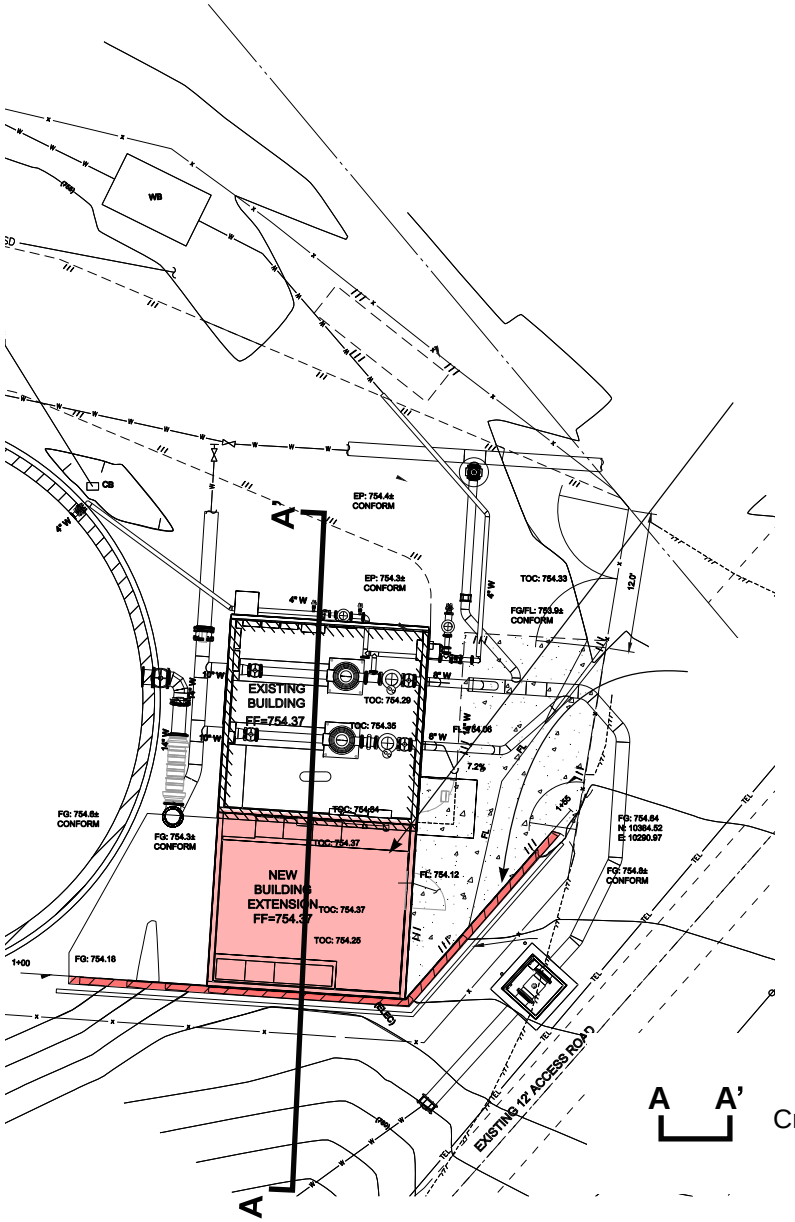
BAJADA Geosciences, Inc.

Project no. 1901.0130

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Scale:
Horizontal:1”=15’
Vertical: 1”=5’
Vertical Exaggeration 3x



A A’ Cross Section

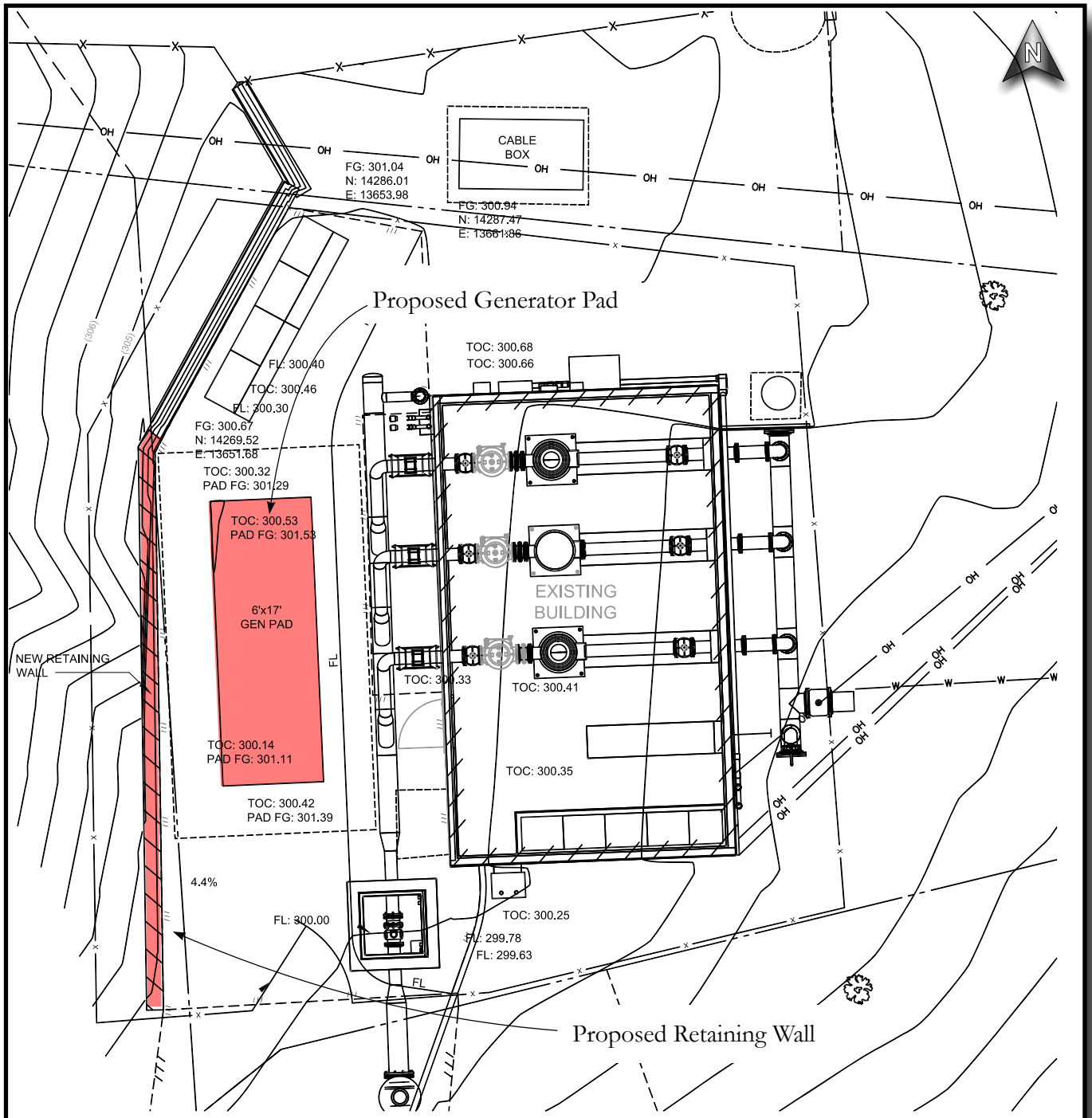
PROPOSED PROJECT IMPROVEMENTS

Lake Drive Pump Station
APN 017-441-290
Water Works Engineers
City of San Bruno, California

Plate No.
2.1

BAJADA Geosciences, Inc.

Project no.
1901.0130



Base map from WWE (2022). Scale undetermined

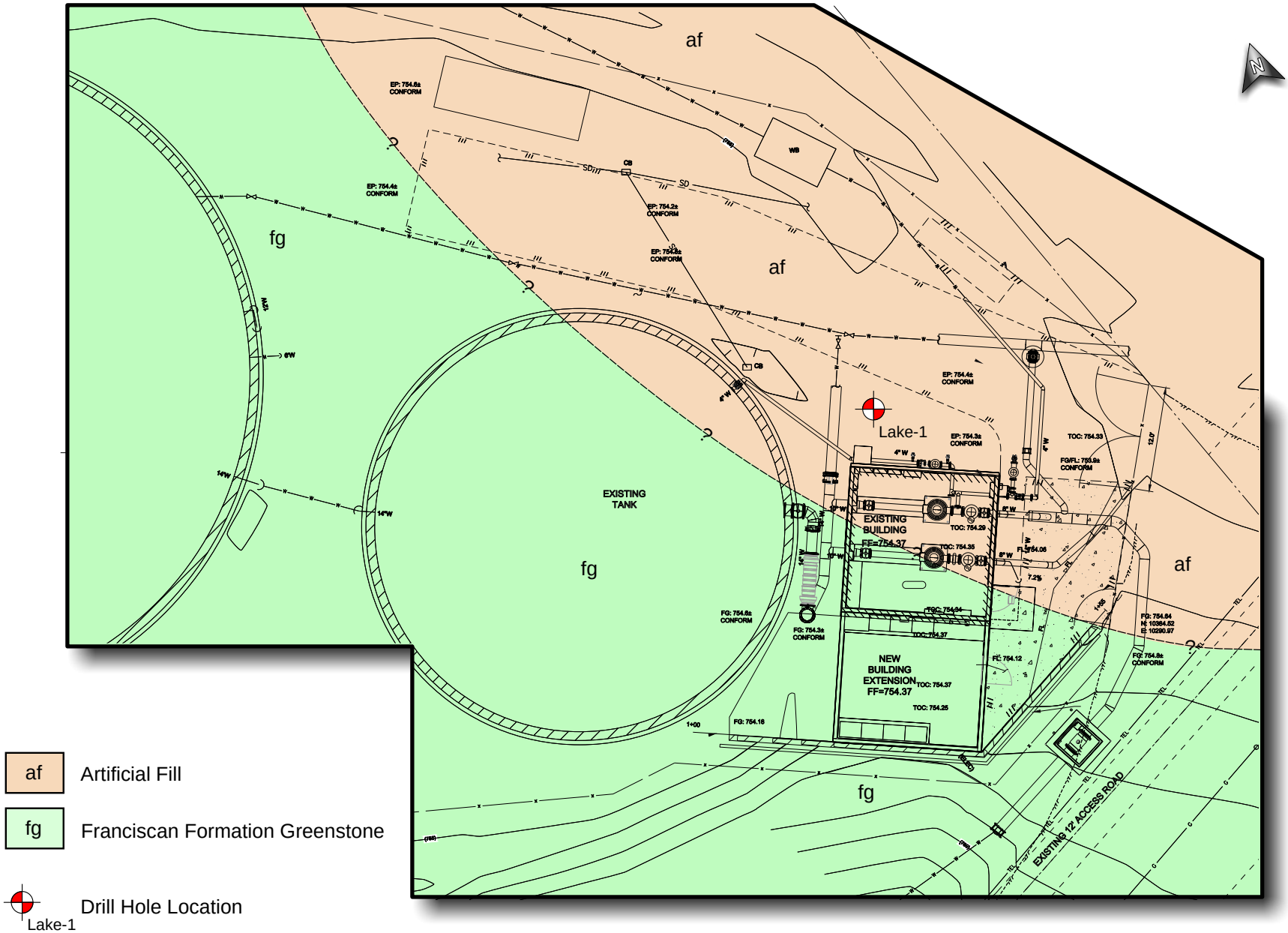
PROPOSED PROJECT IMPROVEMENTS

Sneath Lane Pump Station
APN 017-251-020
Water Works Engineers
City of San Bruno, California

Plate No. 2.2

BAJADA Geosciences, Inc.

Project no. 1901.0130



Base map from WWE (2022). Scale undetermined

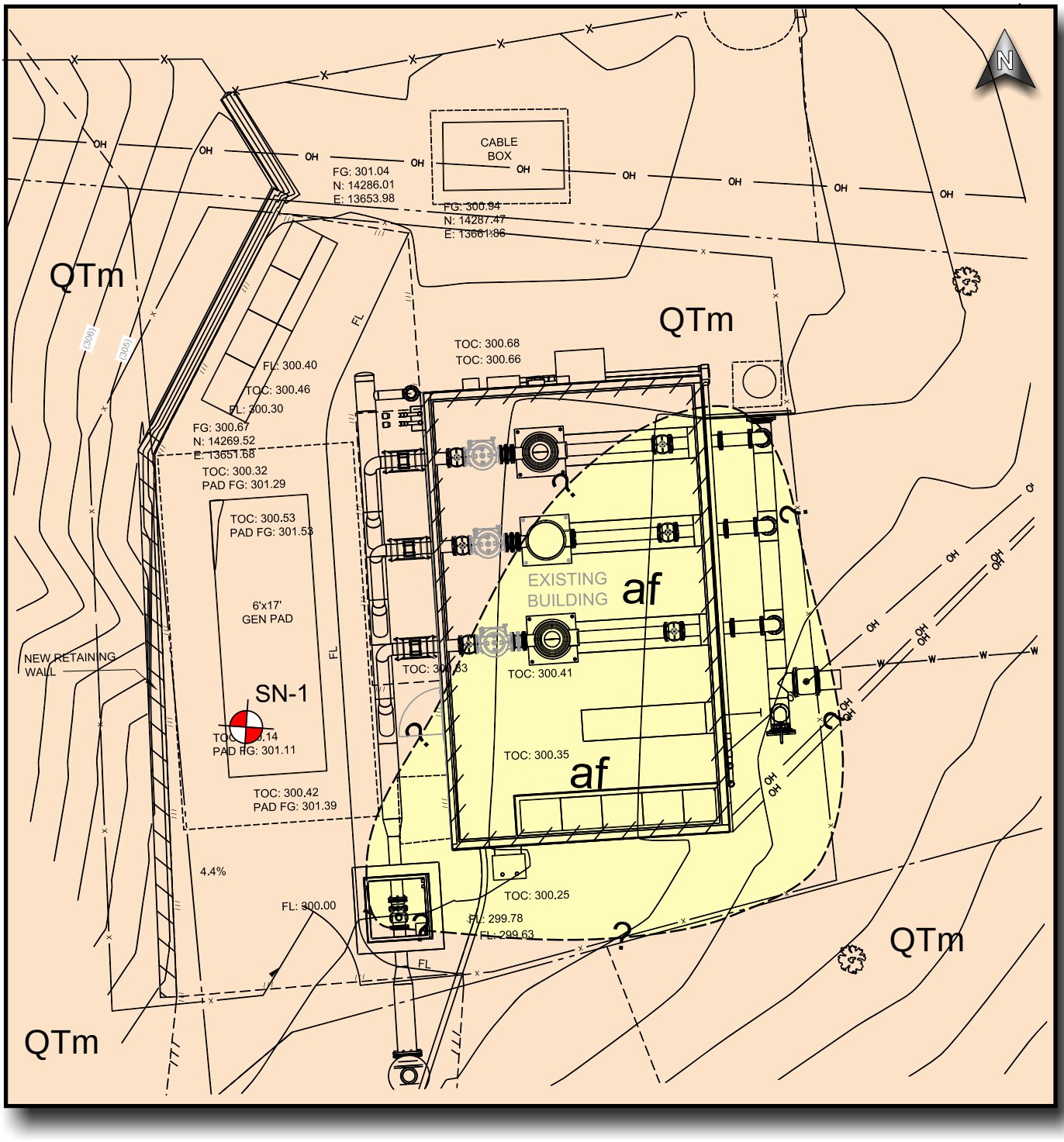
GEOTECHNICAL MAP

Lake Drive Pump Station
APN 017-441-290
Water Works Engineers
City of San Bruno, California

Plate No.
3.1

BAJADA Geosciences, Inc.

Project no.
1901.0130



af — Artificial Fill

QTm — Merced Formation

SN-1 — Drill Hole Location

Base map from Kier+Wright (2019). Scale undetermined

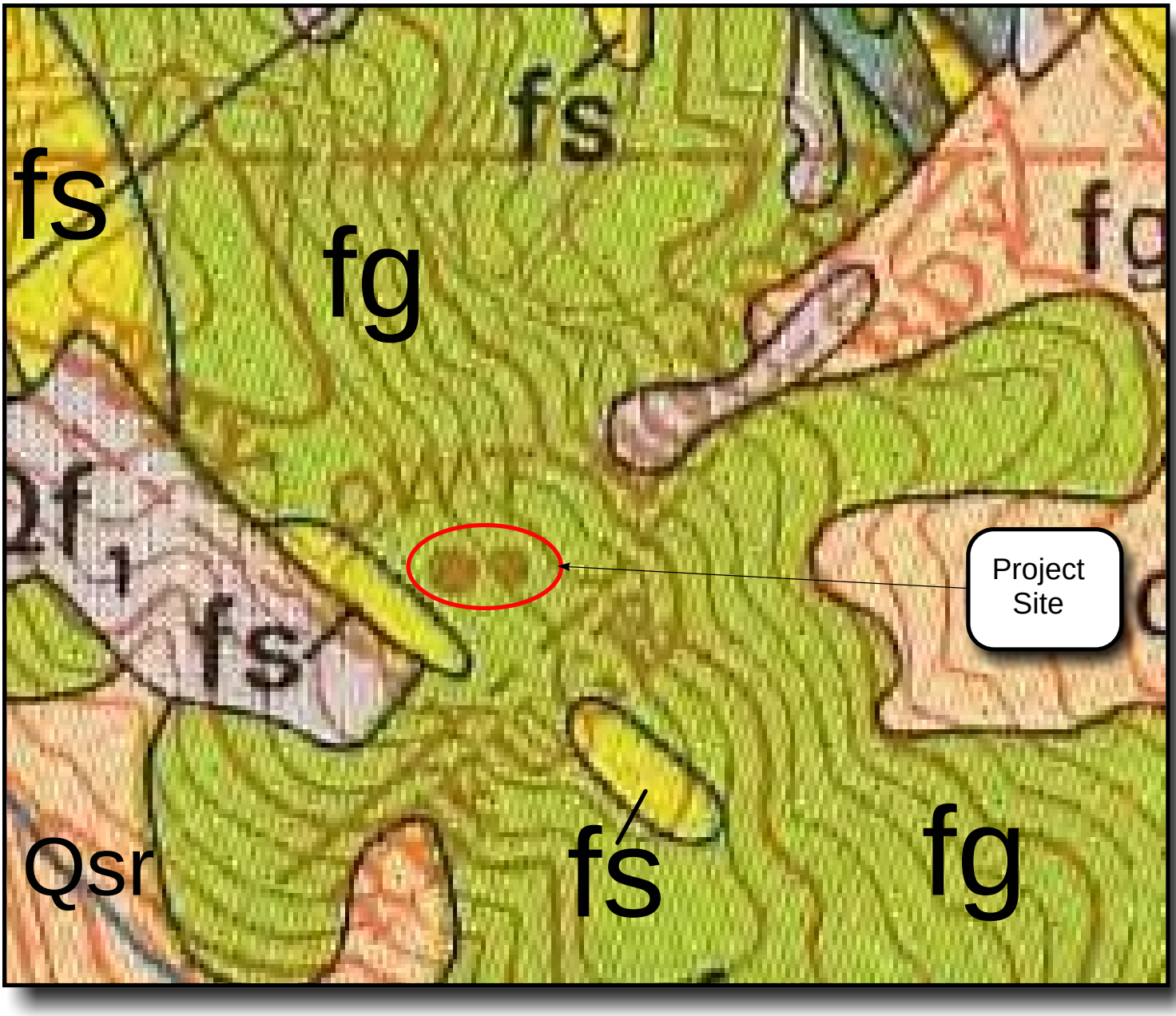
GEOTECHNICAL MAP

Sneath Lane Pump Station
APN 017-251-020
Water Works Engineers
City of San Bruno, California

Plate No. 3.2

BAJADA Geosciences, Inc.

Project no. 1901.0130



Qf_1	Artificial Fill
Qsr	Slope Wash
fs	Franciscan Formation Sandstone
fg	Franciscan Formation Greenstone

Base map from Pampayen (1994). Scale undetermined

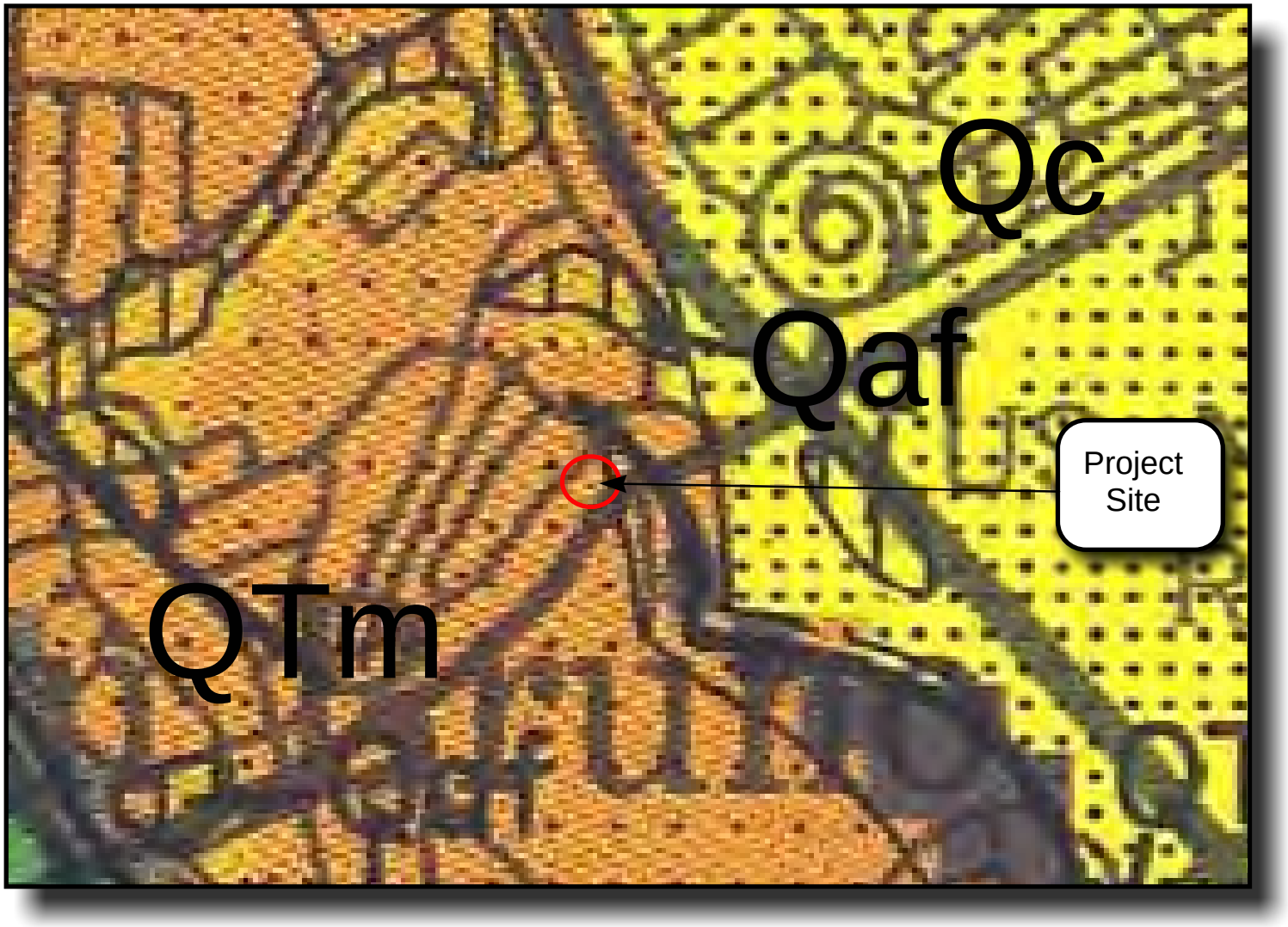
REGIONAL GEOLOGIC MAP

Lake Drive Pump Station
APN 017-441-290
Water Works Engineers
City of San Bruno, California

Plate No. 4.1

BAJADA Geosciences, Inc.

Project no. 1901.0130



Qaf Artificial Fill

Qc Colma Formation

QTm Merced Formattion

N

REGIONAL GEOLOGIC MAP

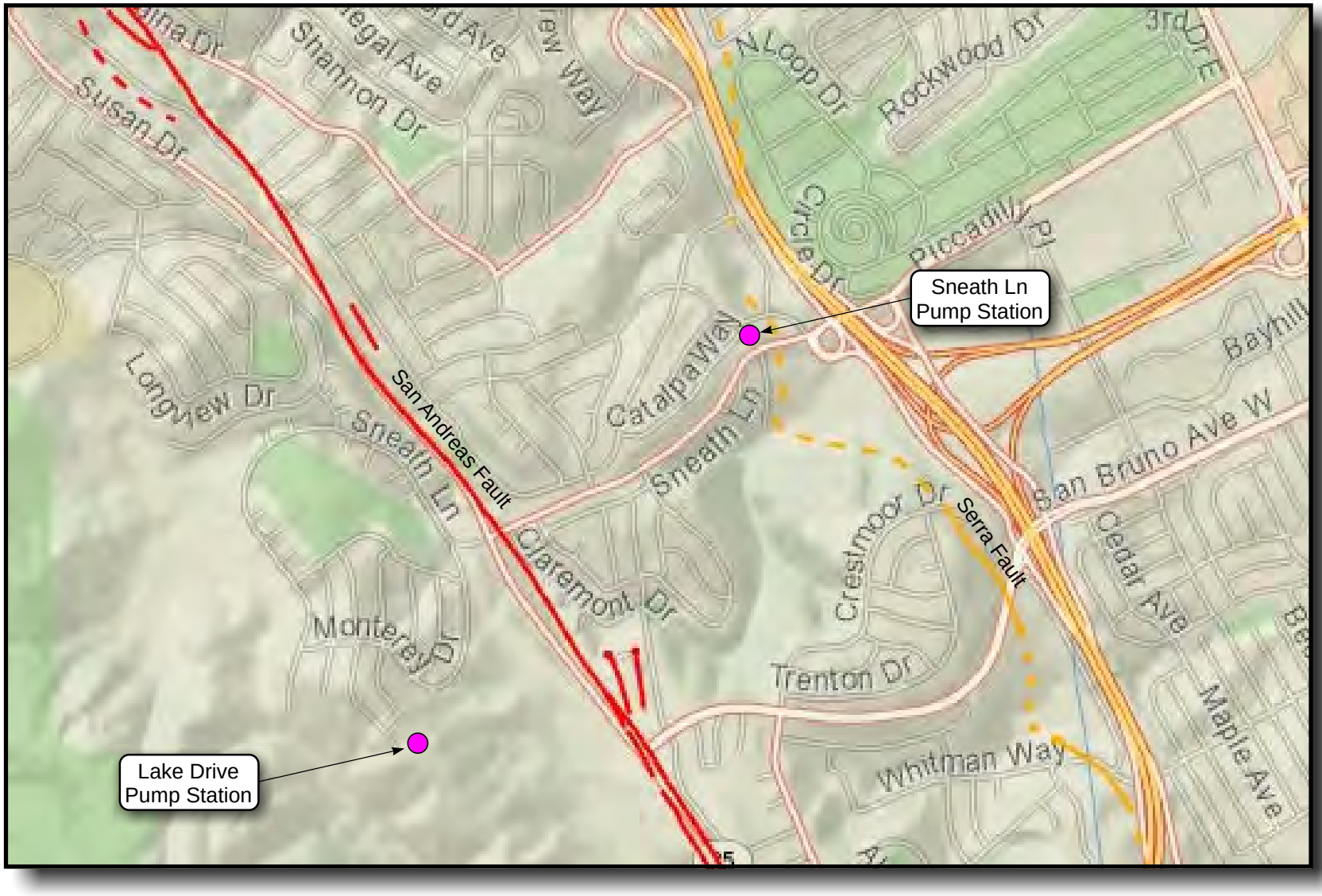
Sneath Lane Pump Station
APN 017-251-020
Water Works Engineers
City of San Bruno, California

Plate No. 4.2

BAJADA Geosciences, Inc.

Project no. 1901.0130

Base map from Brabb & Pampayen (1983). Scale undetermined



Active	
Historic Displacement (last 200 years)	Holocene Displacement (last 11,700 years)
Potentially Active	**Inactive**
Late Quaternary Displacement (last 700,000 years)	Quaternary Fault (last 1.6 million years)

Map from USGS Interactive Fault Map

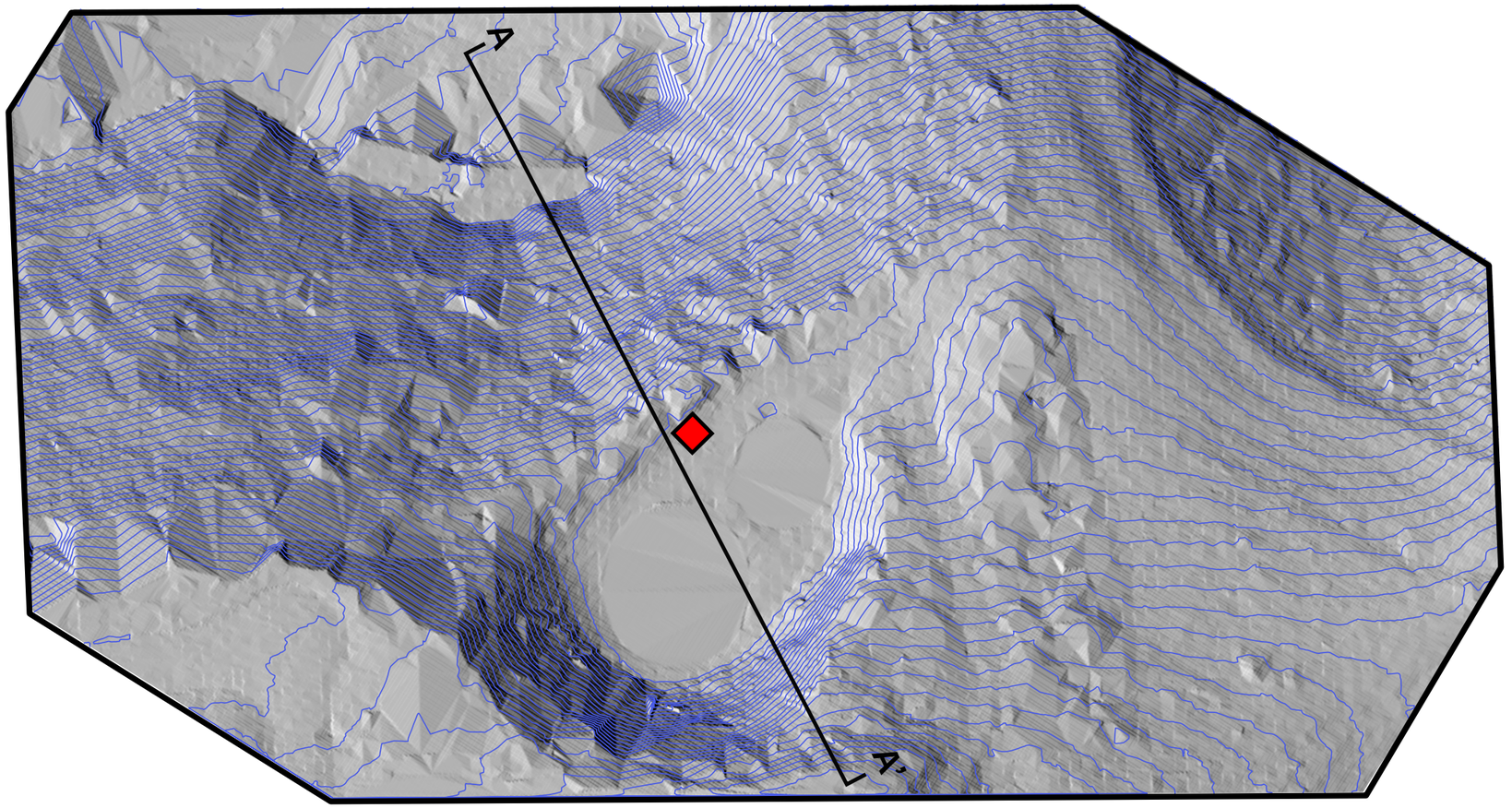
REGIONAL FAULT MAP

Lake Drive Pump Station
Sneath Lane Pump Station
Water Works Engineers
City of San Bruno, California

Plate No. 5

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Project no. 1901.0130

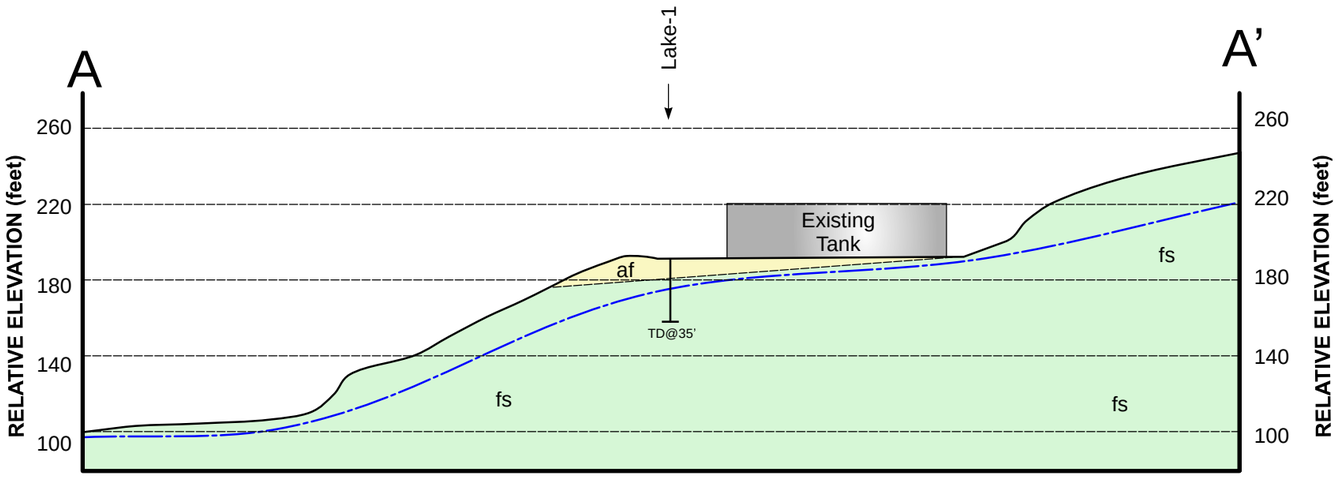


N

A A' Cross Section
see below

0 100 200

Scale: 1”=200’
1:2,400
Contour Intervals: 2’



af Artificial Fill

fs Franciscan Formation
Greenstone

Approximate Depth
to Groundwater

Scale:
Horizontal:1”=100’
Vertical: 1”=80’
Vertical Exaggeration 1.25x

80
40
0
50
100

DH-10 Drill Hole Number &
Projected Distance from
Cross Section Location

Drill Hole Location

TD@65' Total Drill Hole Depth (ft)

Topography developed from open-source LIDAR data.

LAKE DRIVE PUMP STATION
REGIONAL TOPOGRAPHY

Lake Drive Pump Station
APN 017-441-290
Water Works Engineers
City of San Bruno, California

Plate No.
6

BAJADA Geosciences, Inc.

Project no.
1901.0130

APPENDIX A

Subsurface Exploration

APPENDIX A
SUBSURFACE EXPLORATION

The subsurface exploration program for this study consisted of the advancement of two exploratory drill holes at selected locations, as shown on Plates 3.1 and 3.2. Prior to exploration, a drilling permit was obtained from San Mateo County Environmental Health Department. The drill holes were advanced on November 20, 2019 using a CME 75 track-mounted drill rig provided by Britton Exploration of Los Gatos, California. The drill holes were advanced using 8.25-inch diameter hollow-stem auger drilling methods.

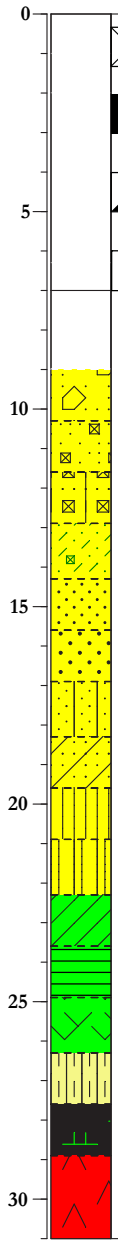
Samples of soils were collected from selected depth increments in the drill holes using California modified split-spoon and/or Standard Penetration Test (SPT) samplers. Samplers were driven by a 140-pound hammer situated on the drill rig, in accordance with standard test method ASTM D1586-11 Bulk samples were also obtained at selected depth intervals. Sample types and depths are presented on Plates A-2.1 through A-2.2. All samples were returned to Bajada's office for assignment of laboratory testing. The results of the testing procedures are attached within Appendix B.

The exploration log describes the earth materials encountered. The logs also show the location, exploration number, date of exploration, and the names of the logger and equipment used. A BAJADA geologist, using ASTM 2488 for visual soil classification, logged the explorations. The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual and may change with time. The drill holes were backfilled with cement grout. Soils generated by drilling operations were spread across the project site.

The drill hole logs are presented as Plates A-2.1 through A-2.2. A legend to the drill hole logs is presented as Plate A-1.1.

LOG OF EXPLORATION: Expl. No.

PROJECT:	BGI's Project Name	**EXPL. VENDOR:**	Expl. Subcontractor	**SURFACE ELEVATION:**	Expl. Elevation
PROJECT NO.:	BGI's Project No.	**EXPL. METHOD:**	Method of Expl.	**TOTAL DEPTH OF HOLE:**	Total Depth of Expl.
LOCATION:	General Location	**LOGGED BY:**	BGI's Logger	**DEPTH TO WATER:**	Depth to Water
START DATE:	Date Started Date	**CHECKED BY:**	BGI's Reviewer	**BACKFILLED WITH:**	Backfill Materials
END DATE:	Finished	**HAMMER TYPE:**	Type of Sample Hammer		



Depth (ft)	Material Symbol	Sample	Sample No.	Blow Count (blows/ft)	USCS Symbol	Material Description	Water Table	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200	Liquid Limit	Plasticity Index	Notes & Assigned Laboratory
			1			SAMPLES/BLOW COUNT SYMBOLS KEY Bulk Soils Sample							
			2	(24)		California modified split spoon sampler (CMSS) Brackets on blow counts indicates CMSS sample							CMSS: 2-3/8" ID, 3" OD, Driven
			3	50:5"		Standard penetration test (SPT) sample and blow count							SPT: 1-3/8" ID, 2" OD, Driven
						No sample recovery							Blow counts are recorded as the number of blows required for one foot of sampler penetration using a 140-lb hammer falling 30 inches. Typically, sampler is driven 18" and the initial 6" discarded.
						LITHOLOGIC GRAPHICS DESCRIPTIONS FOR SOILS MATERIALS (per ASTM D2487 & D2488)							
					GW	well graded GRAVEL							
					GP	poorly graded GRAVEL							
					GM	silty GRAVEL							
					GC	clayey GRAVEL							
					SW	well graded SAND							
					SP	poorly graded SAND							Initial water level measurement
					SM	silty SAND							Water level after initial measurement (may not represent stabilized water levels)
					SC	clayey SAND							
					ML	low plasticity SILT							
					MH	high plasticity SILT							
					CL	lean CLAY							Lab Abbreviations DS-direct shear; C-consolidation; GS-sieve; EI-Expansion Index; PI-Plasticity; UC-Unconfined; SC-soil chem.; SE-sand equiv.; R-R value; P-curve; PP-pocket penetrometer.
					CH	fat CLAY							
					PT	organic soils or peat							
					OL	organic SILTS or CLAYS with low plasticity							
					OH	organic SILTS or CLAYS with high plasticity							
					RX	ROCK							

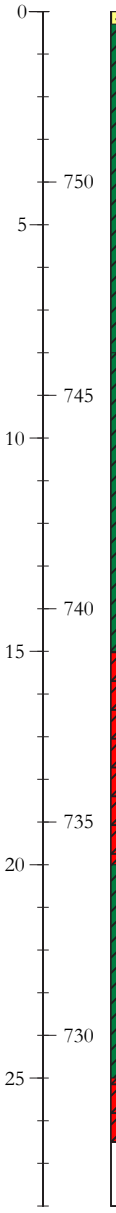
The log and data presented are a simplification of actual conditions encountered at the given location and time of exploration. Subsurface conditions may differ at other locations and with the passage of time.

BAJADA GEOSCIENCES, INC.

PLATE NO.: A-1.1

LOG OF EXPLORATION: Lake-1

PROJECT:	Lake Drive PS	**EXPL. VENDOR:**	Britton Exploration	**ELEVATION:**	754 feet
PROJECT NO.:	**1901.0130**	**EXPL. METHOD:**	6.5" SSA	**DEPTH TO WATER:**	17 feet
LOCATION:	San Bruno, CA	**LOGGED BY:**	J.Bianchin	**DEPTH OF HOLE:**	26.5 feet
START DATE:	11-20-19	**CHECKED BY:**	J. Everett	**BACKFILLED WITH:**	Cement grout
END DATE	11-20-19	**HAMMER TYPE:**	140-lb Auto		



Depth	Elevation	Material Symbol	Sample Type	Sample No.	Blow Count (blows/ft)	USCS	MATERIAL DESCRIPTION	Depth to Water	Dry Unit Weight (pcf)	Moisture Content (%)	% Passing No. 200	Liquid Limit	Plastic Index	Comments
0				B1		GW CL	: ARTIFICIAL FILL (af) Gravel (approximately 2 to 3 inches)				48	37	15	-#200,PI, Curve, Soil Chem, DS
	750			1	(11)		: Silty CLAY, moderate to dark brown, moist, plastic, with fine sand.		83.4	27.1	18			GS
5				2	(14)		: At 3 feet: firm to stiff, with trace subangular fine to medium gravel with thin interbeds of Clayey SAND.		106.3	21.2		41	15	PI
	745					CL	: FRANCISCAN FORMATION (KJfc) Silty CLAY, moderate brown, moist, plastic, with trace fine sand.							
10				3	(36)		: At 10 feet: stiff with thin randomly oriented stringers of wet fat clay, and trace subangular fine gravel.		110.8	18.8	56			GS
	740													
15				4	(45)	RX	: GREENSTONE, moderate brown, intensely weathered, weak, poorly indurated, highly fractured with relic rock texture and mangenese oxide on fracture faces.		115.0	19.7				
	735						: At 17 feet: greenish grey with strong petroleum odor.	▽						
20				5	(34)		: Silty CLAY, greenish grey, wet, stiff, plastic, fine to medium grained, with subangular fine to coarse gravel, possible cobbles, and strong petroleum odor.	▼						
	730													
25				6	(49)		: GREENSTONE, greenish grey, wet, moderately weathered, weak, poorly indurated, highly fractured, with strong petroleum odor.							
							: Bottom of Drill Hole at a Depth of 26.5 Feet.							

BAJADA Geosciences, Inc.

The log and data presented are a simplifaction of actual conditions encountered at the given location and time of exploration. Subsurface conditions may differ at other locations and with the passage of time.

PLATE NO.: A-2.1

LOG OF EXPLORATION: SN-1

PROJECT:	Sneath Ln PS	**EXPL. VENDOR:**	Britton Exploration	**ELEVATION:**	300.5 feet
PROJECT NO.:	1901.0130	**EXPL. METHOD:**	6.5" SSA	**DEPTH TO WATER:**	Not Encountered
LOCATION:	San Bruno, CA	**LOGGED BY:**	J.Bianchin	**DEPTH OF HOLE:**	22.5 feet
START DATE:	11-20-19	**CHECKED BY:**	J. Everett	**BACKFILLED WITH:**	Cement grout
END DATE	11-20-19	**HAMMER TYPE:**	140-lb Auto		

Depth	Elevation	Material Symbol	Sample Type	Sample No.	Blow Count (blows/ft)	USCS	MATERIAL DESCRIPTION	Depth to Water	Dry Unit Weight (pcf)	Moisture Content (%)	% Passing No. 200	Liquid Limit	Plastic Index	Comments
0	300			B1		af RX	: ARTIFICIAL FILL (af) ASPHALTIC CONCRETE (2.5") and AGGREGATE BASE (~2.5")				35			GS, Curve, Soil Chem
				1	(52)		: MERCED FORMATION (QTm) SANDSTONE, moderate brown, dry, fine grained.		119.2	9.1	35			DS
5	295			2	(61)		: At 3 feet: moderate yellowish brown mottled tan, dry, very dense, moderately weathered, weak, poorly indurated, friable, fine grained.		113.3	8.5				
10	290			3	(37)		: At 10 feet: with fine to coarse roots.		113.3	10.1	35			
15	285			4	(50:3")		: At 15 feet: slightly less weathered with thin layers of dark brown fine to coarse sand interbeds.		113.3	12.7				
20	280			5	50:4"		: At 20 feet: grey, fresh, hard.			4.6				
							: Bottom of Drill Hole at a Depth of 22.5 Feet.							

BAJADA Geosciences, Inc.

The log and data presented are a simplifaction of actual conditions encountered at the given location and time of exploration. Subsurface conditions may differ at other locations and with the passage of time.

PLATE NO.: A-2.2

APPENDIX B

Laboratory Testing

APPENDIX B
LABORATORY TESTING

Laboratory Analyses

Laboratory tests were performed on selected bulk soil samples to estimate engineering characteristics of the various earth materials encountered. Testing was performed under procedures described in one of the following references:

- ASTM Standards for Soil Testing, latest revision;
- Lambe, T. William, Soil Testing for Engineers, Wiley, New York, 1951;
- Laboratory Soils Testing, U.S. Army, Office of the Chief of Engineers, Engineering Manual No. 1110-2-1906, November 30, 1970.

In-Situ Moisture Density Relations

Dry density estimates and/or moisture content evaluations were performed on selected soil samples collected during this study. Tests were performed using standard test methods ASTM D2216 for moisture content or ASTM D2937 for dry unit weights. The results are presented on the respective Log of Drill holes.

Grain Size Distribution

Grain size distribution was determined for six selected soil samples in accordance with standard test method ASTM D422. The grain size distribution data are shown on the attached plates labeled *Particle Size Distribution*.

Plasticity Index Tests

Atterberg Limits (plastic limit, liquid limit, and plasticity index) tests were performed on two selected samples in accordance with standard test method ASTM D4318. The results of the tests are presented on the drill hole logs and on attached plates.

Direct Shear Tests

Direct shear tests were performed on two selected soil samples in accordance with standard test method ASTM D3080. Results of those tests are presented on attached plates labeled *Consolidated Drained Direct Shear*.

Maximum Density & Optimum Moisture Content

Maximum density and optimum moisture content were evaluated on two selected bulk soil samples in accordance with standard test method ASTM D1557. Results of those tests are presented on the attached plate labeled *Compaction Test Report*.

Soil Chemistry Tests for Corrosion

Two selected soil samples were tested to evaluate sulfate and chloride contents, pH, and resistivity. Tests were performed in accordance with standard test methods ASTM G51 and

G75, and California Test Method 417 and 422. Test results are presented on the attached plate labeled *Corrosivity Test Summary*.

Materials Testing, Inc.

8798 Airport Road
Redding, California 96002
(530) 222-1116, fax 222-1611

865 Cotting Lane, Suite A
Vacaville, California 95688
(707) 447-4025, fax 447-4143

Client: BAJADA Geosciences, Inc.
28301 Inwood Road
Shingletown, CA 96088

Client No.: 3237-033
Report No.: 0300-001
Date: 01/02/20

Project: San Bruno Pump Stations, Job#1901.013
San Bruno, California

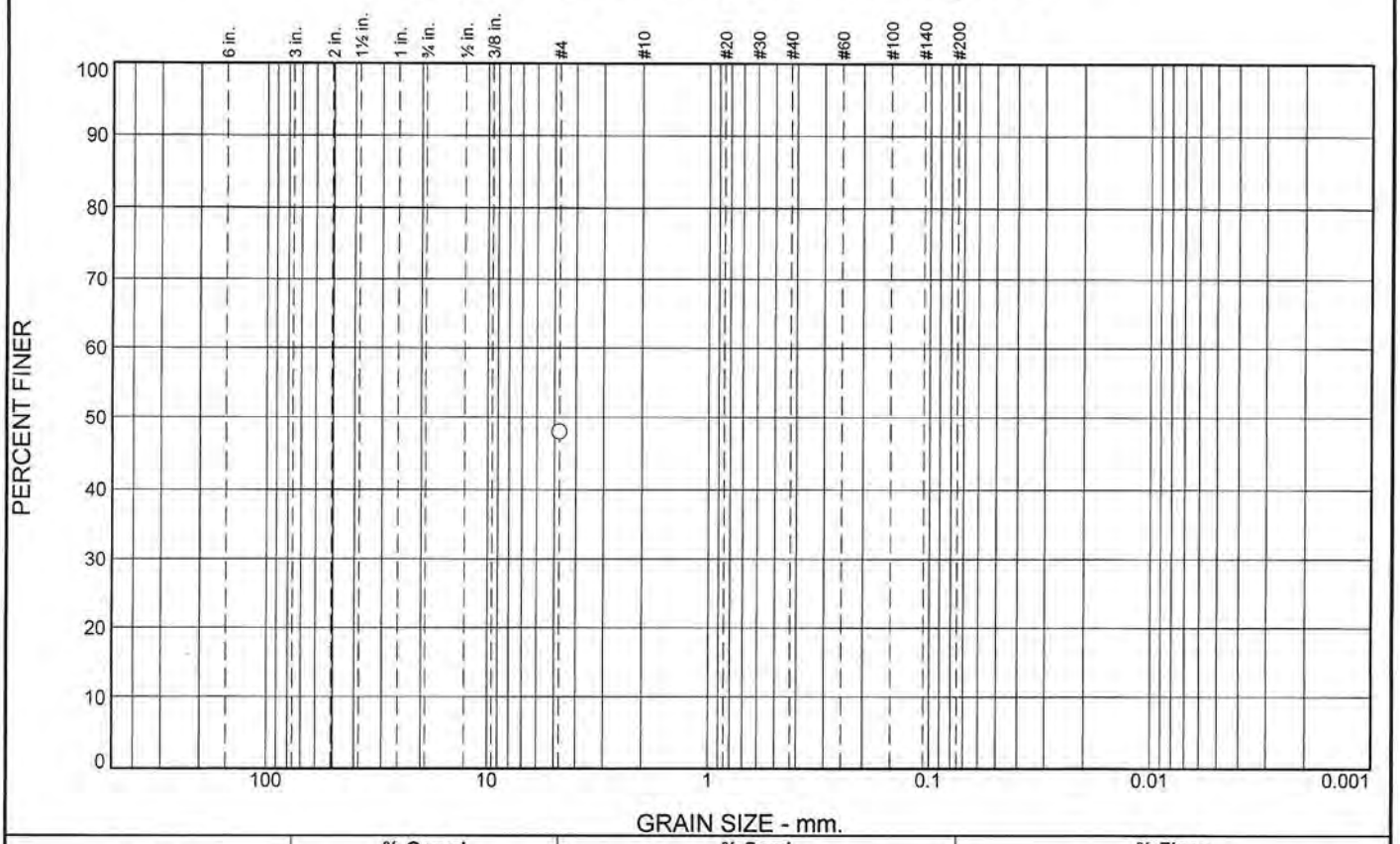
Submitted by: Client

Density of Soil in Place by the Drive-Cylinder Method (ASTM D2937) and Liquid Limit, Plastic Limit & Plasticity Index of Soils (ASTM D4318)

Sample #	Description	Dry Density p.c.f.	Moisture Content %	Liquid Limit	Plastic Limit	Plastic Index
Lake 1,B1 @ 1.5'	Brown Clayey Sand with Gravel	108.7	13.3	37	22	15
Lake 1-1 @ 3.0'	Light Brown Clayey Sand with Gravel (visual)	83.4	27.1	---	---	---
Lake 1-2 @ 5.0'	Brown Sandy Silt (visual)	106.3	21.2	41	26	15
Lake 1-3 @ 10.0'	Dark Brown Sandy Clay (visual)	110.8	18.8	---	---	---
Lake 1-4 @ 15.0'	Light Brown Clayey Silt with Gravel (visual)	115.0	19.7	---	---	---
SN 1-1 @ 3.0'	Brown Clayey Sand (visual)	119.2	9.1	---	---	---
SN 1-2 @ 5.0'	Light Brown Sand with trace Clay (visual)	113.3	8.5	---	---	---
SN 1-3 @ 10.0'	Light Brown Clayey Sand (visual)	113.3	10.1	---	---	---
SN 1-4 @ 15.0'	Brown Clayey Sand with trace Gravel (visual)	113.3	12.7	---	---	---
SN 1-5 @ 20.0'	Gray Silty Sand with Gravel (visual)	---	4.6	---	---	---

Tested by John Hubbard.
The samples were tested according to the referenced standard test procedures and relate only to the items inspected or tested.
Results are not transferable and shall not be reproduced, except in full, without written permission from MTI.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						48	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	48		

* (no specification provided)

Material Description

Brown Clayey Sand with Gravel

Atterberg Limits

PL= 22 LL= 37 PI= 15

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

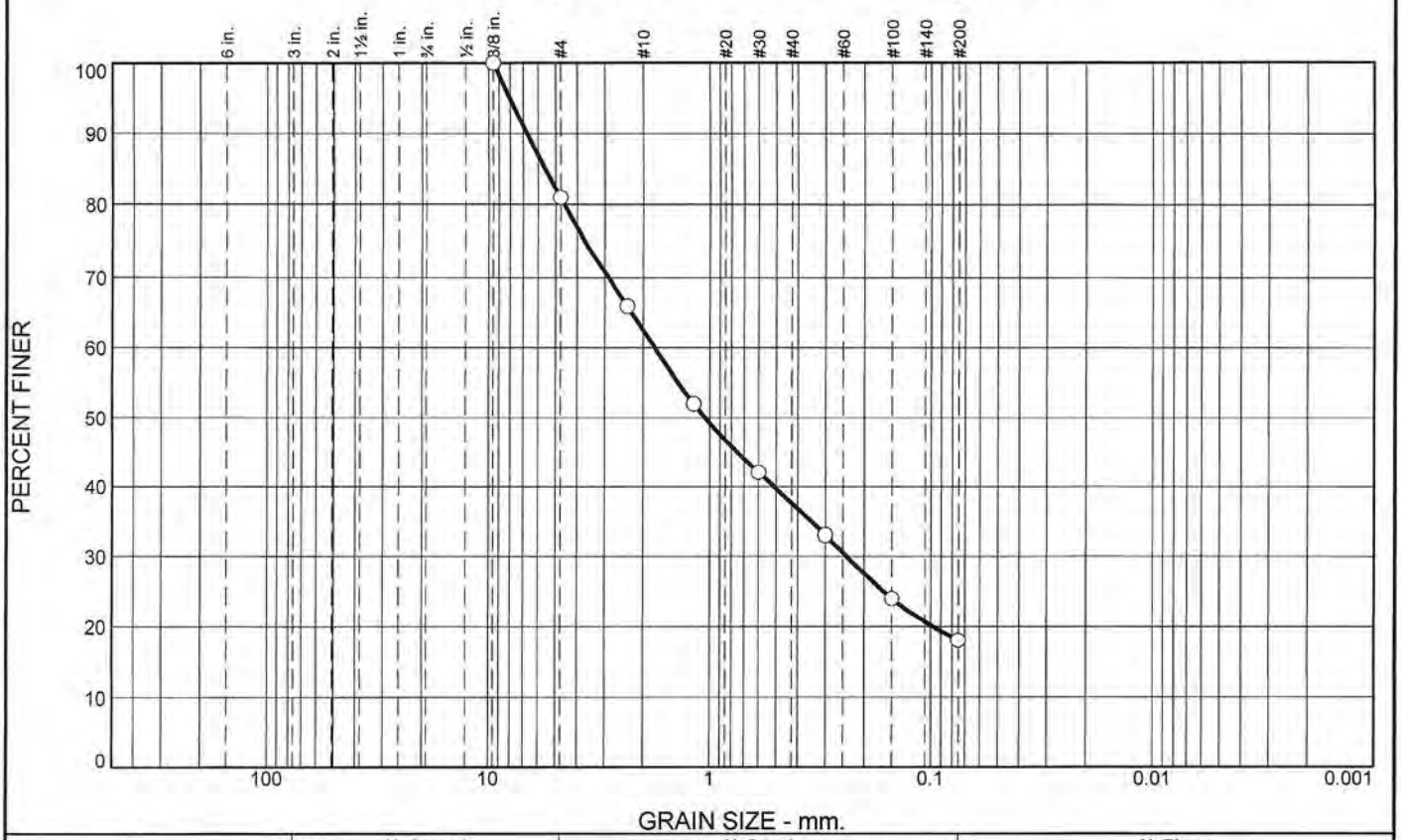
Material tested in accordance with ASTM D1140

Location: Lake 1, B1
Sample Number: 1 **Depth:** 1.5' **Date:** 01/02/20

Client: BAJADA Geosciences, Inc.
Project: San Bruno Dump Stations, Job#1901.013
San Bruno, California
Project No: 3237-033 **Figure** 0300-002

Tested By: Cindy Gooden

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	19	18	25	20	18	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8"	100		
#4	81		
#8	66		
#16	52		
#30	42		
#50	33		
#100	24		
#200	18		

* (no specification provided)

Material Description

Light Brown Clayey Sand with Gravel (visual)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 6.7046 D_{85}= 5.5686 D_{60}= 1.7729
D_{50}= 1.0496 D_{30}= 0.2408 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

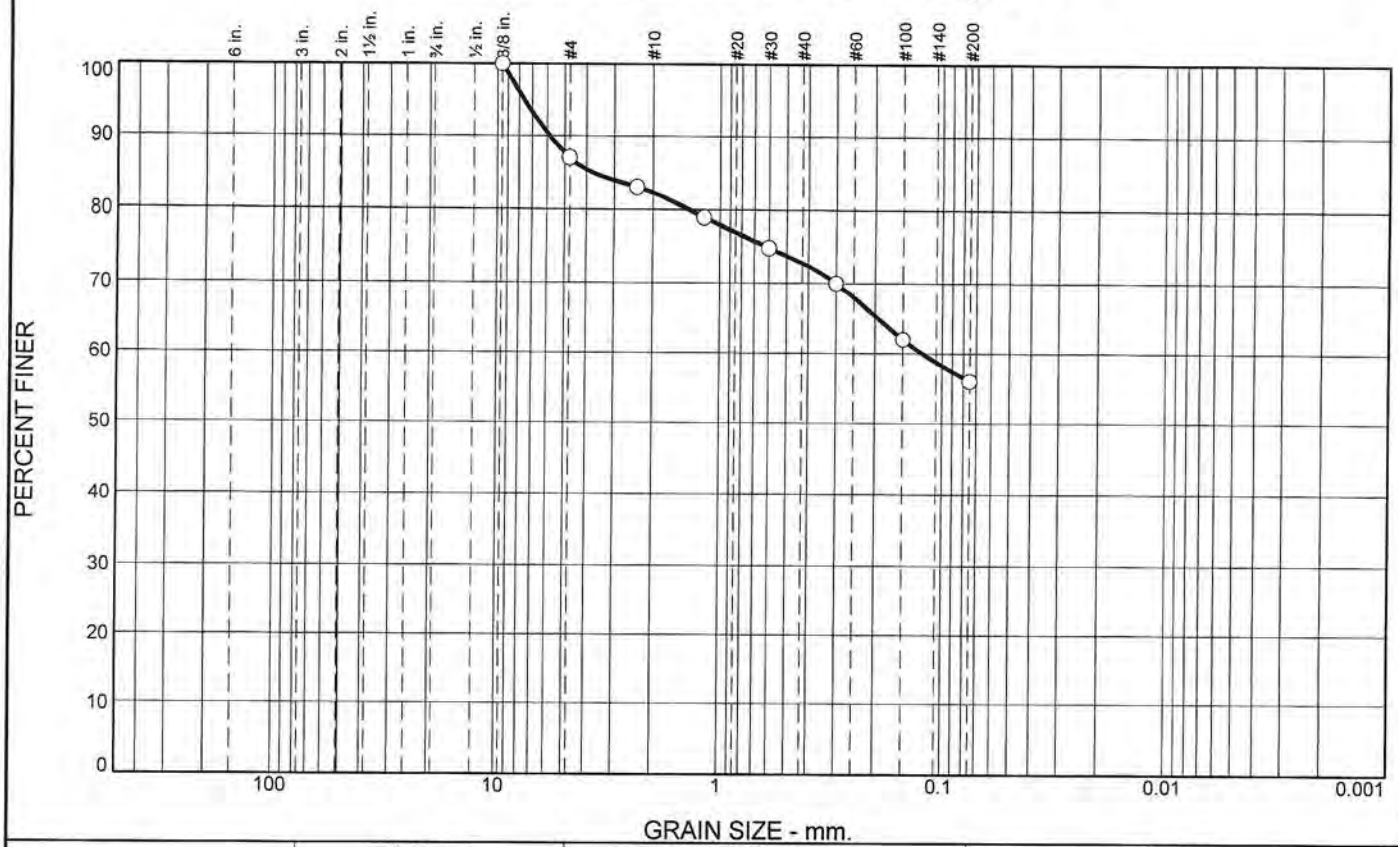
Material tested in accordance with ASTM D6913

Location: Lake 1-1
Sample Number: 2 **Depth:** 3.0' **Date:**

Client: BAJADA Geosciences, Inc.
Project: San Bruno Dump Stations, Job#1901.013
San Bruno, California
Project No: 3237-033 **Figure** 0300-003

Tested By: John Hubbard

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	13	5	9	17	56	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8"	100		
#4	87		
#8	83		
#16	79		
#30	75		
#50	70		
#100	62		
#200	56		

* (no specification provided)

Material Description

Light Brown Clayey Sand (visual)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 5.8393 D_{85}= 3.7868 D_{60}= 0.1227
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

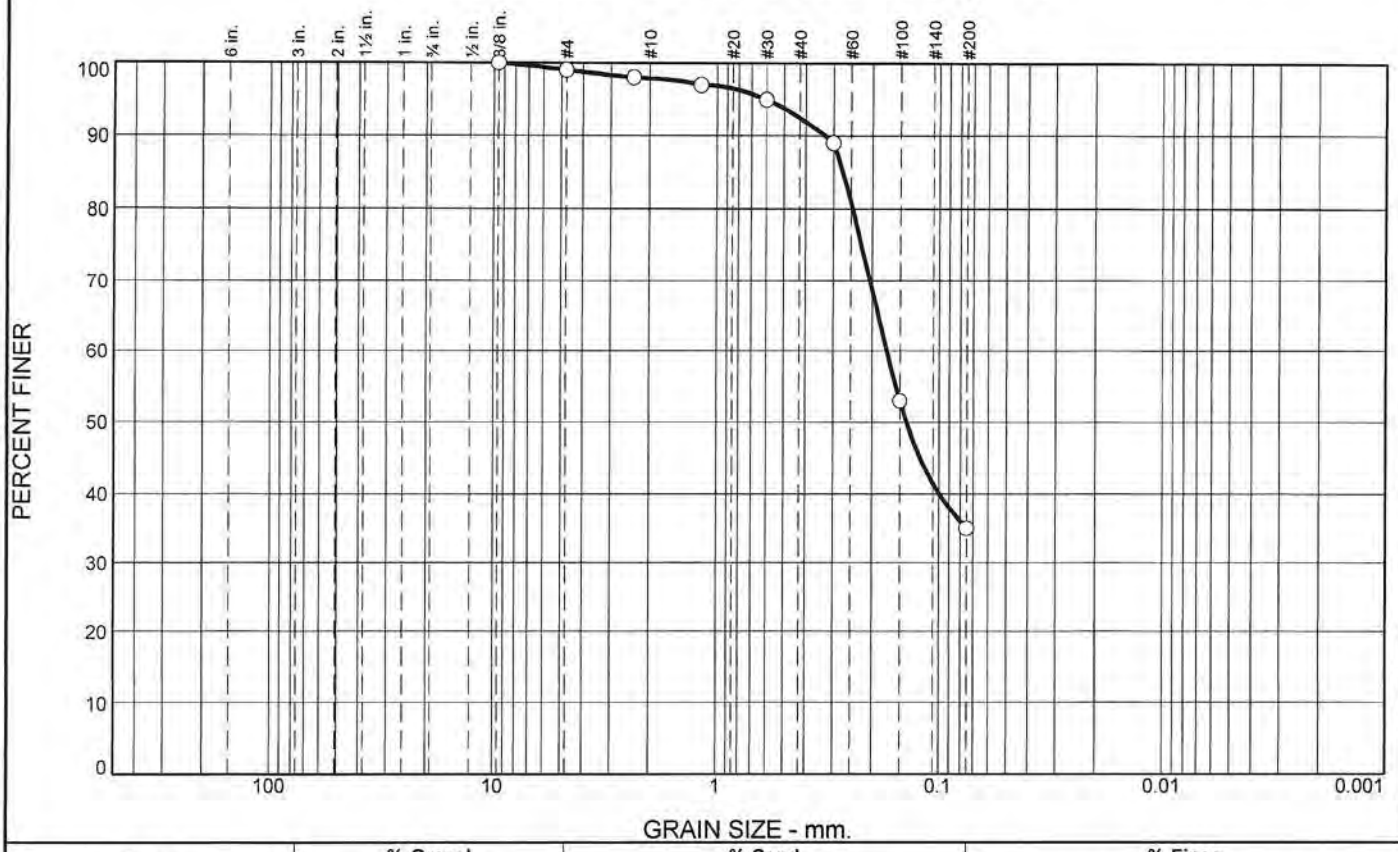
Material tested in accordance with ASTM D6913

Location: Lake 1-3
Sample Number: 4 **Depth:** 10.0' **Date:**

Client: BAJADA Geosciences, Inc.
Project: San Bruno Dump Stations, Job#1901.013
San Bruno, California
Project No: 3237-033 **Figure** 0300-004

Tested By: John Hubbard

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	1	1	5	58	35	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8"	100		
#4	99		
#8	98		
#16	97		
#30	95		
#50	89		
#100	53		
#200	35		

* (no specification provided)

Material Description

Light Brown Clayey Sand (visual)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3281 D_{85}= 0.2712 D_{60}= 0.1721
D_{50}= 0.1399 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

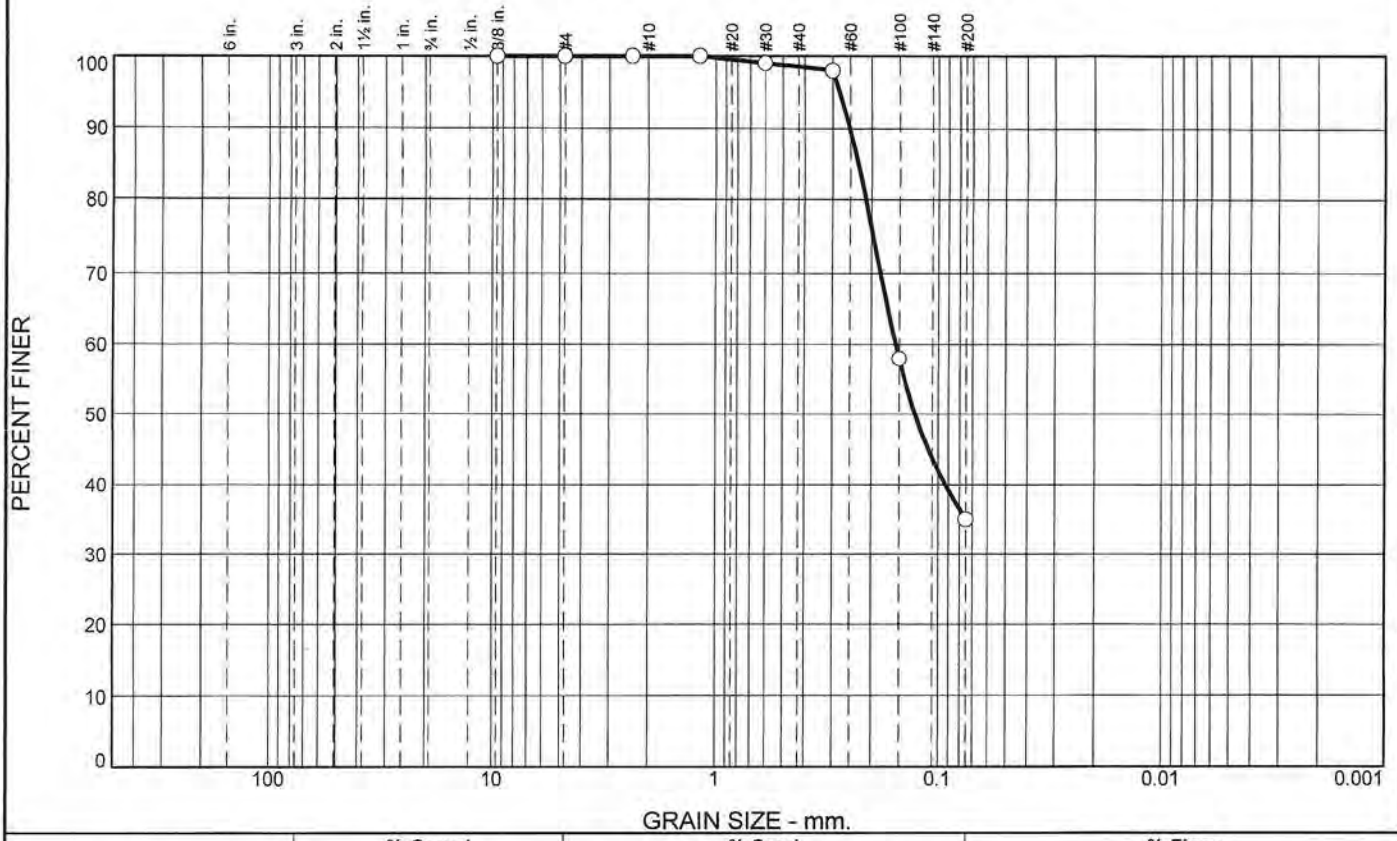
Material tested in accordance with ASTM D6913

Location: SN 1, B1
Sample Number: 6 **Depth:** 1.5' **Date:**

Client: BAJADA Geosciences, Inc.
Project: San Bruno Dump Stations, Job#1901.013
San Bruno, California
Project No: 3237-033 **Figure** 0300-005

Tested By: John Hubbard

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	2	63	35	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8"	100		
#4	100		
#8	100		
#16	100		
#30	99		
#50	98		
#100	58		
#200	35		

* (no specification provided)

Material Description

Brown Clayey Sand (visual)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2506 D_{85}= 0.2299 D_{60}= 0.1555
D_{50}= 0.1267 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

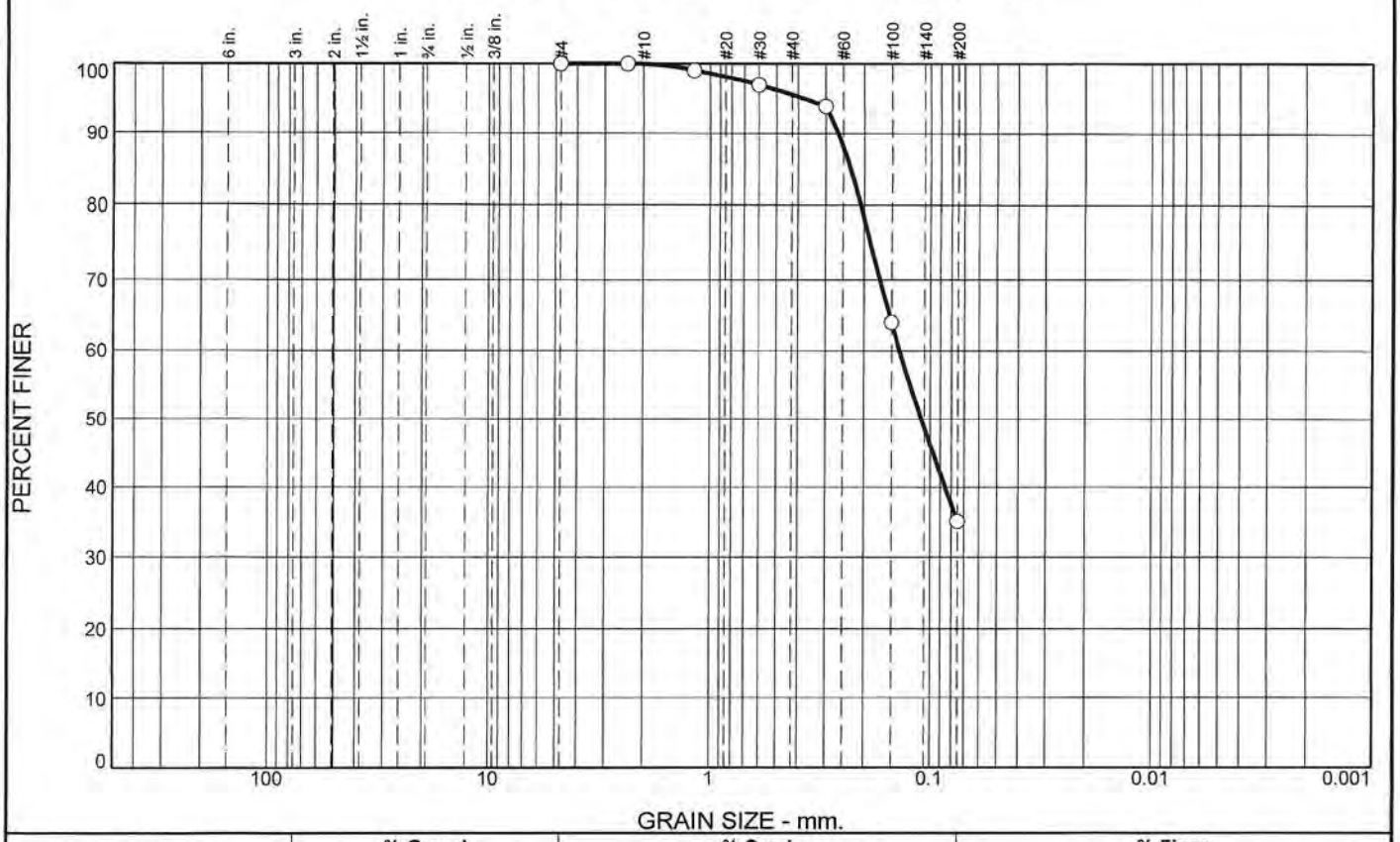
Material tested in accordance with ASTM D6913

Location: SN 1-1
Sample Number: 7 **Depth:** 3.0' **Date:** 01/02/20

Client: BAJADA Geosciences, Inc.
Project: San Bruno Dump Stations, Job#1901.013
San Bruno, California
Project No: 3237-033 **Figure** 0300-006

Tested By: Cindy Gooden

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	4	61	35	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	100		
#16	99		
#30	97		
#50	94		
#100	64		
#200	35		

* (no specification provided)

Material Description

Light Brown Clayey Sand (visual)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2625 D_{85}= 0.2313 D_{60}= 0.1378
D_{50}= 0.1095 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

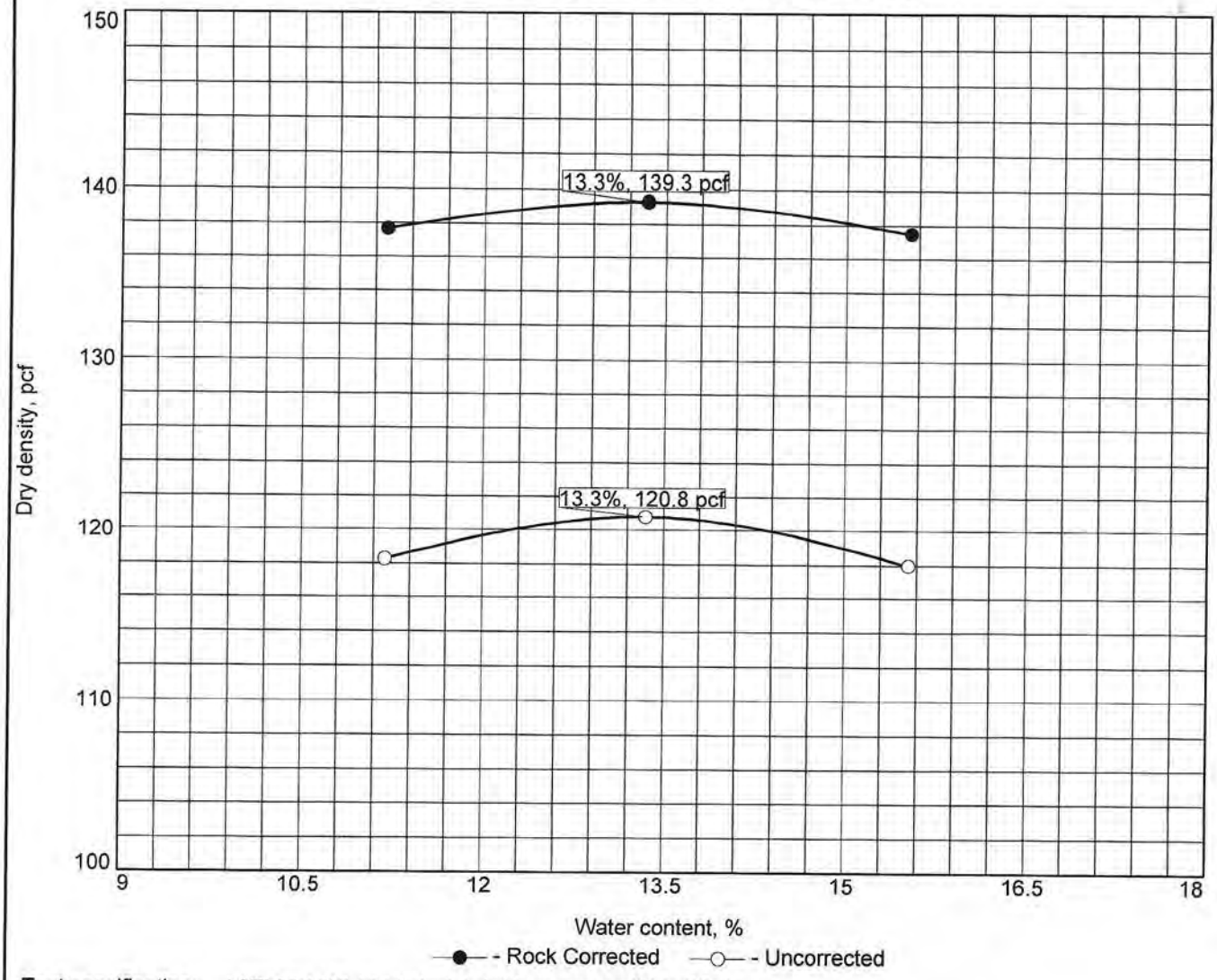
Material tested in accordance with ASTM D6913

Location: SN 1-3
Sample Number: 9 **Depth:** 10.0' **Date:**

Client: BAJADA Geosciences, Inc.
Project: San Bruno Dump Stations, Job#1901.013
San Bruno, California
Project No: 3237-033 **Figure** 0300-007

Tested By: Jack Bianchin

COMPACTION TEST REPORT



Test specification: ASTM D1557-12 Method A (with uncorrected) Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1.5'				2.60	37	15	52	

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 139.3 pcf	120.8 pcf	Brown Clayey Sand with Gravel
Optimum moisture = 13.3 %	13.3 %	

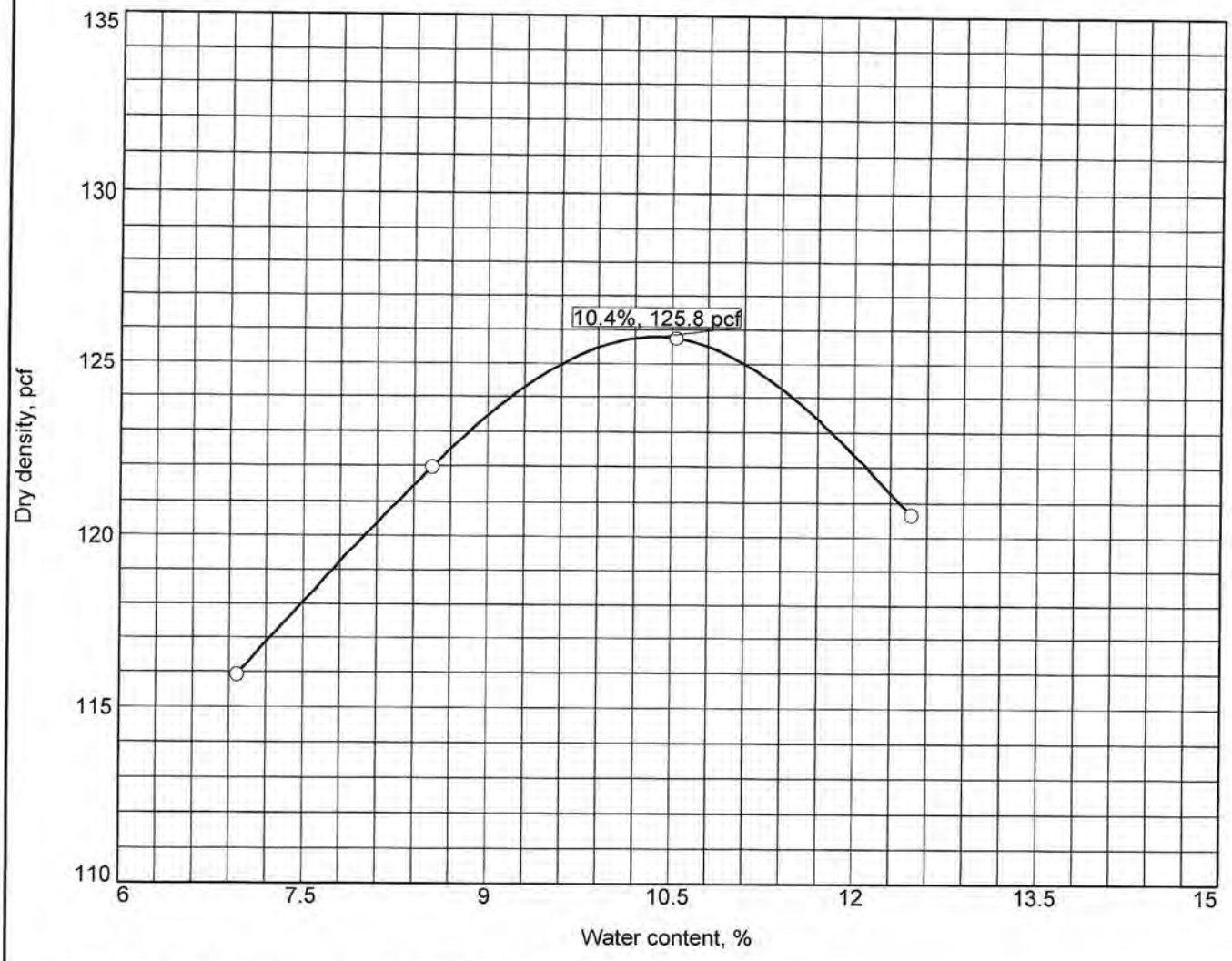
Project No. 3237-033 **Client:** BAJADA Geosciences, Inc.
Project: San Bruno Dump Stations, Job#1901.013
San Bruno, California
○ **Location:** Lake 1, B1 **Sample Number:** 1

Remarks:
Curve #1
(12/04/19)

Figure 0300-008

Tested By: Cindy Gooden

COMPACTION TEST REPORT



Test specification: ASTM D1557-12 Method B Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
1.5'	SC						0.7	35

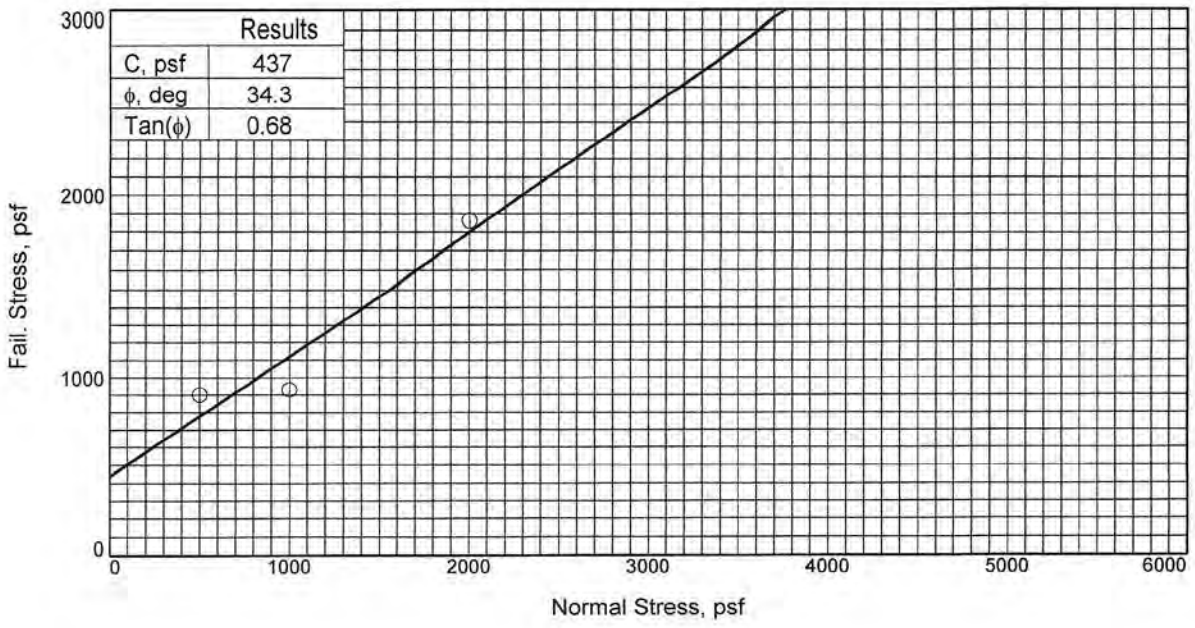
TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 125.8 pcf Optimum moisture = 10.4 %	Light Brown Clayey Sand (visual)

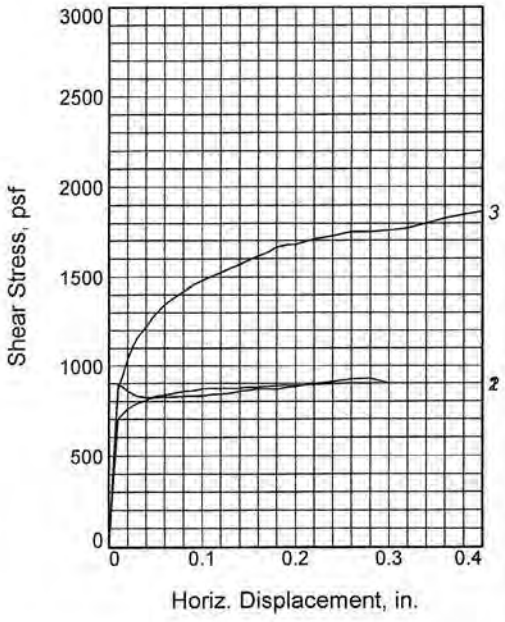
Project No. 3237-033 **Client:** BAJADA Geosciences, Inc.
Project: San Bruno Dump Stations, Job#1901.013
San Bruno, California
○ **Location:** SN 1, B1 **Sample Number:** 6

Remarks:
Curve #2
(01/02/20)

Figure 0300-009

Tested By: John Hubbard





Sample No.		1	2	3
Initial	Water Content, %	13.3	13.3	13.3
	Dry Density, pcf	108.7	108.7	108.7
	Saturation, %	59.8	59.8	59.8
	Void Ratio	0.6316	0.6316	0.6316
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	23.1	22.4	23.1
	Dry Density, pcf	106.5	107.8	106.5
	Saturation, %	98.5	98.6	98.5
	Void Ratio	0.6651	0.6442	0.6651
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.02	1.01	1.02
Normal Stress, psf		500	1000	2000
Fail. Stress, psf		903	931	1862
Displacement, in.		0.26	0.28	0.40
Ult. Stress, psf				
Displacement, in.				
Strain rate, in./min.		0.002	0.002	0.002

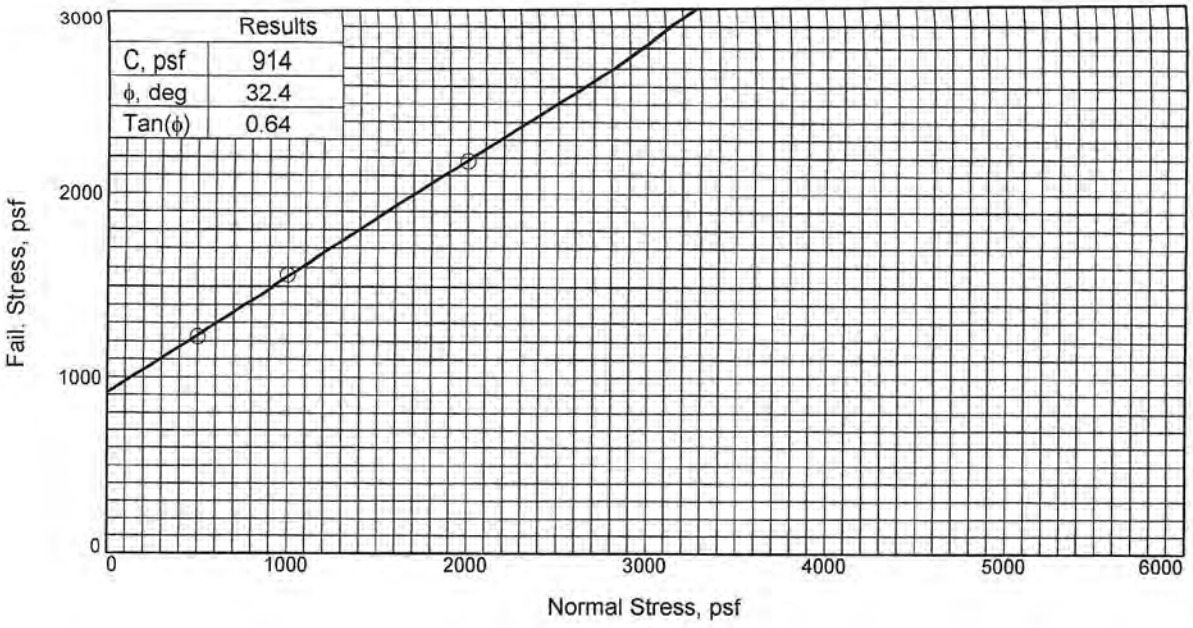
Sample Type: Tube
Description: Brown Clayey Sand with Gravel

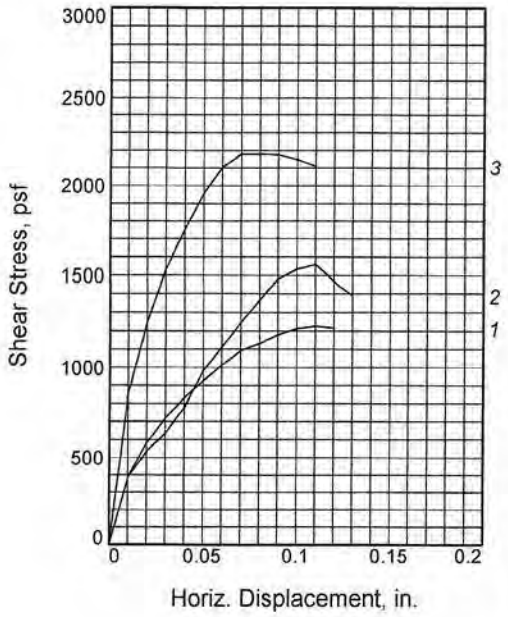
LL= 37 **PL=** 22 **PI=** 15
Specific Gravity= 2.84
Remarks: Material tested in accordance with ASTM D3080
Remolded to 90% of Maximum Density of Optimum Moisture.
Figure 0300-010

Client: BAJADA Geosciences, Inc.

Project: San Bruno Dump Stations, Job#1901.013
San Bruno, California
Location: Lake 1, B1
Sample Number: 1 **Depth:** 1.5'
Proj. No.: 3237-033 **Date Sampled:** 01/02/20

Tested By: Cindy Gooden





Sample No.		1	2	3
Initial	Water Content, %	9.1	9.1	9.1
	Dry Density, pcf	112.5	124.0	121.2
	Saturation, %	54.7	79.2	72.0
	Void Ratio	0.4257	0.2939	0.3236
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	20.4	19.5	19.4
	Dry Density, pcf	110.3	123.9	121.0
	Saturation, %	115.5	169.8	152.4
	Void Ratio	0.4541	0.2945	0.3263
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.02	1.00	1.00
Normal Stress, psf		500	1000	2000
Fail. Stress, psf		1225	1559	2181
Displacement, in.		0.11	0.11	0.07
Ult. Stress, psf				
Displacement, in.				
Strain rate, in./min.		0.002	0.002	0.002

Sample Type: Tube
Description: Brown Clayey Sand (visual)

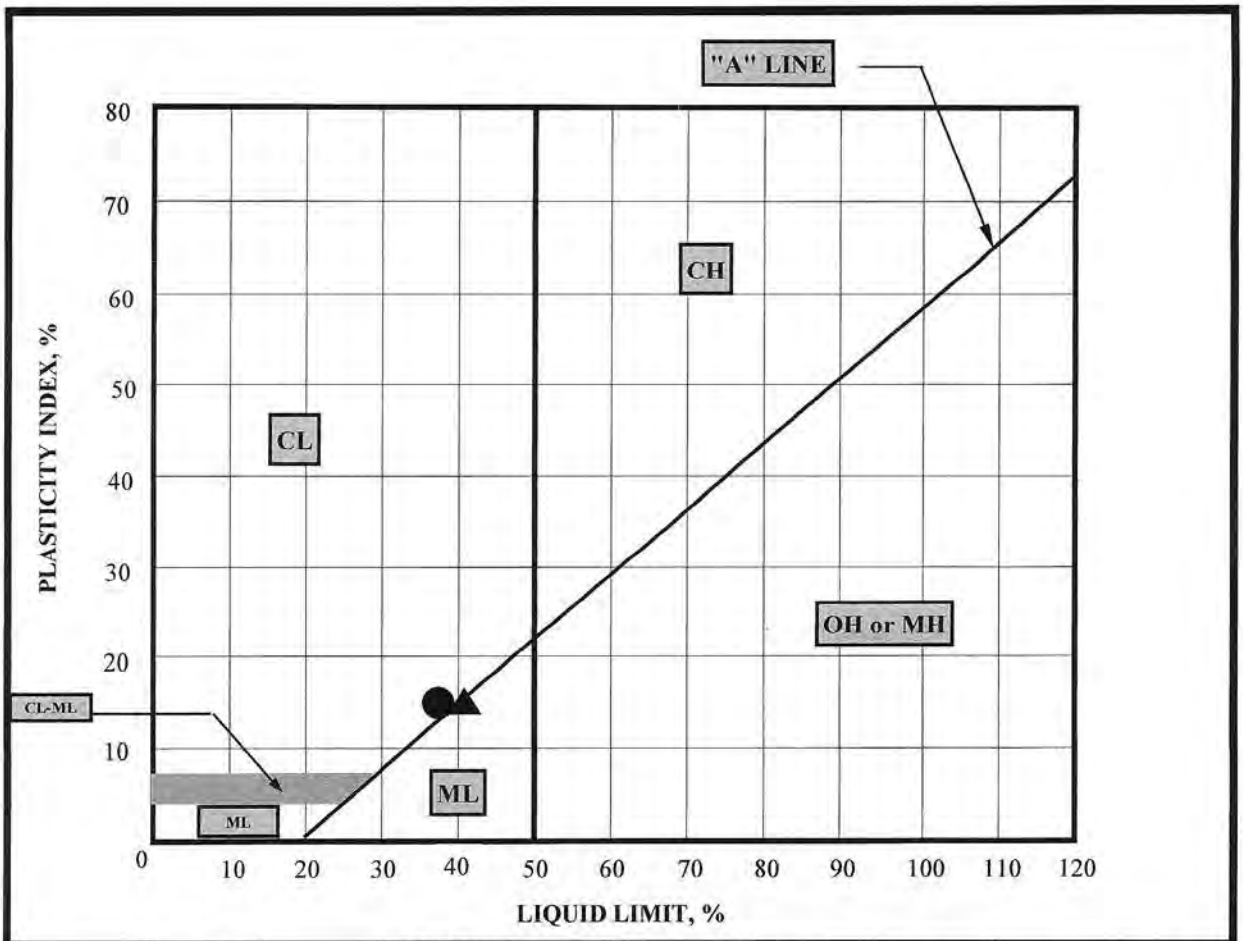
Specific Gravity= 2.57
Remarks: Material tested in accordance with ASTM D3080

Figure 0300-011

Client: BAJADA Geosciences, Inc.

Project: San Bruno Dump Stations, Job#1901.013
San Bruno, California
Location: SN 1-1
Sample Number: 7 **Depth:** 3.0'
Proj. No.: 3237-033 **Date Sampled:** 01/02/20

Tested By: Cindy Gooden



KEY SYMBOL	SAMPLE NUMBER	DEPTH	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, LL, %	PLASTIC LIMIT, PL, %	PLASTICITY INDEX, PI, %	LIQUIDITY INDEX	UNIFIED SOIL CLASSIFICATION SYMBOL
●	Lake 1,B1	1.5'	N/A	37	22	15	N/A	SC
▲	Lake 1-2	5.0'	N/A	41	26	15	N/A	ML

Note: Atterberg Limits tested in accordance with ASTM D4318.

Materials Testing, Inc.

PLASTICITY CHART AND DATA

San Bruno Dump Stations, Job#1901.013
San Bruno, California

Client No:	Date:	Report No:
3237-033	1/2/2020	0300-012

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 12/11/2019
Date Submitted 12/06/2019

To: Andy King
K.C. Engineerig
8798 Airport Rd.
Redding, CA 96002

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 3237-SAN BRUNO PUMP Site ID : 6 SN1 B1@1.5F.
Thank you for your business.

* For future reference to this analysis please use SUN # 81099-169356.

EVALUATION FOR SOIL CORROSION

Soil pH	6.74		
Minimum Resistivity	4.02 ohm-cm (x1000)		
Chloride	6.3 ppm	0.00063	%
Sulfate-SO4	16.9ppm	0.00169	%

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate-SO4 ASTM C1580, Chloride CA DOT Test #422m

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 12/11/2019
Date Submitted 12/04/2019

To: Andy King
K.C. Engineerig
8798 Airport Rd.
Redding, CA 96002

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 3237-BAJADA SAN BRUN Site ID : 1 LAKE 1-B1@1.5.
Thank you for your business.

* For future reference to this analysis please use SUN # 81085-169340.

EVALUATION FOR SOIL CORROSION

Soil pH	7.03		
Minimum Resistivity	2.68 ohm-cm (x1000)		
Chloride	8.2 ppm	0.00082	%
Sulfate-SO4	32.1ppm	0.00321	%

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate-SO4 ASTM C1580, Chloride CA DOT Test #422m

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 12/11/2019
Date Submitted 12/04/2019

To: Andy King
K.C. Engineerig
8798 Airport Rd.
Redding, CA 96002

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 3237-BAJADA SAN BRUN Site ID : 6 SN 1-1B@1.5.
Thank you for your business.

* For future reference to this analysis please use SUN # 81085-169341.

EVALUATION FOR SOIL CORROSION

Soil pH	6.59		
Minimum Resistivity	4.02 ohm-cm (x1000)		
Chloride	4.8 ppm	0.00048	%
Sulfate-SO4	10.3ppm	0.00103	%

METHODS

pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate-SO4 ASTM C1580, Chloride CA DOT Test #422m

APPENDIX C

Slope Stability Analyses



APPENDIX C
SLOPE STABILITY ANALYSES

METHODS OF ANALYSIS

Computer-aided slope stability analyses were performed using the computer program SLIDE 2018. SLIDE 2018 was developed by Rocscience, Inc. (2019) and offers a wide variety of limit-equilibrium procedures. Those include the Modified Bishop, the Simplified and Corrected Janbu, Corps of Engineers #1 and #2, GLE/Morgenstern-Price, Lowe-Karafiath, and the Spencer methods. Those limit-equilibrium procedures are all "method of slices", but they differ from the Ordinary Method of Slices (Fellenius method – also included within SLIDE 2018) in:

1. The simplifying assumptions that have been made achieve static determinacy; and
2. The particular conditions of equilibrium that are satisfied.

SLIDE 2018 allows the use of any or all of the methods listed above because they better satisfy limit equilibrium conditions. A summary of the equilibrium conditions satisfied by each of these procedures and the type of failure surface for which each is useful is presented in the following table.

EQUILIBRIUM CONDITIONS SATISFIED BY PROCEDURES

Procedure of Analysis	Overall			Individual Slices			
	Moment	Vertical Force	Horizontal Force	Moment	Vertical Force	Horizontal Force	Slip Surface
Ordinary Method of Slices (Fellenius)	Yes	No	No	No	No	No	Circular Arc
Modified Bishop	Yes	(Yes)[1]	No	No	Yes	No	General Shape[2]
Simplified Janbu	No	(Yes)[1]	(Yes)[1]	No	Yes	Yes	General Shape
Spencer	Yes	(Yes)[1]	(Yes)[1]	Yes	Yes	Yes	General Shape

Per Wright (1969); (Yes)[1] - Parentheses indicate that this condition of equilibrium is implicitly satisfied as a result of the direct consideration of other equilibrium conditions; [2] – The original presentation of this procedure was for circular surfaces only.

Ordinary Method of Slices. From the above table, it is apparent that for circular failures, the Ordinary Method of Slices (Fellenius method) satisfies overall moment equilibrium, but does not satisfy individual slice moment equilibrium, or horizontal or vertical force equilibrium. Sherard et al. (1963), have suggested that the Fellenius method of slices might also be applied to non-circular surfaces; however, for noncircular surfaces that method would not, in general, satisfy any of the equilibrium conditions (Wright, 1969).

The Ordinary Method of Slices has been widely used by practicing engineers for many years because of its simplicity, but it has long been known to grossly underestimate (and in some cases

overestimate) the factor of safety. Lambe and Whitman (1969) report that in some cases the Ordinary Method of Slices may underestimate the factor of safety by about 10 to 15 percent, but in other problems (particularly for noncircular slip surfaces) the error may be as much as 60 percent. With the development of high-speed computers, this approximate method has largely been replaced by more accurate methods that better satisfy equilibrium conditions. The Ordinary Method of Slices remains an acceptable method for performing hand-calculated estimates of slope stability for conditions where accurate solutions are not required.

Modified Bishop Method. The Modified Bishop Method assumes that the normal and weight forces act through a point on the center of the base of each slice and that there are no interslice shear forces. The resulting equation can be demonstrated to satisfy vertical force equilibrium as well as overall moment equilibrium for circular shear surfaces. The Modified Bishop Method is relatively simple to perform on a calculator, although the necessary iterations make it more suitable for use on a computer system. In spite of the necessary iterations, the Modified Bishop Method typically converges rapidly, therefore, it requires little computer time to perform.

Fredlund and Krahn (1977) have shown that the Modified Bishop Method typically estimates factors of safety that are typically within a few percent of those obtained from more rigorous methods that satisfy complete moment and force equilibrium.

Simplified Janbu Method. Although the simplifying assumption made in the Simplified Janbu Method is the same as that made for the Modified Bishop Method, the conditions of equilibrium that are satisfied are not the same. The Simplified Janbu Method satisfies vertical and horizontal force equilibrium for individual slices and for the overall shear surface while assuming that there are no interslice shear forces. An advantage of the Simplified Janbu Method is its suitability for the analysis of noncircular failure surfaces. While retaining a rapid computational speed, the Simplified Janbu Method yields factors of safety that are closer to those obtained by more rigorous methods (such as the Spencer Method) than those obtained from the Ordinary Method of Slices.

Spencer Method. The Spencer Method assumes that the normal forces are located at the center of the base of each slice and that all side forces are parallel. The result is an equation that satisfies complete moment and force equilibrium. Although the Spencer Method was directly applicable to a circular shear surface, the procedure may be readily extended to slip surfaces of a general shape (Wright, 1969).

Because of the complexity of the procedure, the Spencer Method is suitable only for computer-aided slope stability analyses. Although the Spencer Method typically yields a relatively accurate estimate of the factor of safety for a slope, its solution requires several iterations. Consequently, considerable time is needed to perform the analyses on a personal computer. Therefore, the Spencer Method is commonly used to refine the factor of safety for a critical failure plane that has been located by a

search, which has used a more time-efficient method of analysis such as the Modified Bishop Method or Simplified Janbu procedure.

ANALYSES PERFORMED

Introduction. Analyses were performed to calculate the stability of the earth materials exposed in the slope. It is necessary to know the: 1) surface and subsurface geometry, 2) soil properties (unit weight and shear strength of the soil materials present), and 3) phreatic water level (groundwater) conditions.

Surface and Subsurface Geometry. Data for the surface geometry of the project area was derived from open-source LIDAR data obtained for the project site.

Engineering Properties. A summary and discussion of soil and rock mass strength values is presented in the text of the report.

Piezometric Water Level. The elevations of groundwater beneath the site are discussed in the text of the report.

Results of Analyses. The following table presents the conditions evaluated and results of the stability evaluations:

RESULTS OF STABILITY ANALYSES		
Slope Condition Evaluated	**Factor of Safety**	**File Name**
Static analysis, phreatic surface based on observed conditions, materials strengths C=400 psf, phi=34°	1.91	A-A'_static_GWasObs
Pseudostatic analysis (g=0.26), phreatic surface based on observed conditions, materials strengths C=400 psf, phi=34°	1.10	A-A'_PS_GWasObs

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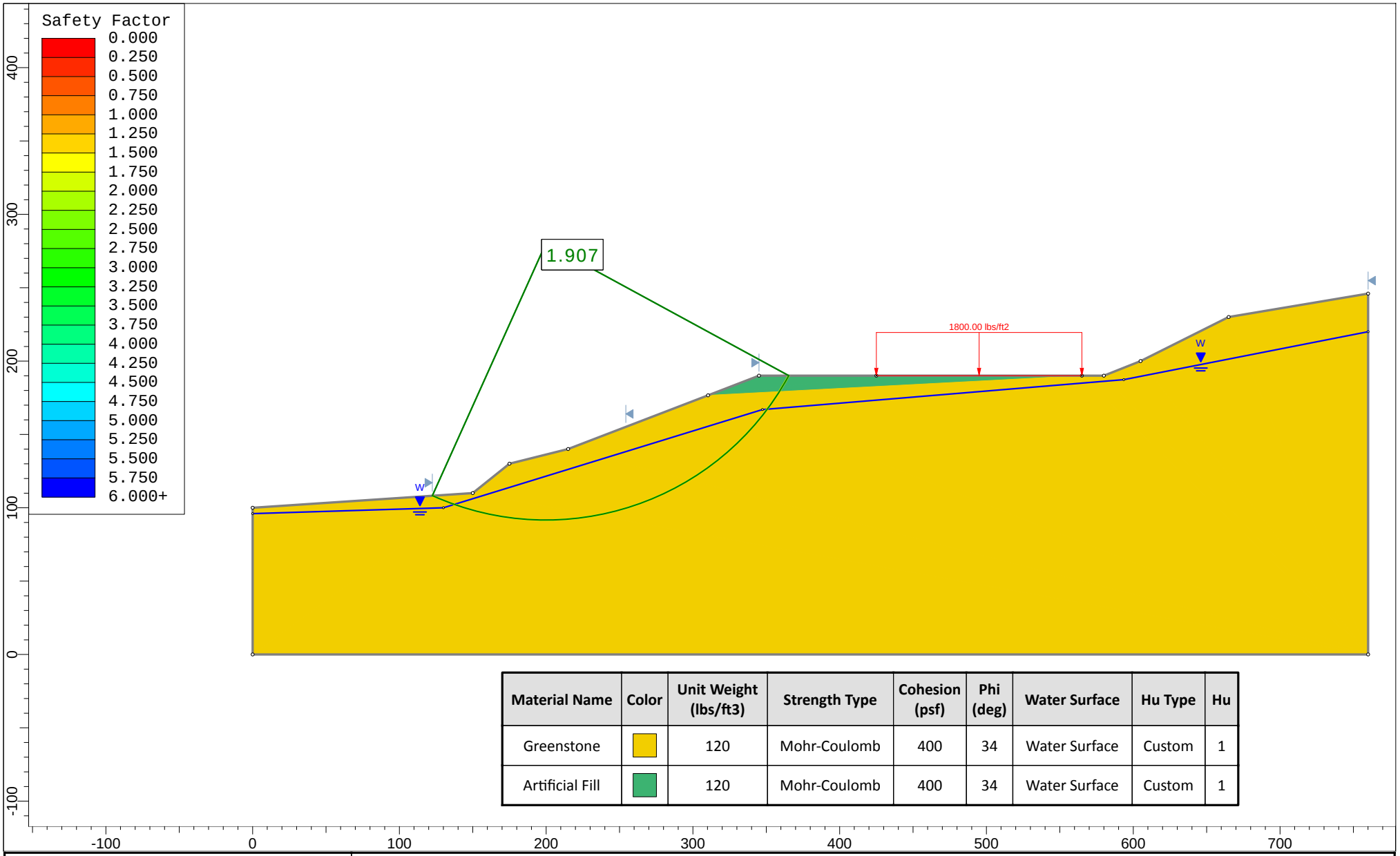
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Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Greenstone		120	Mohr-Coulomb	400	34	Water Surface	Custom	1
Artificial Fill		120	Mohr-Coulomb	400	34	Water Surface	Custom	1

BAJADA Geosciences, Inc.

SLIDEINTERPRET 8.026

Project	Lake Drive Pump Station		
Analysis Description	Static, GW as observed, 1800 psf tank loading		
Drawn By	J.Bianchin	Scale 1:1084	Company Bajada Geosciences, inc.
Date	1/22/2020, 11:36:22 AM		File Name A-A'_Static_GWasObs.slim

Slide Analysis Information

Lake Drive Pump Station

Project Summary

Slide Modeler Version:	8.026
Compute Time:	00h:00m:01.779s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

1 Distributed Load present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	1800
Orientation:	Normal to boundary

Materials

Property	Greenstone	Artificial Fill
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120
Cohesion [psf]	400	400
Friction Angle [°]	34	34
Water Surface	Water Table	Water Table
Hu Value	1	1

Global Minimums

Method: spencer

FS	1.907290
Center:	199.749, 280.079
Radius:	188.478
Left Slip Surface Endpoint:	122.485, 108.166
Right Slip Surface Endpoint:	365.307, 190.000
Resisting Moment:	1.17417e+08 lb-ft
Driving Moment:	6.15622e+07 lb-ft
Resisting Horizontal Force:	560856 lb
Driving Horizontal Force:	294059 lb
Total Slice Area:	9345.71 ft2
Surface Horizontal Width:	242.822 ft
Surface Average Height:	38.4878 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 6319
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.90729

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	4.9383	730.22	-23.383	Greenstone	400	34	375.879	716.911	469.839	0	469.839	307.314	307.314
2	4.9383	2141.96	-21.757	Greenstone	400	34	521.994	995.593	883.002	0	883.002	674.673	674.673
3	4.9383	3457.91	-20.1493	Greenstone	400	34	649.481	1238.75	1243.5	0	1243.5	1005.19	1005.19
4	4.8495	4586.92	-18.5721	Greenstone	400	34	714.398	1362.56	1524.47	97.4154	1427.06	1284.44	1187.03
5	4.8495	5681.21	-17.0236	Greenstone	400	34	723.269	1379.48	1739.89	287.749	1452.14	1518.44	1230.69
6	4.8495	6842.7	-15.4877	Greenstone	400	34	741.34	1413.95	1972.41	469.171	1503.24	1766.99	1297.82
7	4.8495	9445.93	-13.9633	Greenstone	400	34	902.422	1721.18	2600.62	641.888	1958.73	2376.23	1734.34
8	4.8495	12366	-12.4488	Greenstone	400	34	1089.21	2077.43	3292.96	806.081	2486.88	3052.51	2246.43
9	4.8495	15208	-10.9432	Greenstone	400	34	1263.25	2409.39	3940.95	961.908	2979.05	3696.7	2734.79
10	4.8495	17973.3	-9.44514	Greenstone	400	34	1425.67	2719.17	4547.81	1109.5	3438.31	4310.64	3201.14
11	4.8495	20623.2	-7.9536	Greenstone	400	34	1573.85	3001.79	5106.3	1248.98	3857.32	4886.41	3637.43
12	4.8495	22150.8	-6.46747	Greenstone	400	34	1620.31	3090.4	5369.12	1380.45	3988.67	5185.44	3804.99
13	4.8495	23139.4	-4.9857	Greenstone	400	34	1621.25	3092.2	5495.33	1503.97	3991.36	5353.9	3849.93
14	4.8495	24054.5	-3.50726	Greenstone	400	34	1618.61	3087.16	5603.49	1619.61	3983.88	5504.29	3884.68
15	4.8495	24896.6	-2.03117	Greenstone	400	34	1612.6	3075.7	5694.31	1727.42	3966.89	5637.12	3909.7
16	4.8495	25665.8	-0.556419	Greenstone	400	34	1603.42	3058.19	5768.37	1827.42	3940.95	5752.8	3925.38
17	4.8495	26362.5	0.917961	Greenstone	400	34	1591.26	3034.99	5826.17	1919.64	3906.53	5851.66	3932.02
18	4.8495	26986.4	2.39295	Greenstone	400	34	1576.27	3006.4	5868.21	2004.06	3864.15	5934.08	3930.02
19	4.8495	27537.5	3.86953	Greenstone	400	34	1558.59	2972.68	5894.82	2080.68	3814.14	6000.24	3919.56
20	4.8495	28197.1	5.34869	Greenstone	400	34	1552.13	2960.36	5945.34	2149.45	3795.89	6090.66	3941.21
21	4.8495	28981.3	6.83143	Greenstone	400	34	1557.56	2970.71	6021.55	2210.32	3811.23	6208.15	3997.83
22	4.8495	29691.3	8.31879	Greenstone	400	34	1559.71	2974.81	6080.56	2263.25	3817.31	6308.62	4045.37
23	4.8495	30326.4	9.81182	Greenstone	400	34	1558.71	2972.91	6122.6	2308.12	3814.48	6392.17	4084.05
24	4.8495	30885.5	11.3116	Greenstone	400	34	1554.67	2965.21	6147.93	2344.86	3803.07	6458.92	4114.06
25	4.8495	31367.6	12.8193	Greenstone	400	34	1547.7	2951.92	6156.72	2373.34	3783.38	6508.9	4135.56
26	4.8495	31771.4	14.3361	Greenstone	400	34	1537.89	2933.21	6149.04	2393.41	3755.63	6542.08	4148.67
27	4.8495	32095.2	15.8632	Greenstone	400	34	1525.33	2909.25	6125.03	2404.92	3720.11	6558.48	4153.56
28	4.8495	32337.4	17.402	Greenstone	400	34	1510.08	2880.17	6084.68	2407.67	3677.01	6557.97	4150.3
29	4.8495	32496	18.9539	Greenstone	400	34	1492.23	2846.12	6027.98	2401.46	3626.52	6540.45	4138.99
30	4.8495	32568.7	20.5203	Greenstone	400	34	1471.83	2807.21	5954.88	2386.03	3568.85	6505.77	4119.74
31	4.8495	32552.9	22.103	Greenstone	400	34	1448.94	2763.55	5865.24	2361.12	3504.12	6453.68	4092.56
32	4.8495	32445.7	23.7037	Greenstone	400	34	1423.61	2715.24	5758.9	2326.42	3432.48	6383.93	4057.51
33	4.8495	32243.9	25.3242	Greenstone	400	34	1395.9	2662.38	5635.66	2281.56	3354.1	6296.22	4014.66
34	4.8495	31943.7	26.9668	Greenstone	400	34	1365.83	2605.04	5495.24	2226.15	3269.09	6190.17	3964.02
35	4.8495	31540.8	28.6337	Greenstone	400	34	1333.46	2543.3	5337.31	2159.72	3177.59	6065.35	3905.63
36	4.8495	31030.3	30.3275	Greenstone	400	34	1298.84	2477.26	5161.43	2081.77	3079.66	5921.24	3839.47
37	4.8495	30406.8	32.0512	Greenstone	400	34	1261.99	2406.98	4967.16	1991.7	2975.46	5757.31	3765.61
38	4.8495	29663.8	33.808	Greenstone	400	34	1222.96	2332.54	4753.91	1888.81	2865.1	5572.86	3684.05
39	4.8495	28794.1	35.6018	Greenstone	400	34	1181.8	2254.04	4521.06	1772.33	2748.73	5367.2	3594.87
40	4.8495	27789	37.4367	Greenstone	400	34	1138.56	2171.56	4267.78	1641.34	2626.44	5139.43	3498.09
41	4.8495	26638.4	39.3179	Greenstone	400	34	1093.29	2085.23	3993.21	1494.75	2498.46	4888.63	3393.88
42	4.8495	25330.7	41.2512	Greenstone	400	34	1046.08	1995.18	3696.25	1331.31	2364.94	4613.68	3282.37
43	4.8495	23851.5	43.2436	Greenstone	400	34	997.017	1901.6	3375.69	1149.48	2226.21	4313.38	3163.9
44	4.8495	22183.8	45.3036	Greenstone	400	34	946.227	1804.73	3030.03	947.434	2082.6	3986.34	3038.9
45	4.8495	20306.3	47.4415	Greenstone	400	34	893.886	1704.9	2657.51	722.906	1934.6	3631.02	2908.11
46	4.8495	18177.1	49.6704	Greenstone	400	34	839.547	1601.26	2254.02	473.069	1780.95	3242.94	2769.88
47	4.8495	15081.6	52.007	Greenstone	400	34	758.322	1446.34	1732.44	181.174	1551.27	2703.3	2522.12
48	4.13865	9899.95	54.2821	Greenstone	400	34	638.404	1217.62	1212.17	0	1212.17	2100.02	2100.02
49	4.13865	6918.02	56.4995	Greenstone	400	34	478.835	913.278	760.965	0	760.965	1484.39	1484.39
50	6.35235	4117.6	59.5445	Artificial Fill	400	34	273.388	521.43	180.028	0	180.028	644.975	644.975

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.90729

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	122.485	108.166	0	0	0
2	127.423	106.03	2861.59	792.965	15.4884
3	132.362	104.06	7182.64	1990.36	15.4884
4	137.3	102.248	12646.9	3504.54	15.4884
5	142.149	100.618	18599.4	5154.01	15.4884
6	146.999	99.1333	24694.3	6842.97	15.4884
7	151.848	97.7896	30944.1	8574.81	15.4884
8	156.698	96.5837	38461.3	10657.9	15.4884
9	161.547	95.5132	47274.9	13100.2	15.4884
10	166.397	94.5755	57103.4	15823.7	15.4884
11	171.246	93.7688	67694.2	18758.5	15.4884
12	176.096	93.0912	78795.2	21834.7	15.4884
13	180.945	92.5415	89613.6	24832.5	15.4884
14	185.795	92.1184	99809.8	27658	15.4884
15	190.644	91.8212	109334	30297.2	15.4884
16	195.494	91.6492	118143	32738.1	15.4884
17	200.343	91.6021	126199	34970.6	15.4884
18	205.193	91.6798	133472	36986	15.4884
19	210.042	91.8825	139936	38777.2	15.4884
20	214.892	92.2105	145569	40338.3	15.4885
21	219.741	92.6645	150406	41678.5	15.4884
22	224.591	93.2455	154470	42804.6	15.4884
23	229.44	93.9546	157731	43708.2	15.4884
24	234.29	94.7932	160163	44382.3	15.4884
25	239.139	95.7633	161748	44821.4	15.4884
26	243.989	96.8668	162468	45021	15.4884
27	248.838	98.1062	162314	44978.2	15.4884
28	253.688	99.4842	161279	44691.4	15.4884
29	258.537	101.004	159362	44160.3	15.4884
30	263.387	102.67	156568	43386	15.4884
31	268.236	104.485	152905	42371	15.4884
32	273.086	106.454	148388	41119.4	15.4884
33	277.935	108.583	143039	39636.9	15.4883
34	282.785	110.878	136883	37931.1	15.4884
35	287.634	113.346	129955	36011.4	15.4884
36	292.484	115.993	122298	33889.5	15.4884
37	297.333	118.83	113961	31579.3	15.4884
38	302.183	121.867	105006	29097.9	15.4884
39	307.032	125.114	95505.6	26465.2	15.4884
40	311.882	128.586	85545.7	23705.3	15.4884
41	316.731	132.299	75228.8	20846.4	15.4884
42	321.581	136.271	64676.6	17922.3	15.4884
43	326.43	140.524	54035.1	14973.5	15.4884
44	331.28	145.085	43479.4	12048.4	15.4884
45	336.129	149.986	33222.8	9206.27	15.4884
46	340.979	155.267	23527.2	6519.55	15.4884
47	345.828	160.98	14727.6	4081.12	15.4884
48	350.678	167.188	7653.29	2120.78	15.4884
49	354.816	172.944	3321.52	920.414	15.4884
50	358.955	179.197	547.454	151.703	15.4884
51	365.307	190	0	0	0

Entity Information

Water Table



X	Y
0	96
130	100
347.318	166.91
593.563	187.3
760	220

Distributed Load

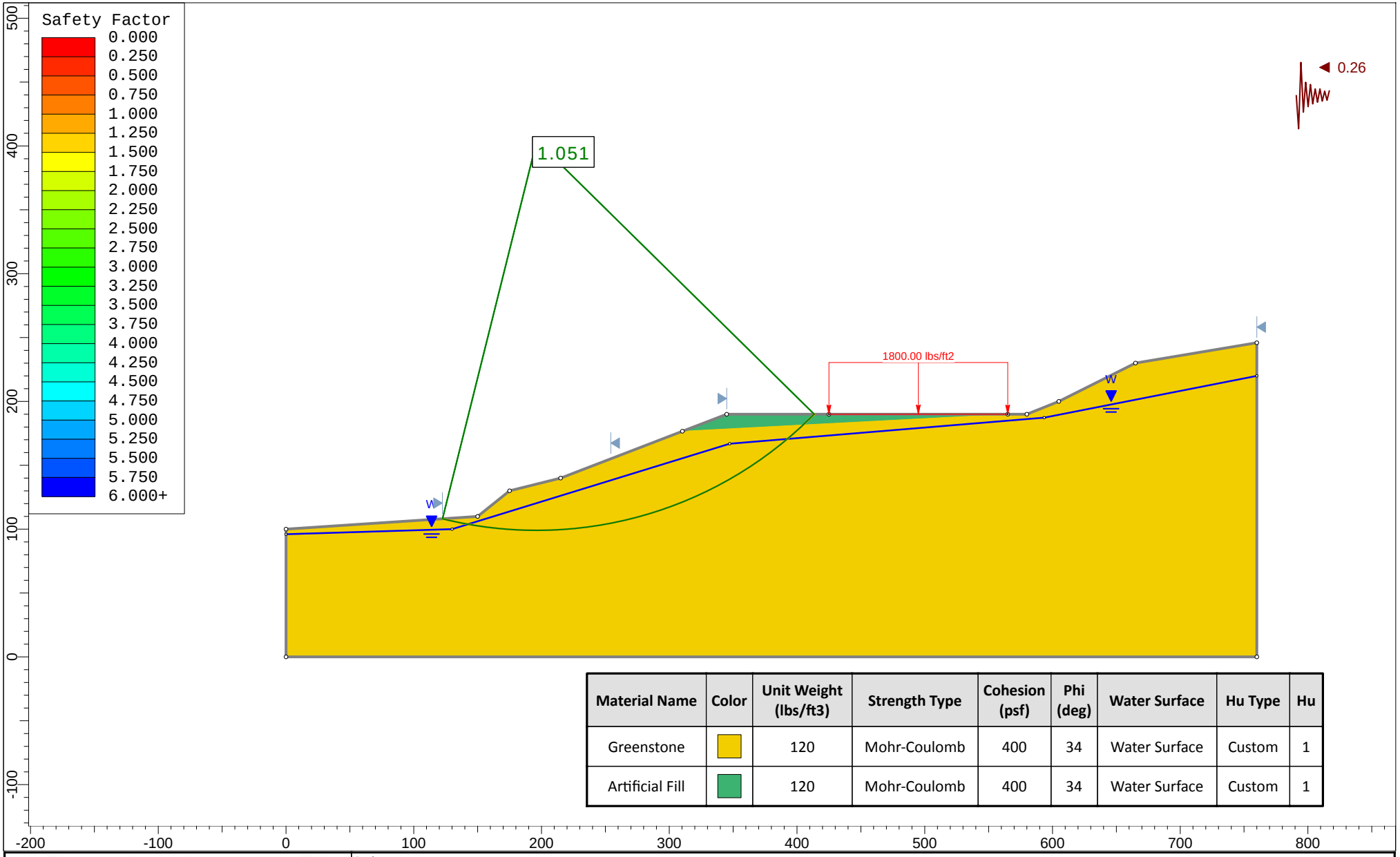
X	Y
565	190
425	190

External Boundary

X	Y
0	0
760	0
760	246
665	230
605	200
580	190
565	190
425	190
345	190
310.275	176.644
215	140
175	130
150	110
0	100

Material Boundary

X	Y
310.275	176.644
565	190



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Greenstone		120	Mohr-Coulomb	400	34	Water Surface	Custom	1
Artificial Fill		120	Mohr-Coulomb	400	34	Water Surface	Custom	1

BAJADA Geosciences, Inc.

SLIDEINTERPRET 8.026

Project	Lake Drive Pump Station		
Analysis Description	Pseudostatic (0.26g), GW as observed, 1800 psf tank loading		
Drawn By	J.Bianchin	Scale 1:1246	Company Bajada Geosciences, inc.
Date	1/22/2020, 11:36:22 AM		File Name A-A'_PS_GWasObs.slim

Slide Analysis Information

Lake Drive Pump Station

Project Summary

Slide Modeler Version:	8.026
Compute Time:	00h:00m:02.169s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical

Analysis Methods Used	
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Seismic Load Coefficient (Horizontal): 0.26

Loading

1 Distributed Load present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	1800
Orientation:	Normal to boundary

Materials

Property	Greenstone	Artificial Fill
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120
Cohesion [psf]	400	400
Friction Angle [°]	34	34
Water Surface	Water Table	Water Table
Hu Value	1	1

Global Minimums

Method: spencer

FS	1.051380
Center:	196.324, 404.037
Radius:	304.949
Left Slip Surface Endpoint:	122.474, 108.165
Right Slip Surface Endpoint:	413.539, 190.000
Resisting Moment:	2.05076e+08 lb-ft
Driving Moment:	1.95054e+08 lb-ft
Resisting Horizontal Force:	633620 lb
Driving Horizontal Force:	602654 lb
Total Slice Area:	10676 ft2
Surface Horizontal Width:	291.065 ft
Surface Average Height:	36.6791 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 4910
Number of Invalid Surfaces: 0

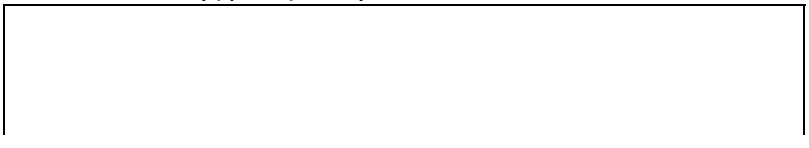
Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.05138

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	6.69355	818.074	-13.3684	Greenstone	400	34	929.034	976.768	855.093	0	855.093	634.307	634.307
2	6.69355	2390.64	-12.079	Greenstone	400	34	1176.96	1237.43	1241.55	0	1241.55	989.678	989.678
3	6.69355	3836.94	-10.7958	Greenstone	400	34	1378.67	1449.51	1555.97	0	1555.97	1293.08	1293.08
4	5.68316	4302.6	-9.61416	Greenstone	400	34	1432.15	1505.73	1723.94	84.6218	1639.31	1481.34	1396.72
5	5.68316	5856.44	-8.53277	Greenstone	400	34	1487.54	1563.97	1976.1	250.448	1725.65	1752.92	1502.47
6	5.68316	9364.74	-7.45444	Greenstone	400	34	1896.36	1993.8	2772.35	409.438	2362.91	2524.22	2114.78
7	5.68316	12935.6	-6.37876	Greenstone	400	34	2290.77	2408.47	3539.32	561.648	2977.67	3283.22	2721.58
8	5.68316	16432.8	-5.30533	Greenstone	400	34	2649.38	2785.5	4243.77	707.123	3536.65	3997.75	3290.62
9	5.68316	19766.6	-4.23377	Greenstone	400	34	2961.2	3113.35	4868.61	845.902	4022.71	4649.4	3803.49
10	5.68316	21522	-3.16369	Greenstone	400	34	3007.9	3162.45	5073.51	978.015	4095.5	4907.26	3929.24
11	5.68316	22669	-2.09471	Greenstone	400	34	2962.57	3114.79	5128.33	1103.49	4024.84	5019.97	3916.48
12	5.68316	23743.5	-1.02647	Greenstone	400	34	2913.07	3062.74	5170.01	1222.34	3947.67	5117.81	3895.47
13	5.68316	24745.8	0.0414225	Greenstone	400	34	2859.88	3006.82	5199.34	1334.57	3864.77	5201.41	3866.84
14	5.68316	25675.8	1.10933	Greenstone	400	34	2803.48	2947.52	5217.05	1440.2	3776.85	5271.34	3831.14
15	5.68316	26533.5	2.17762	Greenstone	400	34	2744.25	2885.25	5223.74	1539.21	3684.53	5328.09	3788.88
16	5.68316	27335.5	3.24667	Greenstone	400	34	2684.73	2822.67	5223.36	1631.59	3591.77	5375.65	3744.06
17	5.68316	28424.3	4.31685	Greenstone	400	34	2668.94	2806.07	5284.48	1717.34	3567.14	5485.95	3768.61
18	5.68316	29585.9	5.38854	Greenstone	400	34	2666.84	2803.86	5360.29	1796.42	3563.87	5611.84	3815.42
19	5.68316	30674.3	6.46213	Greenstone	400	34	2659.76	2796.42	5421.63	1868.79	3552.84	5722.89	3854.1
20	5.68316	31689.1	7.538	Greenstone	400	34	2648.14	2784.2	5469.15	1934.43	3534.72	5819.57	3885.14
21	5.68316	32629.7	8.61655	Greenstone	400	34	2632.36	2767.61	5503.41	1993.29	3510.12	5902.29	3909
22	5.68316	33495.5	9.69819	Greenstone	400	34	2612.79	2747.04	5524.93	2045.3	3479.63	5971.46	3926.16
23	5.68316	34285.9	10.7833	Greenstone	400	34	2589.76	2722.82	5534.13	2090.41	3443.72	6027.37	3936.96
24	5.68316	35000.1	11.8724	Greenstone	400	34	2563.55	2695.26	5531.42	2128.55	3402.87	6070.35	3941.8
25	5.68316	35637.2	12.9659	Greenstone	400	34	2534.43	2664.65	5517.12	2159.64	3357.48	6100.65	3941.01
26	5.68316	36196.3	14.0641	Greenstone	400	34	2502.66	2631.25	5491.55	2183.58	3307.97	6118.51	3934.93
27	5.68316	36676.1	15.1677	Greenstone	400	34	2468.47	2595.3	5454.95	2200.28	3254.67	6124.12	3923.84
28	5.68316	37075.6	16.2771	Greenstone	400	34	2432.07	2557.03	5407.55	2209.62	3197.93	6117.68	3908.06
29	5.68316	37393.5	17.3927	Greenstone	400	34	2393.64	2516.63	5349.53	2211.49	3138.04	6099.32	3887.83
30	5.68316	37628.1	18.5153	Greenstone	400	34	2353.4	2474.32	5281.06	2205.76	3075.3	6069.19	3863.43
31	5.68316	37778.1	19.6452	Greenstone	400	34	2311.5	2430.26	5202.25	2192.27	3009.98	6027.39	3835.12
32	5.68316	37841.5	20.7832	Greenstone	400	34	2268.1	2384.63	5113.2	2170.86	2942.34	5974	3803.14
33	5.68316	37816.5	21.9298	Greenstone	400	34	2223.37	2337.61	5013.99	2141.36	2872.63	5909.12	3767.76
34	5.68316	37701	23.0857	Greenstone	400	34	2177.47	2289.35	4904.65	2103.58	2801.07	5832.78	3729.2
35	5.68316	37492.6	24.2517	Greenstone	400	34	2130.54	2240.01	4785.23	2057.31	2727.92	5745.04	3687.73
36	5.68316	37188.9	25.4284	Greenstone	400	34	2082.72	2189.73	4655.71	2002.31	2653.4	5645.92	3643.61
37	5.68316	36787.1	26.6168	Greenstone	400	34	2034.16	2138.68	4516.05	1938.34	2577.71	5535.43	3597.09
38	5.68316	36284.1	27.8177	Greenstone	400	34	1985.02	2087.01	4366.21	1865.11	2501.1	5413.57	3548.46
39	5.68316	35570.2	29.032	Greenstone	400	34	1927.43	2026.46	4193.65	1782.32	2411.33	5263.45	3481.13
40	5.68316	33652.3	30.2607	Greenstone	400	34	1812.76	1905.9	3884.7	1652.11	2232.59	4942.33	3290.22
41	5.68316	31333.9	31.5051	Greenstone	400	34	1706.61	1794.3	3536.48	1469.35	2067.13	4582.5	3113.15
42	5.68316	28898.8	32.7662	Greenstone	400	34	1604.42	1686.85	3183.75	1275.91	1907.84	4216.39	2940.48
43	5.68316	26342.2	34.0455	Greenstone	400	34	1506.31	1583.7	2826.25	1071.34	1754.91	3844.01	2772.67
44	5.68316	23658.5	35.3444	Greenstone	400	34	1412.43	1485	2463.73	855.152	1608.58	3465.43	2610.28
45	5.68316	20841.5	36.6645	Greenstone	400	34	1322.98	1390.95	2095.92	626.769	1469.15	3080.77	2454
46	5.68316	17884.4	38.0078	Greenstone	400	34	1238.17	1301.79	1722.52	385.566	1336.96	2690.16	2304.59
47	5.68316	14779.5	39.3761	Greenstone	400	34	1158.28	1217.8	1343.26	130.834	1212.43	2293.88	2163.04
48	6.16156	12330.8	40.8318	Greenstone	400	34	998.107	1049.39	962.759	0	962.759	1825.27	1825.27
49	6.16156	8283.84	42.3805	Greenstone	400	34	757.77	796.704	588.138	0	588.138	1279.6	1279.6
50	8.6021	4331.55	44.2932	Artificial Fill	400	34	470.472	494.645	140.317	0	140.317	599.322	599.322

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.05138



Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	122.474	108.165	0	0	0
2	129.167	106.574	7392.37	3630.62	26.1571
3	135.861	105.142	16460.6	8084.3	26.1571
4	142.555	103.865	26716.2	13121.1	26.157
5	148.238	102.903	35430.7	17401.1	26.1571
6	153.921	102.05	44082.7	21650.4	26.1571
7	159.604	101.306	54532.3	26782.5	26.1571
8	165.287	100.671	66491.6	32656.1	26.1571
9	170.97	100.143	79579.2	39083.8	26.1571
10	176.654	99.7227	93388.4	45865.9	26.1571
11	182.337	99.4085	106553	52331.5	26.1571
12	188.02	99.2007	118633	58264.4	26.1571
13	193.703	99.0989	129612	63656.3	26.157
14	199.386	99.103	139478	68502.1	26.1571
15	205.069	99.213	148229	72799.6	26.157
16	210.753	99.4291	155863	76549.1	26.1571
17	216.436	99.7515	162394	79756.7	26.1571
18	222.119	100.18	167969	82494.7	26.1571
19	227.802	100.717	172623	84780.6	26.1571
20	233.485	101.36	176338	86604.9	26.157
21	239.168	102.112	179099	87961.1	26.1571
22	244.851	102.973	180899	88845.2	26.1571
23	250.535	103.945	181736	89256.2	26.1571
24	256.218	105.027	181612	89195.2	26.1571
25	261.901	106.222	180534	88665.7	26.157
26	267.584	107.53	178514	87673.5	26.157
27	273.267	108.954	175567	86226.5	26.1571
28	278.95	110.495	171715	84334.7	26.1571
29	284.634	112.154	166983	82010.4	26.1571
30	290.317	113.934	161398	79267.6	26.1571
31	296	115.838	154995	76122.9	26.1571
32	301.683	117.866	147811	72594.5	26.1571
33	307.366	120.023	139888	68703.2	26.157
34	313.049	122.311	131273	64472	26.157
35	318.733	124.734	122017	59926.1	26.157
36	324.416	127.294	112176	55093.3	26.1572
37	330.099	129.996	101814	50004	26.1571
38	335.782	132.844	90997.1	44691.5	26.1571
39	341.465	135.843	79799.5	39192	26.1571
40	347.148	138.997	68323.1	33555.6	26.1571
41	352.832	142.313	57038.6	28013.4	26.1571
42	358.515	145.796	46313	22745.7	26.157
43	364.198	149.454	36310.6	17833.2	26.157
44	369.881	153.294	27205.8	13361.6	26.1571
45	375.564	157.324	19185.5	9422.6	26.1571
46	381.247	161.555	12450.2	6114.67	26.1571
47	386.93	165.996	7216.32	3544.15	26.157
48	392.614	170.661	3718.91	1826.47	26.1571
49	398.775	175.985	1562.61	767.444	26.157
50	404.937	181.608	790.844	388.408	26.1571
51	413.539	190	0	0	0

Entity Information

Water Table



X	Y
0	96
130	100
347.318	166.91
593.563	187.3
760	220

Distributed Load

X	Y
565	190
425	190

External Boundary

X	Y
0	0
760	0
760	246
665	230
605	200
580	190
565	190
425	190
345	190
310.275	176.644
215	140
175	130
150	110
0	100

Material Boundary

X	Y
310.275	176.644
565	190

APPENDIX B
Hazardous Materials Survey

ENTEK
CONSULTING GROUP, INC.
4200 Rocklin Road, Suite 7, Rocklin, CA 95677 Phone (916) 632-6800 Fax (916) 632-6812 www.entekgroup.com

HAZARDOUS MATERIALS SURVEY
FINAL REPORT

OWNER/CLIENT

Water Works Engineers
1730 El Camino Real, Ste. 280
San Mateo, CA 94402

CONTACT

Ms. Cindy Bertsch
Project Engineer

SURVEY ADDRESS

Pump Houses
End of Lake Drive, Intersection of Sneath Lane & Engvall Court
San Bruno, CA 94066

BUILDING(S) SURVEYED

Pump House Rehabilitation Project
Job #19-077 - TO #1

PREPARED BY

Blake Howes
CAC #13-5015 & CDPH #I/A 23951
Entek Consulting Group, Inc.
4200 Rocklin Road, Suite 7
Rocklin, CA 95677

Entek Project #19-5318

October 15, 2019

ENTEK

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Executive Summary

The United States Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants (US EPA NESHAP), 40 CFR Part 61 - Nov. 20, 1990, requires an owner or operator of a demolition or renovation project to thoroughly inspect the affected facility or part of the facility where the demolition or renovation operation will occur for the presence of asbestos-containing materials (ACM) prior to the commencement of that project.

This inspection report was requested by Ms. Cindy Bertsch, Project Engineer with Water Works Engineers on behalf of the City of San Bruno.

The purpose of the inspection was to comply with US EPA NESHAP requirements and the Bay Area Air Quality Management District (BAAQMD) which has jurisdiction for this project site to determine if asbestos containing materials are present which may be impacted during an upcoming rehabilitation project, which will include upgrades to two separate pump house structures in San Bruno.

The attached drawing shows approximate sample locations. Materials are classified in the tables of this report as regulated asbestos containing material (RACM), Category I (CAT-I) or Category II (CAT-II) ACM, or asbestos containing construction material (ACCM), which included collecting multiple samples of some materials.

This is a summary of the report. The report must be read in its entirety, and the reader must review all the detailed information provided in the body of the report prior to making any interpretations, or conclusions pertaining to the information. Any conclusions made by the reader about the information provided in the body of this report which are contradictory or not included in this report are the responsibility of the reader.

Asbestos

On October 9, 2019, Entek conducted a survey specific to areas designated by the Client which included all interior and exterior areas of two pump house structures, one located at the end of Lake Drive, and the other at the intersection of Sneath Lane and Engvall Court in San Bruno, California.

The results of testing for asbestos during this survey indicate asbestos is present in pipe gasket material found at pipe bolt joints on the large diameter water pipe found on the exterior east side of the Lake Drive pump house. No other accessible gasket material was observed during this survey due to paint coatings on all pipes, but may be present at any bolted pipe joint. Any discovered pipe gasket material that is not foam, rubber, or fiberglass must be assumed to contain asbestos unless tested and found otherwise. Specifics pertaining to individual materials can be found in later sections of this report.

Lead

Entek investigated existing paints and applied coatings in an effort to determine if lead was present in these materials. The gray paint on the wood exterior, the bright blue paint on interior metal pipes, and the gray floor coating of the Sneath Lane pump house were determined to contain lead in amounts less than 5,000 ppm and are classified as lead containing paint (LCP). Any work designated by California Occupational Safety Health Administration (Cal/OSHA) as a "trigger task" which will impact these paints, coatings, or materials must be done by properly trained personnel, in compliance with all lead related Cal/OSHA regulations and requirements.

All other paints and coatings from the Sneath Lane pump house and all paints and coating from the Lake Drive Pump House were found not to contain lead above the analysis method detection limit.

Introduction

This report presents results of an asbestos and lead survey performed by Entek which included specific interior and exterior designated areas included in an upcoming project. Those areas include all accessible areas of two pump houses in San Bruno. One pump house is located at the end of Lake Drive and the other is located at the intersection of Sneath Lane and Engvall Court.

The inspection was conducted by Mr. Blake Howes on October 9, 2019. Mr. Howes is a Cal/OSHA Certified Asbestos Consultant (CAC) and a State of California Department of Public Health (CDPH) certified Lead Inspector/Assessor.

This report was prepared for Ms. Cindy Bertsch, Project Engineer with Water Works Engineers on behalf of the City of San Bruno.

Building Description

The Lake Drive pump house is a single story wood framed slab on grade structure that measures approximately 15'x15'. Finishes include exterior wood siding, interior painted drywall, and a concrete floor with a traction coating. The roof is a rock covered asphaltic roof system with rolled asphaltic material on several roof jacks. The interior is one large open room with several large water pumps. Large diameter water pipes are present on the interior and exterior.

The Sneath Lane pump house is constructed in the same manner, but measures approximately 15'x25'.

Asbestos Inspection and Sample Collection Protocols

Entek included all specific designated interior and exterior areas of the buildings included in this report, but did not use any demolition methods to look within enclosed wall or ceiling cavities during this investigation. Entek did include all suspect materials observed in, on, or associated with the areas included in this report.

Bulk samples were collected of various materials suspected to contain asbestos by utilizing a power drill and coring tube, cutting the materials with a razor knife, or use of other appropriate hand tools.

Miscellaneous materials were collected from each homogenous area in a manner sufficient to determine whether the material is or is not ACM as required in 40 CFR Part 763, Asbestos-Containing Materials in Schools; Final Rule and Notice, published October 30, 1987.

Approximate locations of all samples collected during this inspection are indicated on the "Bulk Asbestos Material Analysis Request Form for Entek", which served as the chain of custody for the samples, and on the building diagram(s) attached to this report.

Asbestos Bulk Sample Results

There were several materials observed which are considered "suspect" under US EPA guidelines. Under current US EPA guidelines for conducting building inspections for ACM, all "suspect" materials must be assumed to contain asbestos until otherwise determined by laboratory testing.

The samples of materials suspected of containing asbestos were submitted to Asbestech, a laboratory located in Carmichael, California. These samples were subsequently analyzed by polarized light microscopy (PLM) with dispersion staining.

The US EPA NESHAP and BAAQMD uses the terms Regulated Asbestos Containing Material (RACM), Category I, and Category II when identifying materials which contain asbestos in amounts greater than 1%. Cal/OSHA uses the term Asbestos Containing Material (ACM) for materials containing >1% asbestos and the term Asbestos Containing Construction Material (ACCM) which indicates a manufactured construction material contains greater than 0.1% asbestos by weight by the PLM method. This definition can be found in Title 8, 1529.

A total of 16 bulk samples were collected of all the materials considered to be "suspect" which were observed during this investigation. Some of those samples contained multiple layers which were individually analyzed to determine their asbestos content. Analysis of all samples collected was by PLM with dispersion staining. Results of the analysis are listed in the following tables:

Suspect Materials Found or Known TO Contain >1% Asbestos (Category I)				
Sample ID#'s	**Suspect Material**	**Asbestos Content/Type (%) by PLM**	**Location**	**Total Estimated Quantity**
Lake-05A	Pipe gasket material	15-20% CHRYSOTILE	Lake Drive pump house, exterior east side large diameter pipe at bolted joint (See photographs)	1 Sq. Ft.
N/A	Pipe gasket material*	ASSUMED TO CONTAIN ASBESTOS*	Lake Drive & Sneath Lane pump houses at bolted pipe joints*	Unknown*
*Although no additional gasket material was observed during this survey due to paint coatings on all pipes at both pump houses, gasket material may be present at any bolted pipe joint. Any gasket material should be treated as asbestos containing until proven otherwise.				

NOTE: Any Category I or Category II materials identified in the previous tables which will be subjected to mechanical removal, must be considered RACM for the purposes of notification to BAAQMD and classification of waste. Removal of any Category I or Category II materials prior to demolition of a building is dependent upon how the materials will be impacted and if the impact will cause the materials to become friable. If any remaining Category I or Category II materials will become friable they must be removed prior to the initiation of demolition.

Suspect Materials Found NOT TO Contain Asbestos or Considered Non-Suspect				
Sample ID#'s	**Suspect Material**	**EPA AHERA "Suspected" ACBM**	**Asbestos Content**	**Location**
Lake-01A-B	Rock covered asphaltic roof, brown roofing	Miscellaneous	NONE DETECTED	Lake Drive pump house
Lake-02A	Composition asphalt rolled roofing	Miscellaneous	NONE DETECTED	Lake Drive pump house
Lake-03A	Roof penetration mastic	Miscellaneous	NONE DETECTED	Lake Drive pump house
Lake-04A	Foundation & slab concrete	Miscellaneous	NONE DETECTED	Lake Drive pump house
Lake-06A-B	Drywall & joint compound	Miscellaneous	NONE DETECTED	Lake Drive pump house
Lake-07A	Gray floor coating	Miscellaneous	NONE DETECTED	Lake Drive pump house
Sneath-01A-B	Rock covered asphaltic roof	Miscellaneous	NONE DETECTED	Sneath Lane pump house
Sneath-02A	Roof penetration mastic	Miscellaneous	NONE DETECTED	Sneath Lane pump house

Suspect Materials Found NOT TO Contain Asbestos or Considered Non-Suspect				
Sample ID#'s	**Suspect Material**	**EPA AHERA "Suspected" ACBM**	**Asbestos Content**	**Location**
Sneath-03A	Foundation & slab concrete	Miscellaneous	NONE DETECTED	Sneath Lane pump house
Sneath-04A-B	Drywall & joint compound	Miscellaneous	NONE DETECTED	Sneath Lane pump house
Sneath-05A	Gray floor coating	Miscellaneous	NONE DETECTED	Sneath Lane pump house

All sample number noted in the tables above start with EGG-19-5318-

The tables above provide an estimate of the amount of materials in square feet or linear feet. Contractors are responsible for quantifying the exact quantity of materials impacted by the renovation or demolition and shall not rely on the quantities in the above tables.

US EPA AHERA uses three terms when determining the classification of a material for the purpose of sampling. These terms include miscellaneous, surfacing, and thermal system insulation (TSI).

Miscellaneous materials are building materials on structural components, structural members or fixtures, such as floor and ceiling tiles, and does not include surfacing material or TSI.

Surfacing materials are materials that are sprayed-on, troweled-on, or otherwise applied to surfaces, such as acoustical plaster on ceiling and fireproofing materials on structural members, or other materials on surfaces for acoustical, fireproofing, or other purposes.

TSI is material applied to pipes, fittings, boilers, breeching, tanks, ducts, or other structural components to prevent heat loss or gain, water condensation, or for other purposes.

The information provided in the tables of this report are for use by the Owner in determining where asbestos containing materials are located, and whether or not any future work may impact those materials. The information is also provided for use by any contractor who may perform work in areas impacting the materials listed in this report, and for use as appropriate by asbestos abatement contractors to provide costs related to work impacting ACM.

Any building materials which are considered "suspect" for containing asbestos which have not been identified in this report must be assumed to contain asbestos in amounts >1% until properly investigated and/or tested.

Materials commonly excluded from being suspected for containing asbestos include, but are not limited to: unwrapped pink and yellow fiberglass insulating materials or products, foam insulation, wood, metal, plastic, or glass. All other types of building materials or coatings on the materials listed above are commonly listed as "suspect" and must be tested

prior to impact by a Contractor. Work impacting these untested or newly discovered materials must cease until an investigation can be completed.

Asbestos Regulatory Requirements

US EPA

The property included in this survey report is located in San Mateo County. Bay Area Air Quality Management District (BAAQMD) has been given authority for enforcement of the NESHAP regulations by means of their own rules (Regulation 11, Rule 2) in this area.

A demolition is the wrecking, taking out, or burning of any load supporting structural member. A renovation is everything else. **10 day written notification to the BAAQMD is required prior to the performance of any demolition project regardless of asbestos being present or not**. This notification would also apply to any renovation project which involves the wrecking, taking out, or burning of any load bearing structural member during a renovation as well.

There is not a sufficient amount of ACM present to require a 10 day notification to the BAAQMD be submitted for asbestos purposes prior to starting work which will impact materials identified as RACM or Category I and Category II materials if they are made friable. If more than 100 square feet, 100 linear feet or 35 cubic feet of RACM is planned for removal on the project, formal written notification to BAAQMD is required.

Cal/OSHA

Disturbance of any ACM or ACCM could generate airborne asbestos fibers and would be regulated by Cal/OSHA. Cal/OSHA worker health and safety regulations apply during any disturbance of ACM or ACCM by a person while in the employ of another. This is true regardless of friability or quantity disturbed.

Since it has been estimated less than 100 square feet of ACCM or ACM does exist and will be impacted during the upcoming project, a licensed asbestos contractor, certified by the State of California, and registered with Cal/OSHA is not required to perform the asbestos related removal work. Entek recommends a licensed asbestos contractor be used to remove ACCM even if less than 100 square feet of ACCM is being disturbed. Regardless of the type of contractor, all workers must still be in compliance with Title 8, Section 1529.

For compliance with Title 8, Section 341.9, the asbestos contractor must send written notice at least one day (24 hours) prior to start of any work which will impact any amount of asbestos to the local office for the State of California, Department of Occupational Safety and Health, and perform all work in accordance with Cal/OSHA requirements.

Lead Inspection, Sampling, & Results

A total of 15 bulk samples of the painted surfaces from the pump houses were collected and submitted to Asbestech laboratory. These samples were subsequently analyzed by atomic absorption spectrometry (AAS). Results of the analysis are listed in the following tables:

Paints/Coatings/ Materials Determined to be Lead Containing Paint (LCP)		
Paint/Coating Color or Material	**Lead Content**	**Component/Location**
Gray colored paint	2,000 ppm	Exterior wood siding - Sneath Lane pump house
Gray colored coating	53 ppm	Interior concrete floor - Sneath Lane pump house
Bright blue colored paint	280 ppm	Interior metal pipes - Sneath Lane pump house

LCP - Materials/coatings/paints which contain measurable amounts of lead. The disturbance of these materials/coatings/paints is regulated by Cal/OSHA.

Paints/Coatings/Materials Determined NOT TO Contain Lead (<50 ppm)	
Paint/Coating Color or Material	**Building Component**
Gray colored paint	Exterior wood siding - Lake Drive pump house
Blue colored paint	Exterior wood trim & fascia - Lake Drive pump house
Bright Blue colored paint	Interior /Exterior large diameter metal pipes - Lake Drive pump house
Yellow colored paint	Interior/Exterior metal valves - Lake Drive pump house
Red colored paint	Interior/Exterior metal valve wheels - Lake Drive pump house
Gray colored coating	Interior concrete floor - Lake Drive pump house
Gray colored paint	Interior drywall walls - Lake Drive pump house
Blue colored paint	Exterior wood trim & fascia - Sneath Lane pump house
Blue colored paint	Exterior large diameter metal pipes - Sneath Lane pump house
Red colored paint	Interior/Exterior metal valve wheels & hose connections - Sneath Lane pump house
Yellow colored paint	Interior metal valves - Sneath Lane pump house
Gray colored paint	Interior drywall walls - Sneath Lane pump house

Paints determined “NOT TO” contain lead for the purposes of this report are those samples which when analyzed did not indicate lead to be present at or above the reportable limit for the analysis method used. This reportable limit was 50 parts per million (ppm). As a result, any paints shown “NOT TO” contain lead will not require any special training or work practices related to lead when impacted.

Lead Regulatory Compliance

Any upcoming project which may result in the disturbance of lead containing products or surfaces, but is not intended to remediate a lead hazard or specifically designed to remove LBP to reduce or eliminate a known hazard, would be considered "lead related construction work".

Lead related construction work does not fit the classification of a "lead abatement project" under CDPH Title 17 regulations. "*Abatement*" is defined in Title 17, Division 1, Chapter 8, Article 1 as "any set of measures designed to reduce or eliminate lead hazards or LBP for public and residential buildings, but does not include containment or cleaning." A *lead hazard* is defined in Title 17, Division 1, Chapter 8, Article 1 as "deteriorated LBP, lead contaminated dust, lead contaminated soil, disturbing LBP or presumed LBP without containment, or any other nuisance which may result in persistent and quantifiable lead exposure."

Lead related construction work means any "construction, alteration, painting, demolition, salvage, renovation, repair, or maintenance of any residential or public building, including preparation and cleanup, that, by using or disturbing lead-containing material or soil, may result in significant exposure of adults or children to lead". (Title 17, California Code of Regulations, Division 1, Chapter 8, Article 1).

Currently, Cal/OSHA has not established a definition for LBP, nor have they established minimum concentrations where their regulations do not apply. Cal/OSHA regulates all construction activities involving materials containing lead, including LBP. These regulations are found in CCR, Title 8 Section 1532.1 (§1532.1) Lead in Construction.

Since Cal/OSHA has not established a concentration of lead in a product where their regulations do not apply, any disturbance to products containing lead come under the jurisdiction of Cal/OSHA and their regulations. Disturbance of paints/coatings or materials determined to be LBP may trigger a pre-work notification to Cal/OSHA if "trigger tasks" disturb 100 square feet or more of those paints/coatings or materials. Trigger tasks are described in Title 8 CCR 1532.1.

Limitations

Entek inspected only the specific designated areas identified by the client to be included in the upcoming project, which included all accessible interior and exterior areas of the pump houses located at the end of Lake Drive and at the intersection of Sneath Lane and Engvall Court.

As a result the information provided in this inspection report may not be used to extend the inspection results to areas not included in this report without additional review and sampling as necessary.

Entek did not perform any destructive sampling to look into ceiling and wall cavities. As a result, it may be possible for materials to be hidden in these areas which are not included in this report. Entek also did not employ any destructive measures on floors of interior spaces or exterior areas covered with asphalt, concrete, or dirt.

If any new materials not listed as having been sampled, or listed as assumed for containing asbestos in this report are discovered, the new material must be assumed to contain asbestos until properly inspected and tested for asbestos content.

Entek's policy is to retain a full copy of these written documents for three (3) years once the file is closed. At the end of the 3 year period the written files will be destroyed without further notice. It is suggested copies of the file(s) are maintained as per the your company's policy.

Entek will be providing only this electronic copy of the report and its attachments for your use. However, if you would like a hard copy of this report please do not hesitate to ask. Entek will be happy to mail the report upon receipt of your request.

Thank you for choosing Entek for your environmental needs. Please call me at (916) 632-6800 if you have any questions regarding this report.

Prepared by: 

Blake Howes
Senior Project Manager
Cal/OSHA #13-5015
CDPH #23951

Appendices

A. Asbestos Related Documents
B. Lead Related Documents
C. Backup Documentation

C:\Users\bhowes\Entek Consulting Group, Inc\Entekgroup - Documents\Clients\Water Works Engineers\19-5318 San Bruno - Asb & Pb\Project Letters & Reports\Final Haz Mat Report 10-15-19.wpd

Photo Log

Job Number:	19-5318	Date:	10-15-19
Client:	Water Works Engineers		
Site Address:	Lake Drive & Sneath Lane Pump Houses, San Bruno		



Lake Drive Pump House



Asbestos Containing Pipe Gasket Material, Exterior East Side of Lake Drive Pump House



Sneath Lane Pump House

ENTEK

APPENDIX A

ASBESTOS RELATED DOCUMENTS

- Bulk Asbestos Material Analysis Report Form for Entek
- Bulk Asbestos Analysis Report From Asbestech
- Bulk Asbestos Material Analysis Request Form for Entek
- Asbestos Bulk Sample Location Drawing

ENTEK

BULK ASBESTOS MATERIAL *Analysis Report*

ENTEK CONSULTING GROUP, INC.
4200 ROCKLIN ROAD, SUITE 7
ROCKLIN, CA 95677
(916) 632-6800 PHONE
(916) 632-6812 FAX
mainoffice@entekgroup.com

Date of Sampling: October 9, 2019 **Lab:** Asbestech

Job Number: 19-5318 **Collected by:** Blake Howes

Client Name: Water Works Engineers

Site Address: Pump Houses
Lake Drive & Sneath Lane
San Bruno, CA 94066

SAMPLE #	RESULTS	MATERIAL DESCRIPTION/LOCATION
ECG-19-5318-Lake-01A	NONE DETECTED	Rock covered asphaltic roof - Pump house roof
ECG-19-5318-Lake-01B	NONE DETECTED	Rock covered asphaltic roof - Pump house roof
ECG-19-5318-Lake-02A	NONE DETECTED	Composition asphalt rolled roofing - Pump house roof at jacks
ECG-19-5318-Lake-03A	NONE DETECTED	Roof penetration mastic - Pump house roof
ECG-19-5318-Lake-04A	NONE DETECTED	Foundation & slab concrete - Southeast corner of pump house
ECG-19-5318-Lake-05A	**15-20% CHRYSOTILE**	Pipe gasket material - East exterior of pump house at large diameter metal pipe
ECG-19-5318-Lake-06A	NONE DETECTED	Drywall & joint compound - Interior northeast corner of pump house
ECG-19-5318-Lake-06B	NONE DETECTED	Drywall & joint compound - Interior southeast corner of pump house
ECG-19-5318-Lake-07A	NONE DETECTED	Floor coating - Interior concrete floor of pump house
ECG-19-5318-Sneath-01A	NONE DETECTED	Rock covered asphaltic roof - Pump house roof
ECG-19-5318-Sneath-01B	NONE DETECTED	Rock covered asphaltic roof - Pump house roof
ECG-19-5318-Sneath-02A	NONE DETECTED	Roof penetration mastic - Pump house roof
ECG-19-5318-Sneath-03A	NONE DETECTED	Foundation & slab concrete - Southwest corner of pump house

ENTEK

BULK ASBESTOS MATERIAL *Analysis Report*

ENTEK CONSULTING GROUP, INC.
4200 ROCKLIN ROAD, SUITE 7
ROCKLIN, CA 95677
(916) 632-6800 PHONE
(916) 632-6812 FAX
mainoffice@entekgroup.com

Date of Sampling: October 9, 2019 **Lab:** Asbestech

Job Number: 19-5318 **Collected by:** Blake Howes

Client Name: Water Works Engineers

Site Address: Pump Houses
Lake Drive & Sneath Lane
San Bruno, CA 94066

SAMPLE #	RESULTS	MATERIAL DESCRIPTION/LOCATION
ECG-19-5318-Sneath-04A	NONE DETECTED	Drywall & joint compound - Interior southeast corner of pump house
ECG-19-5318-Sneath-04B	NONE DETECTED	Drywall & joint compound - Interior northwest corner of pump house
ECG-19-5318-Sneath-05A	NONE DETECTED	Floor coating - Interior concrete floor of pump house

C:\Users\bhowes\Entek Consulting Group, Inc\Entekgroup - Documents\Clients\Water Works Engineers\19-5318 San Bruno - Asb & Pb\Bulk Sample Asb\Bulk Report 10-9-19.wpd

ASBESTECH
6825 Fair Oaks Blvd., Suite 103
Carmichael, California 95608
Tel.(916) 481-8902 asbestech@sbcglobal.net

Client:
Entek Consulting Group, Inc.
4200 Rocklin Rd., Suite 7
Rocklin, CA 95677

Job:
19-5318 Water Works Engineers
Pump House, End of Lake Dr.
San Bruno , Ca

BULK ASBESTOS ANALYSIS REPORT

LAB JOB # 67020-1
Date/Time Collected: 10/9/19
Date Received: 10/10/19

NVLAP Lab Code 101442-0
CDPH # 1153
Date Analyzed: 10/11/19

Sample No.	*Color/Description*	*% Type Asbestos*	*Other Materials*
ECG-19-5318- Lake-			
01A	Black rock covered asphaltic roof, pump house roof	NONE DETECTED	Tar Binder Fibrous Glass
01B	Black rock covered asphaltic roof, pump house roof	NONE DETECTED	Tar Binder Fibrous Glass
	Brown roofing	NONE DETECTED	Cellulose
02A	Black composition asphalt rolled roofing, pump house roof at jacks	NONE DETECTED	Tar Binder Synthetics
03A	Black roof penetration mastic, pump house roof	NONE DETECTED	Tar Binder Cellulose
04A	Gray foundation & slab concrete , SE corner of pump house	NONE DETECTED	Granular Mins.
05A	Blue & black pipe gasket material, east exterior of pump house at large diameter metal pipe	15-20 CHRYSOTILE	Opaques Tar Binder
06A	White drywall , interior NE corner of pump house	NONE DETECTED	Gypsum Fibrous Glass
	White joint compound	NONE DETECTED	Calcite

THE ANALYSIS USES POLARIZED LIGHT MICROSCOPY AND DISPERSION STAINING FOLLOWING E.P.A. METHOD 600/R-93/116. NON-FRIABLE MATERIALS WERE ANALYZED APPLYING THE SAME METHOD. THE LOWER DETECTION LIMIT IS <1 % WITH THE PROVISO THAT PLM MAY NOT DETECT FIBERS <0.25 MICRONS IN DIAMETER THAT MAY BE PRESENT IN SAMPLES SUCH AS FLOOR TILES. IN ACCORDANCE WITH TITLE 22, CCR, SECTION 66261.24(a)(2)(A),THE MCL IS 1 %. SAMPLES WERE NOT COLLECTED BY ASBESTECH. THIS REPORT MUST NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE APPROVAL OF ASBESTECH. THIS REPORT RELATES ONLY TO THE ITEMS TESTED. THIS REPORT MUST NOT BE USED TO CLAIM PRODUCT ENDORSEMENT BY N.V.L.A.P. OR ANY AGENCY OF THE U.S. GOVERNMENT. ASBESTECH ACCEPTS TECHNICAL RESPONSIBILITY FOR THIS REPORT AND DATE OF ISSUE.

NVLAP LAB CODE 101442-0 LAB DIRECTOR: TOM CONLON ANALYST: JIM JUNGLES

ASBESTECH
6825 Fair Oaks Blvd., Suite 103
Carmichael, California 95608
Tel.(916) 481-8902 asbestech@sbcglobal.net

Client:
Entek Consulting Group, Inc.
4200 Rocklin Rd., Suite 7
Rocklin, CA 95677

Job:
19-5318 Water Works Engineers
Pump House, End of Lake Dr.
San Bruno , Ca

BULK ASBESTOS ANALYSIS REPORT

LAB JOB # 67020-2
Date/Time Collected: 10/9/19
Date Received: 10/10/19

NVLAP Lab Code 101442-0
CDPH # 1153
Date Analyzed: 10/11/19

Sample No.	*Color/Description*	*% Type Asbestos*	*Other Materials*
ECG-19-5318- Lake-			
06B	White drywall , interior SE corner of pump house	NONE DETECTED	Gypsum Fibrous Glass
	White joint compound	NONE DETECTED	Calcite
07A	Gray floor coating , interior concrete floor of pump house	NONE DETECTED	Opaques

THE ANALYSIS USES POLARIZED LIGHT MICROSCOPY AND DISPERSION STAINING FOLLOWING E.P.A. METHOD 600/R-93/116. NON-FRIABLE MATERIALS WERE ANALYZED APPLYING THE SAME METHOD. THE LOWER DETECTION LIMIT IS <1 % WITH THE PROVISO THAT PLM MAY NOT DETECT FIBERS <0.25 MICRONS IN DIAMETER THAT MAY BE PRESENT IN SAMPLES SUCH AS FLOOR TILES. IN ACCORDANCE WITH TITLE 22, CCR, SECTION 66261.24(a)(2)(A),THE MCL IS 1 %. SAMPLES WERE NOT COLLECTED BY ASBESTECH. THIS REPORT MUST NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE APPROVAL OF ASBESTECH. THIS REPORT RELATES ONLY TO THE ITEMS TESTED. THIS REPORT MUST NOT BE USED TO CLAIM PRODUCT ENDORSEMENT BY N.V.L.A.P. OR ANY AGENCY OF THE U.S. GOVERNMENT. ASBESTECH ACCEPTS TECHNICAL RESPONSIBILITY FOR THIS REPORT AND DATE OF ISSUE.

NVLAP LAB CODE 101442-0 LAB DIRECTOR: TOM CONLON ANALYST: JIM JUNGLES 

ASBESTECH
6825 Fair Oaks Blvd., Suite 103
Carmichael, California 95608
Tel.(916) 481-8902 asbestech@sbcglobal.net

Client:
Entek Consulting Group, Inc.
4200 Rocklin Rd., Suite 7
Rocklin, CA 95677

Job:
19-5318 Water Works Engineers
Pump House, Intersection of Sneath & Engvall
San Bruno , Ca

BULK ASBESTOS ANALYSIS REPORT

LAB JOB # 67019
Date/Time Collected: 10/9/19
Date Received: 10/10/19

NVLAP Lab Code 101442-0
CDPH # 1153
Date Analyzed: 10/11/19

Sample No.	*Color/Description*	*% Type Asbestos*	*Other Materials*
ECG-19-5318- Sneath-			
01A	Black rock covered asphaltic roof, pump house roof	NONE DETECTED	Tar Binder Fibrous Glass
01B	Black rock covered asphaltic roof, pump house roof	NONE DETECTED	Tar Binder Fibrous Glass
02A	Black roof penetration mastic, pump house roof	NONE DETECTED	Tar Binder Cellulose
03A	Gray foundation & slab concrete , SW corner of pump house	NONE DETECTED	Granular Mins.
04A	White drywall , interior SE corner of pump house	NONE DETECTED	Gypsum Fibrous Glass
	White joint compound	NONE DETECTED	Calcite
04B	White drywall , interior NW corner of pump house	NONE DETECTED	Gypsum Fibrous Glass
	White joint compound	NONE DETECTED	Calcite
05A	Gray floor coating , interior concrete floor of pump house	NONE DETECTED	Opaques

THE ANALYSIS USES POLARIZED LIGHT MICROSCOPY AND DISPERSION STAINING FOLLOWING E.P.A. METHOD 600/R-93/116. NON-FRIABLE MATERIALS WERE ANALYZED APPLYING THE SAME METHOD. THE LOWER DETECTION LIMIT IS <1 % WITH THE PROVISO THAT PLM MAY NOT DETECT FIBERS <0.25 MICRONS IN DIAMETER THAT MAY BE PRESENT IN SAMPLES SUCH AS FLOOR TILES. IN ACCORDANCE WITH TITLE 22, CCR, SECTION 66261.24(a)(2)(A),THE MCL IS 1 %. SAMPLES WERE NOT COLLECTED BY ASBESTECH. THIS REPORT MUST NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE APPROVAL OF ASBESTECH. THIS REPORT RELATES ONLY TO THE ITEMS TESTED. THIS REPORT MUST NOT BE USED TO CLAIM PRODUCT ENDORSEMENT BY N.V.L.A.P. OR ANY AGENCY OF THE U.S. GOVERNMENT. ASBESTECH ACCEPTS TECHNICAL RESPONSIBILITY FOR THIS REPORT AND DATE OF ISSUE.

NVLAP LAB CODE 101442-0 LAB DIRECTOR: TOM CONLON ANALYST: JIM JUNGLES Jim Jungles

ENTEK

67020

BULK ASBESTOS MATERIAL *Analysis Request*

ENTEK CONSULTING GROUP, INC.
4200 ROCKLIN ROAD, SUITE 7
ROCKLIN, CA 95677
(916) 632-6800 PHONE
(916) 632-6812 FAX
mainoffice@entekgroup.com

Date of Sampling: October 9, 2019

Job Number: 19-5318

Client Name: Water Works Engineers

Site Address: Pump House
End of Lake Drive
San Bruno, CA 94066

Lab: Asbestech

Collected by: Blake Howes

Turnaround Time: Monday 10-14-19 by 5:00 pm

ANALYSIS REQUESTED: Asbestos by PLM with Dispersion Staining

Special Instruction: *Stop Analysis upon first positive result (>1%) for sample in a series. Also stop analysis upon first positive result (>1%) in the joint compound for sample series.*

Please e-mail results as soon as available and include copy of submittal with those results.

SAMPLE #	MATERIAL DESCRIPTION/LOCATION
ECG-19-5318-Lake-01A	Rock covered asphaltic roof - Pump house roof
ECG-19-5318-Lake-01B	Rock covered asphaltic roof - Pump house roof
ECG-19-5318-Lake-02A	Composition asphalt rolled roofing - Pump house roof at jacks
ECG-19-5318-Lake-03A	Roof penetration mastic - Pump house roof
ECG-19-5318-Lake-04A	Foundation & slab concrete - Southeast corner of pump house
ECG-19-5318-Lake-05A	Pipe gasket material - East exterior of pump house at large diameter metal pipe
ECG-19-5318-Lake-06A	Drywall & joint compound - Interior northeast corner of pump house
ECG-19-5318-Lake-06B	Drywall & joint compound - Interior southeast corner of pump house
ECG-19-5318-Lake-07A	Floor coating - Interior concrete floor of pump house

C:\Users\bhowes\Entek Consulting Group, Inc\Entekgroup - Documents\Clients\Water Works Engineers\19-5318 San Bruno - Asb & Pb\Bulk Sample Asb\Bulk Request 10-9-19 Lake.wpd

Delivered by: _____ **Date:** 10/10/19 **Time:** 9:31 **AM/PM**

Received by: _____ **Date:** 10/10/19 **Time:** 9:31 **AM/PM**

ENTEK

BULK ASBESTOS MATERIAL *Analysis Request*

67019

ENTEK CONSULTING GROUP, INC.
4200 ROCKLIN ROAD, SUITE 7
ROCKLIN, CA 95677
(916) 632-6800 PHONE
(916) 632-6812 FAX
mainoffice@entekgroup.com

Date of Sampling: October 9, 2019

Job Number: 19-5318

Client Name: Water Works Engineers

Site Address: Pump House
Intersection of Sneath & Engvall
San Bruno, CA 94066

Lab: Asbestech

Collected by: Blake Howes

Turnaround Time: Monday 10-14-19 by 5:00 pm

ANALYSIS REQUESTED: Asbestos by PLM with Dispersion Staining

Special Instruction: *Stop Analysis upon first positive result (>1%) for sample in a series. Also stop analysis upon first positive result (>1%) in the joint compound for sample series.*

Please e-mail results as soon as available and include copy of submittal with those results.

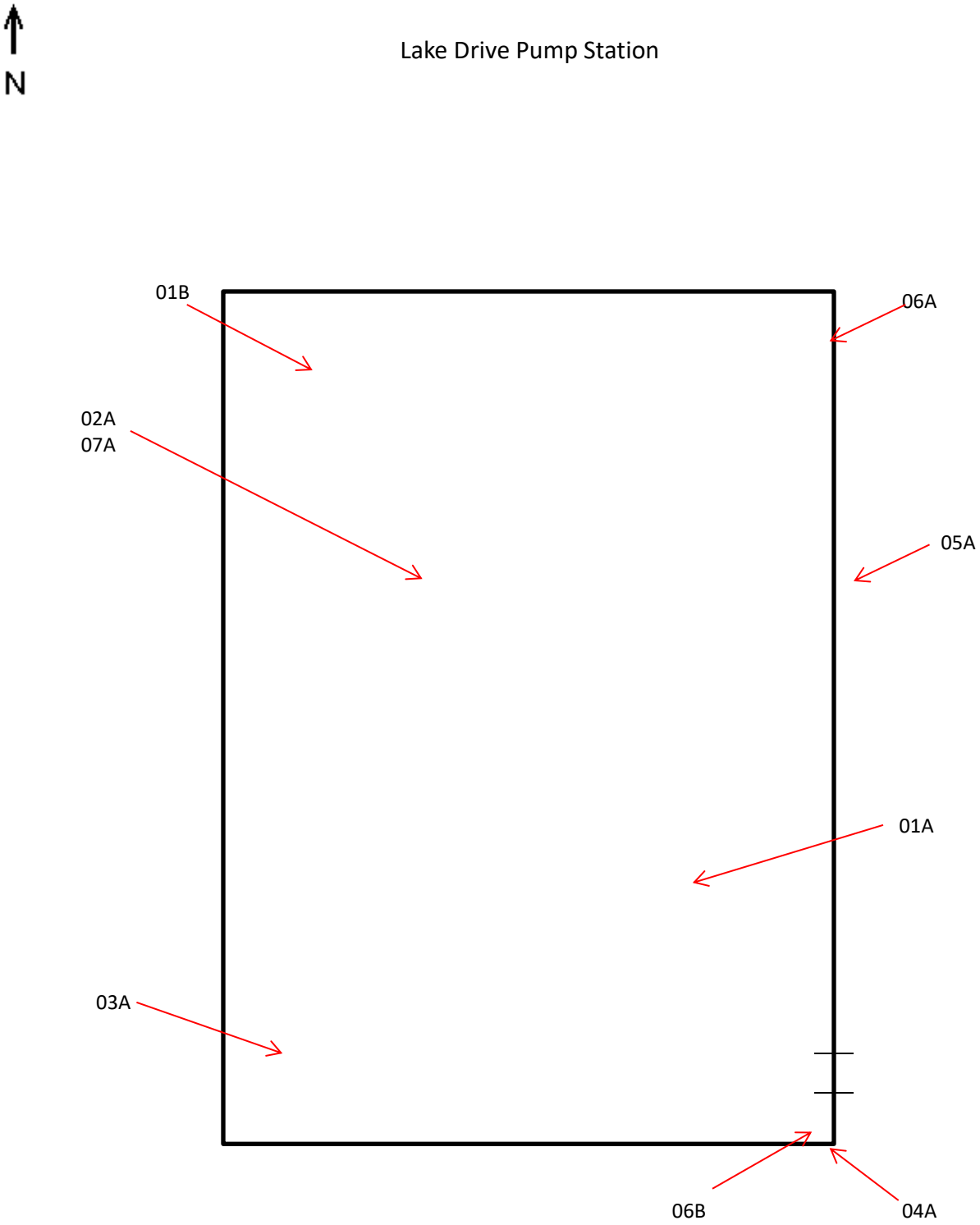
SAMPLE #	MATERIAL DESCRIPTION/LOCATION
ECG-19-5318-Sneath-01A	Rock covered asphaltic roof - Pump house roof
ECG-19-5318-Sneath-01B	Rock covered asphaltic roof - Pump house roof
ECG-19-5318-Sneath-02A	Roof penetration mastic - Pump house roof
ECG-19-5318-Sneath-03A	Foundation & slab concrete - Southwest corner of pump house
ECG-19-5318-Sneath-04A	Drywall & joint compound - Interior southeast corner of pump house
ECG-19-5318-Sneath-04B	Drywall & joint compound - Interior northwest corner of pump house
ECG-19-5318-Sneath-05A	Floor coating - Interior concrete floor of pump house

C:\Users\bhowes\Entek Consulting Group, Inc\Entekgroup - Documents\Clients\Water Works Engineers\19-5318 San Bruno - Asb & Pb\Bulk Sample Asb\Bulk Request 10-9-19 Sneath.wpd

Delivered by: _____ **Date:** 10/10/19 **Time:** 9:31 06 **AM/PM**

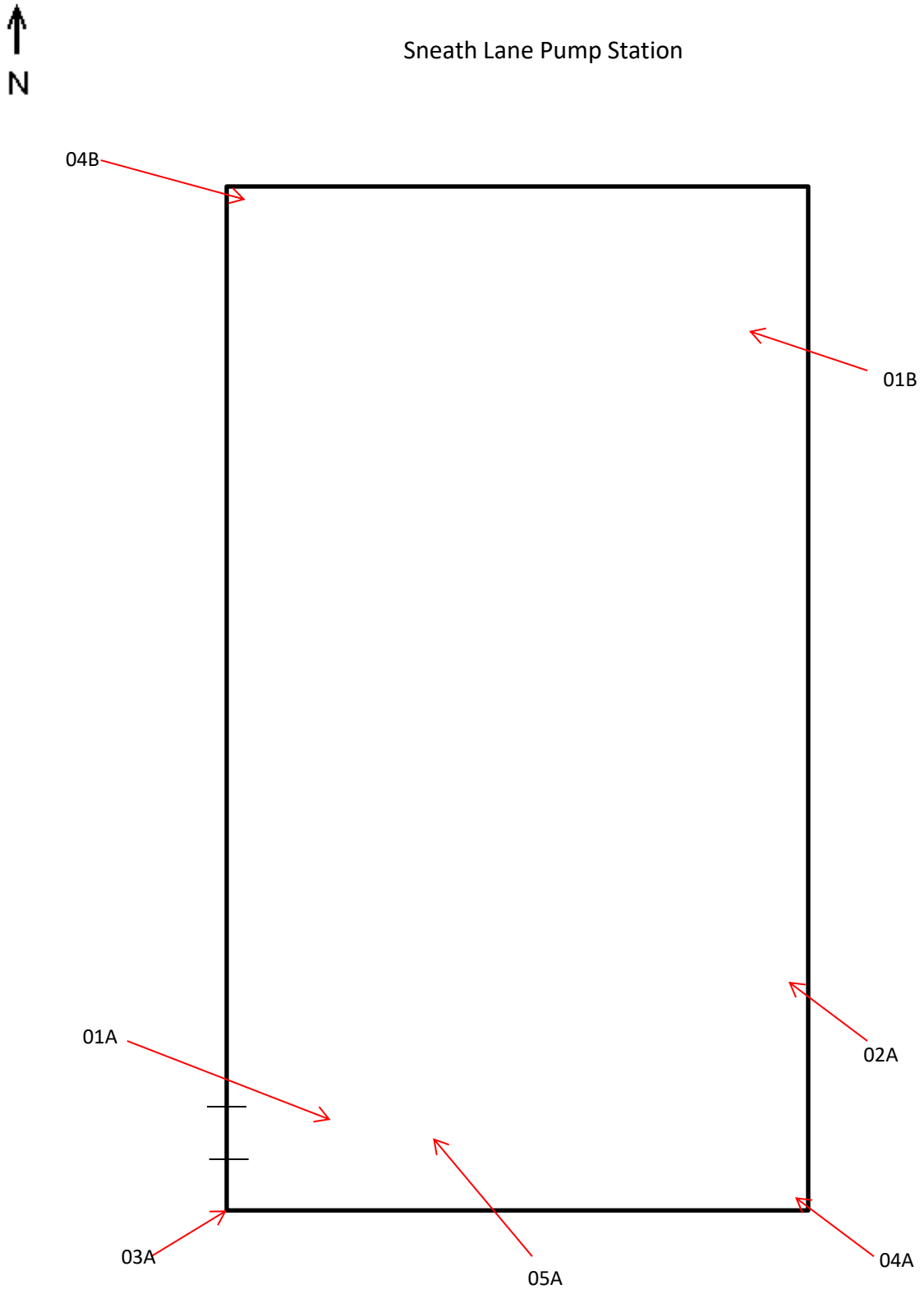
Received by: _____ **Date:** 10 10 19 **Time:** 930 **AM/PM**

Lake Drive Pump Station



Water Works Engineers San Bruno Water Pump House End of Lake Drive San Bruno, CA 94066	Entek Consulting Group, Inc. 4200 Rocklin Road, Suite 7 Rocklin CA 95677 Map Not to Scale Cloud/Client/WaterEWorks/19-5318SanBrucoDrawing/LakeAsb	Asbestos Bulk Sample Locations Collected by Blake Howes On October 9, 2019 Project Number 19-5318

Sneath Lane Pump Station



Water Works Engineers San Bruno Water Pump House Sneath Lane & Engvall Ct San Bruno, CA 94066	Entek Consulting Group, Inc. 4200 Rocklin Road, Suite 7 Rocklin CA 95677 Map Not to Scale Cloud/Client/WaterEWorks/19-5318SanBrunoDrawing/SneathAsb	Asbestos Bulk Sample Locations Collected by Blake Howes On October 9, 2019 Project Number 19-5318

APPENDIX B

LEAD RELATED DOCUMENTS

- Bulk Lead Material Analysis Report Forms for Entek
- Lead in Paint Samples Analysis Reports From Asbestech
- Bulk Lead Material Analysis Request Forms for Entek
- Lead Bulk Sample Location Drawing
- Lead Hazard Evaluation Report (CDPH 8552)

ENTEK

BULK LEAD MATERIAL *Analysis Report*

ENTEK CONSULTING GROUP, INC.
4200 ROCKLIN ROAD, SUITE 7
ROCKLIN, CA 95677
(916) 632-6800 PHONE
(916) 632-6812 FAX
mainoffice@entekgroup.com

Date of Sampling: October 9, 2019 **Lab:** Asbestech

Job Number: 19-5318 **Collected by:** Blake Howes

Client Name: Water Works Engineers

Site Address: Pump Houses
Lake Drive & Sneath Lane
San Bruno, CA 94066

SAMPLE #	LEAD RESULT (PPM)	RESULT IN WT%	MATERIAL DESCRIPTION/LOCATION
ECG-19-5318-Lake-01Pb	< 50	< 0.0050	Gray colored paint - Exterior wood siding of pump house
ECG-19-5318-Lake-02Pb	< 50	< 0.0050	Blue colored paint - Exterior wood trim & fascia of pump house
ECG-19-5318-Lake-03Pb	< 50	< 0.0050	Bright blue colored paint - Interior/Exterior of pump house on large metal pipes
ECG-19-5318-Lake-04Pb	< 50	< 0.0050	Yellow colored paint - Interior/Exterior of pump house on metal valves
ECG-19-5318-Lake-05Pb	< 50	< 0.0050	Red colored paint - Interior/Exterior of pump house on metal valve wheels
ECG-19-5318-Lake-06Pb	< 50	< 0.0050	Gray colored coating - Interior concrete floor of pump house
ECG-19-5318-Lake-07Pb	< 50	< 0.0050	Gray colored paint - Interior drywall walls of pump house
ECG-19-5318-Sneath-01Pb	2,000	0.2	Gray colored paint - Exterior wood siding of pump house
ECG-19-5318-Sneath-02Pb	< 50	< 0.0050	Blue colored paint - Exterior wood trim & fascia of pump house
ECG-19-5318-Sneath-03Pb	< 50	< 0.0050	Blue colored paint - Exterior large diameter metal pipe
ECG-19-5318-Sneath-04Pb	< 50	< 0.0050	Red colored paint - Interior/Exterior metal valve wheels & hose connections
ECG-19-5318-Sneath-05Pb	53	0.0053	Gray colored coating - Interior concrete floor of pump house

ENTEK

BULK LEAD MATERIAL *Analysis Report*

ENTEK CONSULTING GROUP, INC.
4200 ROCKLIN ROAD, SUITE 7
ROCKLIN, CA 95677
(916) 632-6800 PHONE
(916) 632-6812 FAX
mainoffice@entekgroup.com

Date of Sampling: October 9, 2019 **Lab:** Asbestech

Job Number: 19-5318 **Collected by:** Blake Howes

Client Name: Water Works Engineers

Site Address: Pump Houses
Lake Drive & Sneath Lane
San Bruno, CA 94066

SAMPLE #	LEAD RESULT (PPM)	RESULT IN WT%	MATERIAL DESCRIPTION/LOCATION
ECG-19-5318-Sneath-06Pb	280	0.028	Bright blue colored paint - Interior metal pipes of pump house
ECG-19-5318-Sneath-07Pb	< 50	< 0.0050	Yellow colored paint - Interior metal valves of pump house
ECG-19-5318-Sneath-08Pb	< 50	< 0.0050	Gray colored paint - Interior drywall walls of pump house

C:\Users\bhowes\Entek Consulting Group, Inc\Entekgroup - Documents\Clients\Water Works Engineers\19-5318 San Bruno - Asb & Pb\Bulk Sample Pb\Bulk Report Pb 10-9-19.wpd

ASBESTECH
6825 Fair Oaks Blvd., Suite 103
Carmichael, California 95608
Tel (916) 481-8902
asbestech@sbcglobal.net

FLAME ATOMIC ABSORPTION SPECTROMETRY
LEAD (Pb) IN PAINT SAMPLES
METHOD SW846-3050B-7420

CLIENT:
Entek Consulting Group, Inc.
4200 Rocklin Rd., Suite 7
Rocklin, CA 95677

CDPH ELAP#1153
ELPAT#101801

JOB I.D: 19-5318, Water Works Engineers,
Pump House, End of Lake Dr.,
San Bruno , Ca

DATE RECEIVED: 10/10/19

DATE ANALYZED: 10/11/19

LAB JOB NO: 11823

DATE REPORTED: 10/11/19

SAMPLE DATE	SAMPLE NUMBER	DESCRIPTION	PPM	RESULT IN WT%	RL	Q.C. BATCH
10/9/19	ECG-19-5318-Lake-01Pb	Gray paint , exterior wood siding of pump house	<50	<0.0050	0.0050%	114
10/9/19	ECG-19-5318-Lake-02Pb	Blue paint , exterior wood trim & fascia of pump house	<50	<0.0050	0.0050%	114
10/9/19	ECG-19-5318-Lake-03Pb	Bright blue paint , interior/ exterior of pump house on large metal pipes	<50	<0.0050	0.0050%	114
10/9/19	ECG-19-5318-Lake-04Pb	Yellow paint , interior/ exterior of pump house on metal valves	<50	<0.0050	0.0050%	114
10/9/19	ECG-19-5318-Lake-05Pb	Red paint , interior/ exterior of pump house on metal valve wheels	<50	<0.0050	0.0050%	114
10/9/19	ECG-19-5318-Lake-06Pb	Gray coating , interior wood siding of pump house	<50	<0.0050	0.0050%	114
10/9/19	ECG-19-5318-Lake-07Pb	Gray paint , interior drywall walls of pump house	<50	<0.0050	0.0050%	114

Analytical results and reports are generated at the request and for the exclusive use of the client. This report applies only to the items tested. Samples were not collected by ASBESTECH. This report must not be reproduced except in full, and only with the express permission of ASBESTECH. This report must not be used to claim product endorsement by any agency of the U.S. Government.

Jim Jungles

LABORATORY DIRECTOR: TOM CONLON ANALYST: JIM JUNGLES

ASBESTECH
6825 Fair Oaks Blvd., Suite 103
Carmichael, California 95608
Tel (916) 481-8902
asbestech@sbcglobal.net

FLAME ATOMIC ABSORPTION SPECTROMETRY
LEAD (Pb) IN PAINT SAMPLES
METHOD SW846-3050B-7420

CLIENT:
Entek Consulting Group, Inc.
4200 Rocklin Rd., Suite 7
Rocklin, CA 95677

CDPH ELAP#1153
ELPAT#101801

JOB I.D: 19-5318, Water Works Engineers,
Pump House, Intersection of Sneath & Engvall,
San Bruno , Ca

DATE RECEIVED: 10/10/19

DATE ANALYZED: 10/11/19

LAB JOB NO: 11822

DATE REPORTED: 10/11/19

SAMPLE DATE	SAMPLE NUMBER	DESCRIPTION	PPM	RESULT IN WT%	RL	Q.C. BATCH
10/9/19	ECG-19-5318-Sneath-01Pb	Gray paint , exterior wood siding of pump house	2000	0.20	0.0050%	113
10/9/19	ECG-19-5318-Sneath-02Pb	Blue paint , exterior wood trim & fascia of pump house	<50	<0.0050	0.0050%	113
10/9/19	ECG-19-5318-Sneath-03Pb	Blue paint , exterior large diameter metal pipe	<50	<0.0050	0.0050%	113
10/9/19	ECG-19-5318-Sneath-04Pb	Red paint , interior/ exterior metal valve wheels & hose connections	<50	<0.0050	0.0050%	113
10/9/19	ECG-19-5318-Sneath-05Pb	Gray coating , interior concrete floor of pump house	53	0.0053	0.0050%	113
10/9/19	ECG-19-5318-Sneath-06Pb	Bright blue paint , interior metal pipes of pump house	280	0.028	0.0050%	114
10/9/19	ECG-19-5318-Sneath-07Pb	Yellow paint , interior metal valves of pump house	<50	<0.0050	0.0050%	114
10/9/19	ECG-19-5318-Sneath-08Pb	Gray paint , interior drywall walls of pump house	<50	<0.0050	0.0050%	114

Analytical results and reports are generated at the request and for the exclusive use of the client. This report applies only to the items tested. Samples were not collected by ASBESTECH. This report must not be reproduced except in full, and only with the express permission of ASBESTECH. This report must not be used to claim product endorsement by any agency of the U.S. Government.

Jim Jungles

LABORATORY DIRECTOR: TOM CONLON ANALYST: JIM JUNGLES

ENTEK

11823

BULK LEAD MATERIAL *Analysis Request*

ENTEK CONSULTING GROUP, INC.
4200 ROCKLIN ROAD, SUITE 7
ROCKLIN, CA 95677
(916) 632-6800 PHONE
(916) 632-6812 FAX
mainoffice@entekgroup.com

Date of Sampling: October 9, 2019

Job Number: 19-5318

Client Name: Water Works Engineers

Site Address: Pump House
End of Lake Drive
San Bruno, CA 94066

Lab: Asbestech

Collected by: Blake Howes

Turnaround Time: Monday 10-14-19 by 5:00 pm

ANALYSIS REQUESTED: Lead by Atomic Absorption Spectrometry

Special Instruction: *Please report result in PPM and % by weight. Please email results as soon as possible.*

B114

SAMPLE #	MATERIAL DESCRIPTION/LOCATION	
ECG-19-5318-Lake-01Pb	Gray colored paint - Exterior wood siding of pump house	<
ECG-19-5318-Lake-02Pb	Blue colored paint - Exterior wood trim & fascia of pump house	<
ECG-19-5318-Lake-03Pb	Bright blue colored paint - Interior/Exterior of pump house on large metal pipes	<
ECG-19-5318-Lake-04Pb	Yellow colored paint - Interior/Exterior of pump house on metal valves	<
ECG-19-5318-Lake-05Pb	Red colored paint - Interior/Exterior of pump house on metal valve wheels	<
ECG-19-5318-Lake-06Pb	Gray colored coating - Interior concrete floor of pump house	<
ECG-19-5318-Lake-07Pb	Gray colored paint - Interior drywall walls of pump house	<

C:\Users\bhowes\Entek Consulting Group, Inc\Entekgroup - Documents\Clients\Water Works Engineers\19-5318 San Bruno - Asb & Pb\Bulk Sample Pb\Bulk Request Pb 10-9-19 Lake.wpd

Delivered by: _____ **Date:** 10/10/19 **Time:** 9:31 AM/PM

Received by: _____ **Date:** 10/10/19 **Time:** 9:31 AM/PM

ENTEK

11823

BULK LEAD MATERIAL *Analysis Request*

ENTEK CONSULTING GROUP, INC.
4200 ROCKLIN ROAD, SUITE 7
ROCKLIN, CA 95677
(916) 632-6800 PHONE
(916) 632-6812 FAX
mainoffice@entekgroup.com

Date of Sampling: October 9, 2019

Job Number: 19-5318

Client Name: Water Works Engineers

Site Address: Pump House
Intersection of Sneath & Engvall
San Bruno, CA 94066

Lab: Asbestech

Collected by: Blake Howes

Turnaround Time: Monday 10-14-19 by 5:00 pm

ANALYSIS REQUESTED: Lead by Atomic Absorption Spectrometry

Special Instruction: *Please report result in PPM and % by weight. Please email results as soon as possible.*

B113

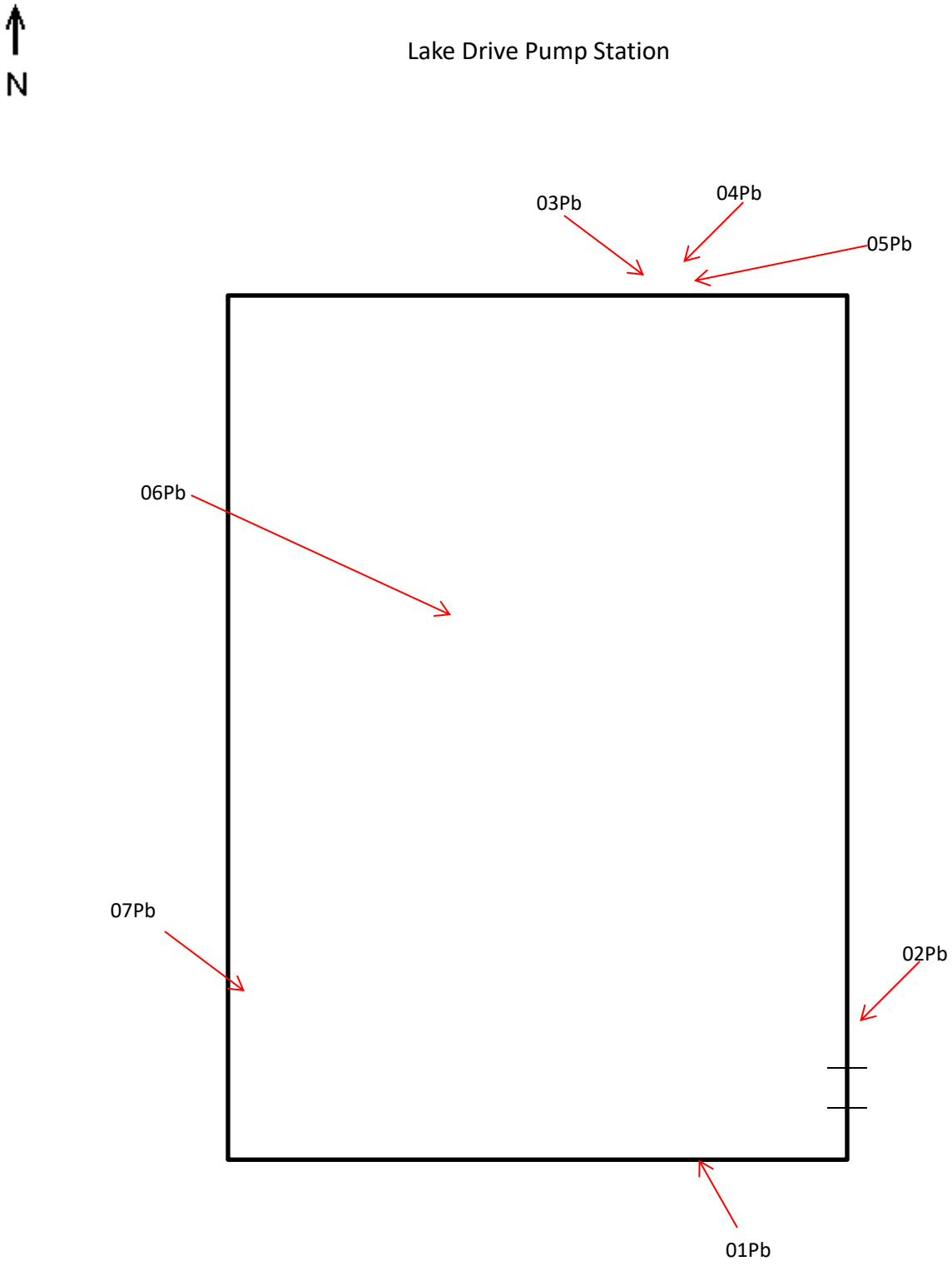
SAMPLE #	MATERIAL DESCRIPTION/LOCATION	
ECG-19-5318-Sneath-01Pb	Gray colored paint - Exterior wood siding of pump house	2000 / .20
ECG-19-5318-Sneath-02Pb	Blue colored paint - Exterior wood trim & fascia of pump house	<
ECG-19-5318-Sneath-03Pb	Blue colored paint - Exterior large diameter metal pipe	<
ECG-19-5318-Sneath-04Pb	Red colored paint - Interior/Exterior metal valve wheels & hose connections	<
ECG-19-5318-Sneath-05Pb	Gray colored coating - Interior concrete floor of pump house	53 / .0053
ECG-19-5318-Sneath-06Pb	Bright blue colored paint - Interior metal pipes of pump house	280 / .028 B114
ECG-19-5318-Sneath-07Pb	Yellow colored paint - Interior metal valves of pump house	<
ECG-19-5318-Sneath-08Pb	Gray colored paint - Interior drywall walls of pump house	<

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Delivered by: _____ **Date:** 10/10/19 **Time:** 9:31 AM/PM

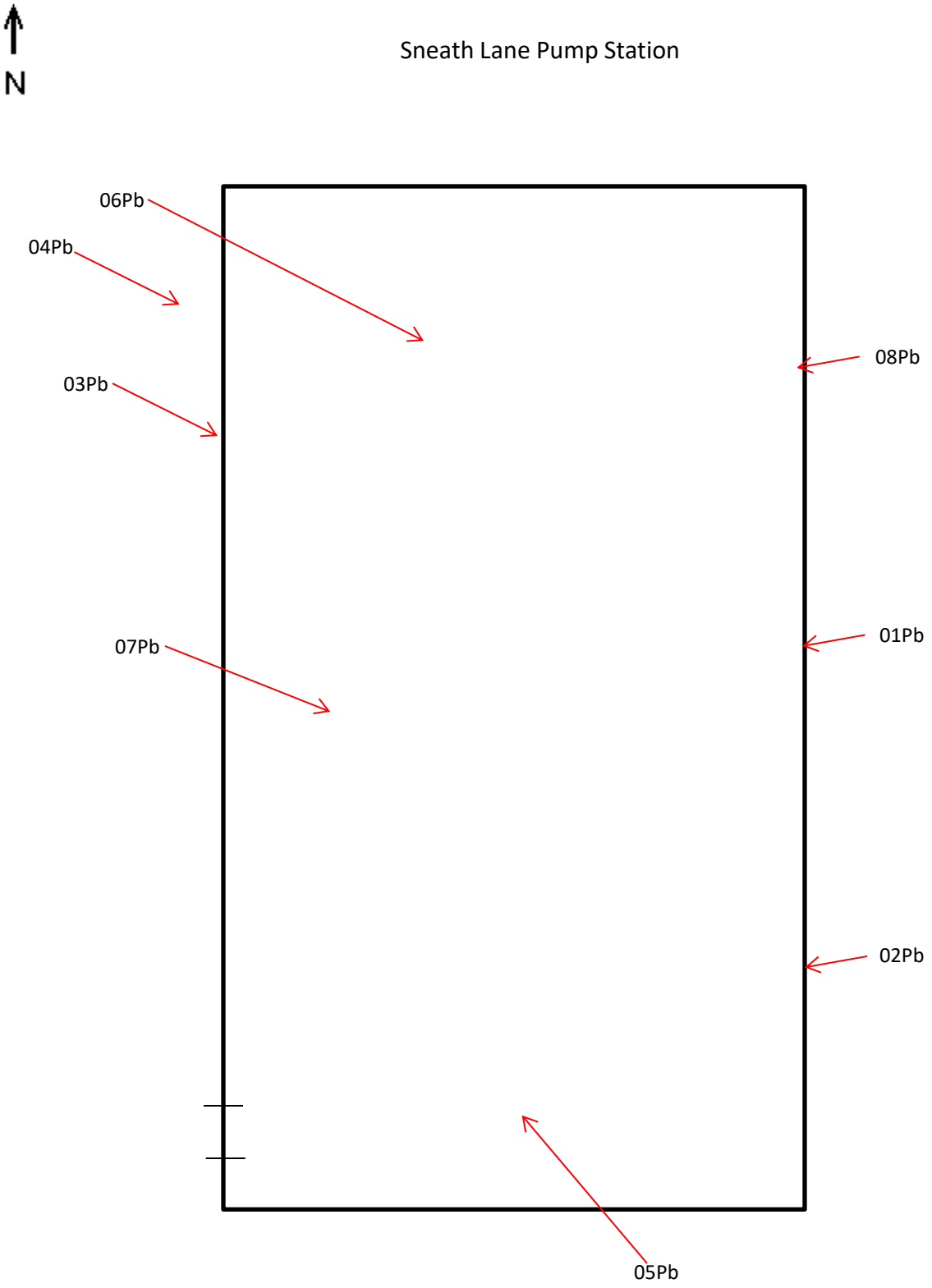
Received by: _____ **Date:** 10/10/19 **Time:** 931 AM/PM

Lake Drive Pump Station



Water Works Engineers San Bruno Water Pump House End of Lake Drive San Bruno, CA 94066	Entek Consulting Group, Inc. 4200 Rocklin Road, Suite 7 Rocklin CA 95677 Map Not to Scale Cloud/Client/WaterEWorks/19-5318SanBrucoDrawing/LakePb	Lead Bulk Sample Locations Collected by Blake Howes On October 9, 2019 Project Number 19-5318

Sneath Lane Pump Station



Water Works Engineers
San Bruno Water Pump House
Sneath Lane & Engvall Ct
San Bruno, CA 94066

Entek Consulting Group, Inc.
4200 Rocklin Road, Suite 7
Rocklin CA 95677
Map Not to Scale
Cloud/Client/WaterEWorks/19-5318SanBrunoDrawing/SneathLead

Lead Bulk Sample Locations
Collected by Blake Howes
On October 9, 2019
Project Number 19-5318

LEAD HAZARD EVALUATION REPORT

Section 1 – Date of Lead Hazard Evaluation October 9, 2019

Section 2 – Type of Lead Hazard Evaluation (Check one box only)

❒ Lead Inspection ❒ Risk Assessment ❒ Clearance Inspection ■ Other (specify) See Attached Letter dated April 21, 2015

Section 3–Structure Where Lead Hazard Evaluation Was Conducted

Address [number, street, apartment (if applicable)]	City	County	Zip Code
End of Lake Drive, Intersection of Sneath Lane & Engvall Ct	San Bruno	San Mateo	94066

Construction date (year) of structure	Type of structure	Children living in structure?
1960's	❒ Multi-unit building ❒ School or daycare ❒ Single family dwelling ■ Other (specify) Pump Houses	❒ Yes ■ No ❒ Don't Know

Section 4–Owner of Structure (If business/agency, list contact person)

	Telephone Number
City of San Bruno, Ms. Cindy Bertsch	(916) 316-2245

Address [number, street, apartment (if applicable)]	City	State	Zip Code
1730 El Camino Real, Ste. 280	San Mateo	California	94402

Section 5–Results of Lead Hazard Evaluation (Check all that apply)

■ No lead-based paint detected ❒ Intact lead-based paint detected. ❒ Deteriorated lead-based paint detected

❒ No lead hazards detected ❒ Lead-contaminated dust found ❒ Lead contaminated soil found ❒ Other _____

Section 6–Individual Conducting Lead Hazard Evaluation

Name	Telephone Number
Entek Consulting Group, Inc. - Blake Howes	(916) 632-6800

Address [number, street, apartment (if applicable)]	City	State	Zip Code
4200 Rocklin Road, Suite 7	Rocklin	CA	95677

CDPH certification number	Signature	Date
23951	Blake Howes	10-14-19

Name and CDPH certification number of any other individuals conducting sampling or testing (if applicable)

N/A

Section 7–Attachments

A. A foundation diagram or sketch of the structure indicating the specific locations of each lead hazard or presence of lead-based paint;

B. Each testing method, device, and sampling procedure used;

C. All data collected, including quality control data, laboratory results, indicating laboratory name, address, and phone number.

First copy and attachments retained by inspector

Second copy and attachments retained by owner

Third copy only (no attachments) mailed or faxed to:

California Department of Public Health
Childhood Lead Poisoning Prevention Branch Reports
850 Marina Bay Parkway, Building P, Third Floor
Richmond, CA 94804-6403
Fax: (510) 620-5656

ENTEK
CONSULTING GROUP, INC.
4200 Rocklin Road, Suite 7, Rocklin, CA 95677 Telephone (916) 632-6800 Fax (916) 632-6812 www.entekgroup.com

April 21, 2015

State of California
Health and Human Services Agency
California Department of Public Health
Childhood Lead Poisoning Prevention Branch Reports
850 Marina Parkway, Building P, Third Floor
Richmond, CA 94804-6403

RE: Lead Hazard Evaluation Report (CDPH 8552 - 6/07)

To Whom it May Concern:

In a memorandum issued to all "California Department of Health Services Certified Inspector/Assessors and Project Monitors", by the State of California - Health and Human Services Agency, Department of Health Services (CDPH), dated June 5, 2006, and signed by Mr. Paul Fitzmaurice, Chief, Lead Hazard Reduction Section, Childhood Lead Poisoning Prevention Branch, it was made clear that"... the on-site investigation, for compensation, of lead-based paint or lead hazards..." includes"... conducting testing and/or sampling activities as part of a non-'abatement' project (e.g. painting remodeling, etc.)."

As a result of this directive, Entek Consulting Group, Inc. (Entek) is providing you with the current CDPH Form 8552 (06/07) documenting an inspection/assessment performed by Entek.

The investigation results being reported on the attached CDPH Form 8552 do not reflect a "Lead Inspection/Assessment" as defined in Title 17. As a result the "Other" box, in "Section 2 - Type of Lead Hazard Evaluation", is checked. This is being done to make it clear this investigation does not meet the definition of a "Lead Inspection/Assessment", and submission of the attached CDPH Form 8552 is not meant to reflect that it does.

CDPH Form 8552, Section 5 - Results of Lead Hazard Evaluation, does not allow for an appropriate option pertaining to the results of the investigation/assessment performed and being reported (i.e. for the purpose of compliance with Cal/OSHA, Title 8 1532.1 Lead), or an assessment being performed in an unregulated structure. While one of or more of the four boxes is checked to reflect the results of the inspection/assessment. The lead inspection/assessment was not required under Title 17.

This letter is not intended to disagree whether a CDPH Form 8552 must be submitted, but is for clarification as to the information included on the CDPH Form 8552, and its intended purpose, namely to reflect the goal of the services performed by Entek.

Sincerely,

Richard A. Beall, CIH, CSP
President

Z:\Lead\Lead Hazard Evaluation Report CDPH 8552 Ltr 4-21-15.wpd

ENTEK

APPENDIX C

BACK UP DOCUMENTATION

- Inspector Accreditations and Certifications
- Laboratory Accreditations for Asbestos Analysis

State of California
Division of Occupational Safety and Health

Certified Site Surveillance Technician

Blake W Howes
Name



Certification No. 13-5015

Expires on 04/17/20

This certification was issued by the Division of Occupational Safety and Health as authorized by Sections 7180 et seq. of the Business and Professions Code.

State of California Department of Public Health

Lead-Related Construction Certificate

Certificate Type

Inspector/Assessor

Expiration Date

09/10/2019



24303

Blake W. Howes

ID #: 23951

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 101442-0

ASBESTECH

Carmichael, CA

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Asbestos Fiber Analysis

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2019-07-01 through 2020-06-30

Effective Dates

DEPARTMENT OF COMMERCE * UNITED STATES OF AMERICA *

For the National Voluntary Laboratory Accreditation Program

NVLAP® National Voluntary Laboratory Accreditation Program

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

ASBESTECH
6825 Fair Oaks Blvd., Suite 103
Carmichael, CA 95608
Mr. Tommy Conlon
Phone: 916-481-8902 Fax: 916-481-3975
Email: asbestech@sbcglobal.net
http://www.asbestechlab.com

ASBESTOS FIBER ANALYSIS — NVLAP LAB CODE 101442-0

Bulk Asbestos Analysis

Code	*Description*
18/A01	EPA -- 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples
18/A03	EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials

Airborne Asbestos Analysis

Code	*Description*
18/A02	U.S. EPA's "Interim Transmission Electron Microscopy Analytical Methods-Mandatory and Nonmandatory-and Mandatory Section to Determine Completion of Response Actions" as found in 40 CFR, Part 763, Subpart E, Appendix A.

For the National Voluntary Laboratory Accreditation Program

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

CALIFORNIA STATE

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

CERTIFICATE OF ENVIRONMENTAL ACCREDITATION

Is hereby granted to

Laboratory: Asbestech

6825 Fair Oaks Boulevard

Carmichael, CA 95608

Scope of the certificate is limited to the
"Fields of Testing"
which accompany this Certificate.

Continued accredited status depends on successful completion of on-site inspection, proficiency testing studies, and payment of applicable fees.

This Certificate is granted in accordance with provisions of
Section 100825, et seq. of the Health and Safety Code.

Certificate No.: **1153**

Expiration Date: **3/31/2020**

Effective Date: **4/1/2018**

Sacramento, California
subject to forfeiture or revocation

Christine Sotelo, Chief
Environmental Laboratory Accreditation Program

CALIFORNIA STATE
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM
Accredited Fields of Testing

Asbestech

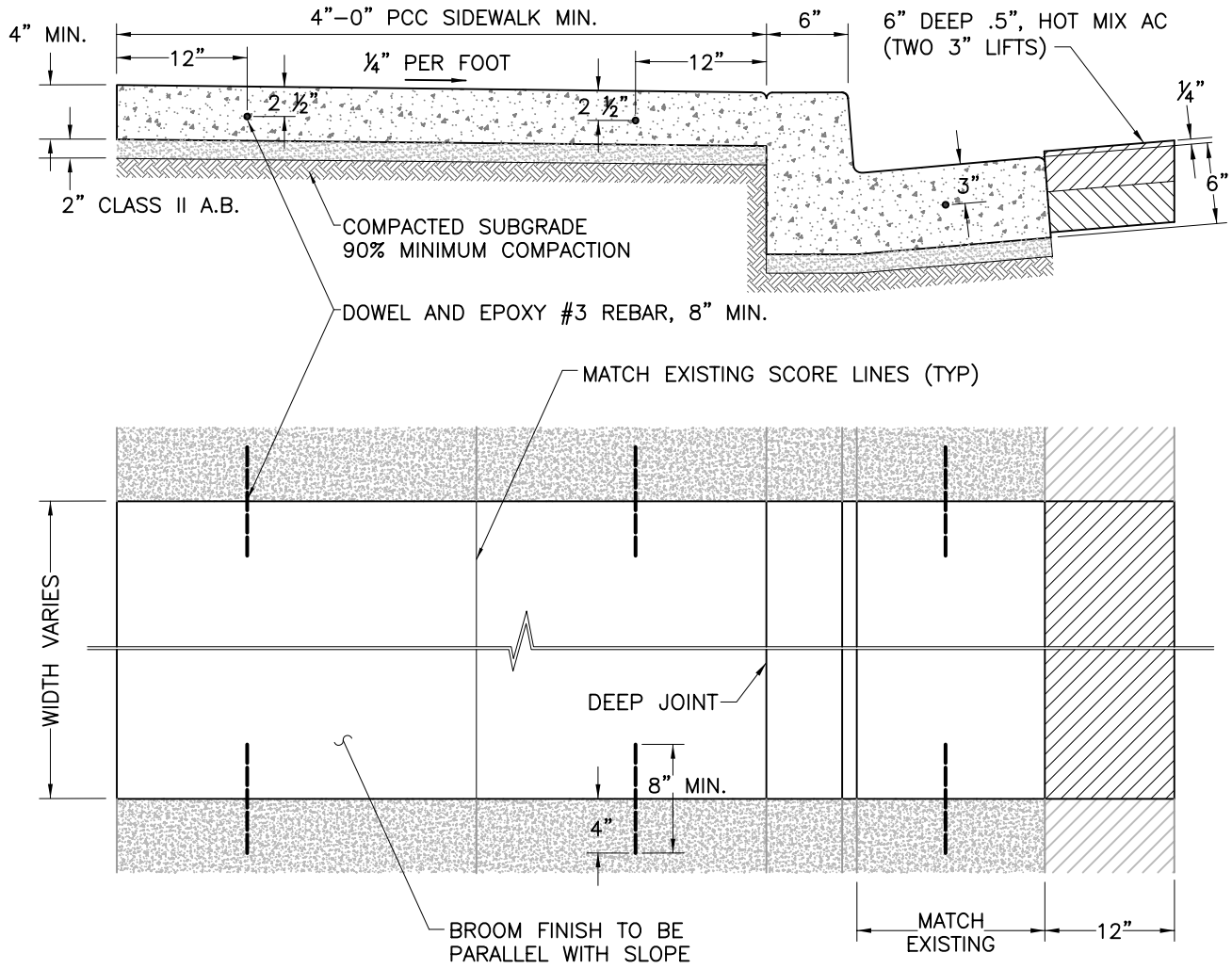
6825 Fair Oaks Boulevard
Carmichael, CA 95608
Phone: (916) 481-8902

Certificate No. 1153
Expiration Date 3/31/2020

Field of Testing: 114 - Inorganic Chemistry of Hazardous Waste			
114.130	001	Lead	EPA 7420
Field of Testing: 115 - Extraction Test of Hazardous Waste			
115.020	001	Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311 (TCLP)
115.030	001	Waste Extraction Test (WET)	CCR Chapter11, Article 5, Appendix II
Field of Testing: 121 - Bulk Asbestos Analysis of Hazardous Waste			
121.010	001	Bulk Asbestos	EPA 600/M4-82-020

As of 10/23/2018 , this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

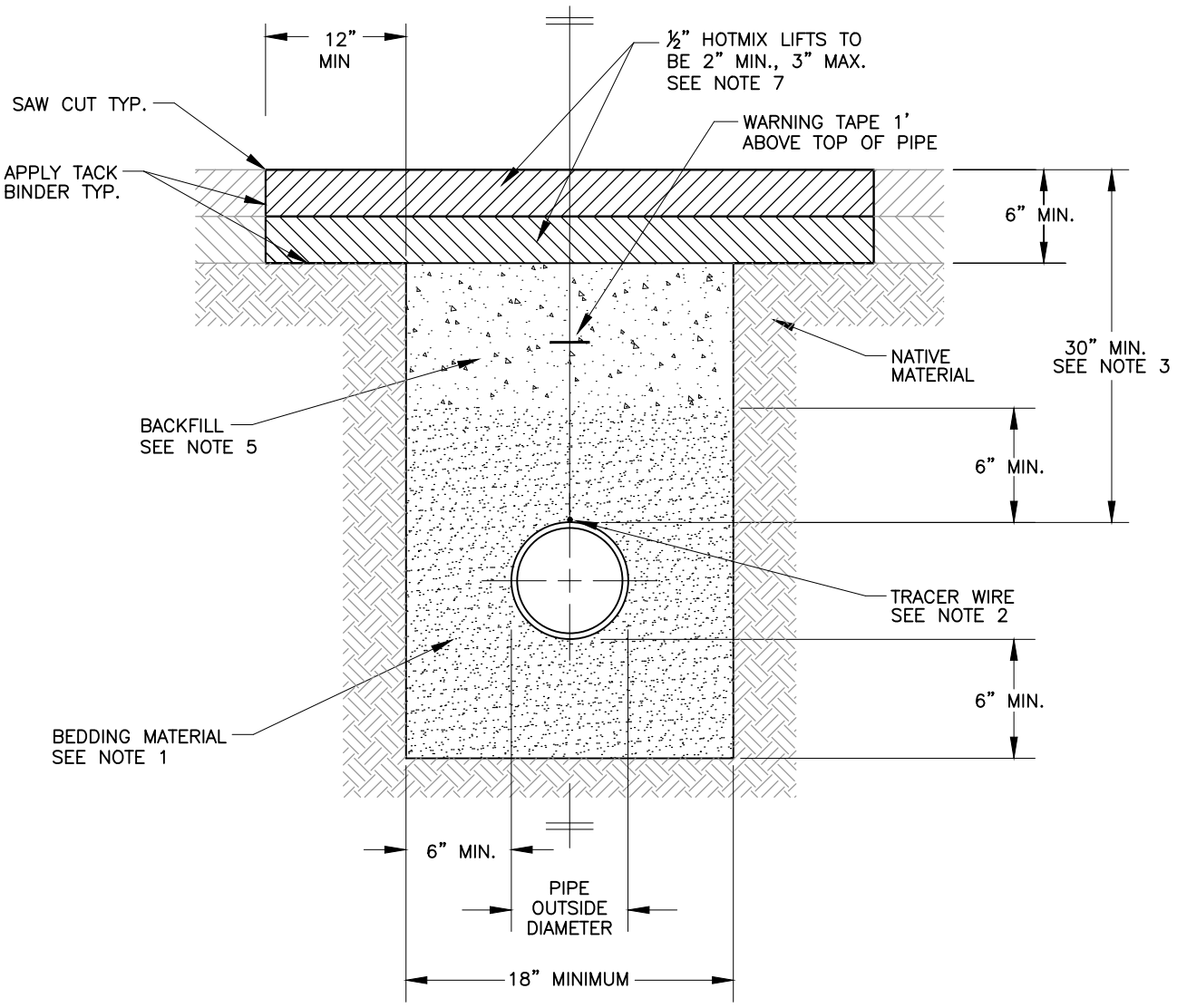
APPENDIX C
Applicable City Standard Details



NOTES:

1. ALL WORK AND MATERIALS SHALL CONFORM TO APPLICABLE SECTIONS OF CALTRANS SPECIFICATIONS AND CITY OF SAN BRUNO SPECIFICATIONS AND STANDARD DRAWINGS.
2. GROUND SHALL BE COMPACTED TO A MINIMUM OF 90% RELATIVE COMPACTION, AND DAMPENED BEFORE PLACING NEW CONCRETE.
3. ALL CONCRETE DEMOLITION SHALL BE TO SCORE LINES OR JOINTS. ALL CUTS SHALL BE SAWED NEAT AND STRAIGHT AND SHALL HAVE A MINIMUM DEPTH OF 1–1/2". WATER USED FOR SAWCUTTING OPERATIONS SHALLED BE VACUUMED IMMEDIATELY.
4. ALL NEW CONCRETE SHALL BE CLASS B, USING 1–3/4" MAXIMUM SIZE AGGREGATE, 5" MAXIMUM SLUMP. FINISH TO BE UNIFORM FINE BROOMED TEXTURE.
5. NEW SIDEWALKS SHALL BE SCORED TO MATCH CONTIGUOUS EXISTING SIDEWALK AND CURB.
6. ALL NEW CONCRETE SHALL HAVE 1 LB LAMP BLACK PER CUBIC YD TO MATCH COLOR OF ADJACENT CONCRETE TO THE MAXIMUM EXTENT POSSIBLE. CONCRETE TAG TO BE SUBMITTED TO CITY INSPECTOR. EXPANSION JOINTS TO BE ½" EX–TRUDED POLYETHYLENE FOAM OR EQUIVALENT.
7. SUITABLE REFLECTIVE CONES, BARRICADES AND/OR WARNING LIGHTS SHALL SURROUND THE WORK AT ALL TIMES. THE CITY MAY REQUIRE THE SUBMITTAL AND APPROVAL OF A TRAFFIC/PEDESTRIAN CONTROL PLAN.
8. CONTRACTOR SHALL USE CITY APPROVED 'NO PARKING' SIGNS ISSUED WHEN THE ENCROACHMENT PERMIT IS PULLED.
9. CONTRACTOR SHALL CALL 24 HRS IN ADVANCE FOR BOTH THE PRE–POUR AND FINAL INSPECTIONS. 650–616–7065
10. UNLESS OTHERWISE NOTED, ALL RADII TO BE ½"
11. ALL WORK WITHIN CITY RIGHT–OF–WAY REQUIRES ENCROACHMENT PERMIT FROM CITY'S ENGINEERING DIVISION, ANY UN–AUTHORIZED WORK WILL RESULT IN A FINE

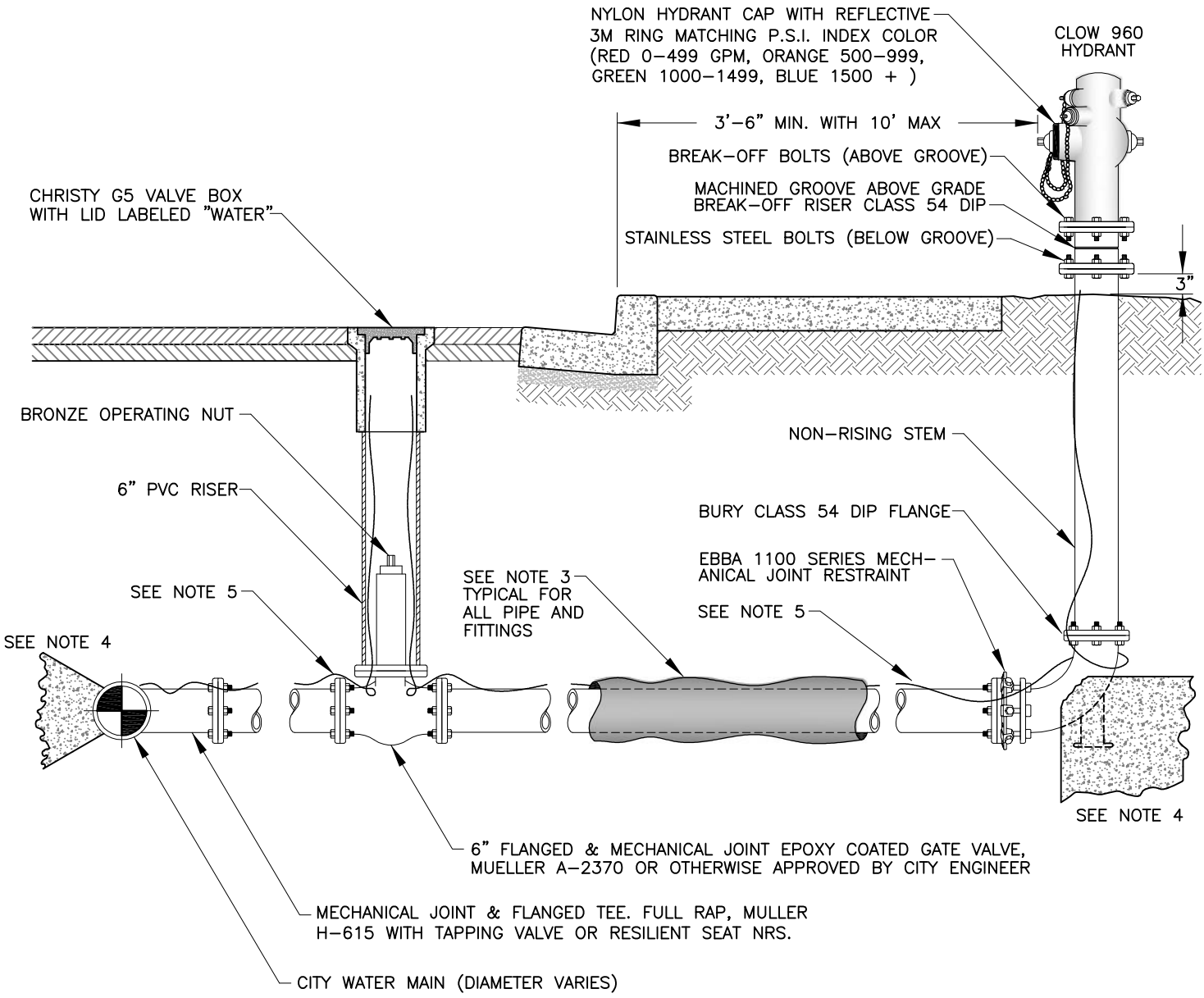
City of San Bruno *Standard Detail*	SIDEWALK	DATE: AUG 2011 DRAWN BY: JMH
	CITY ENGINEER: APPROVED BY: WING WONG R.C.E. C35688	ST–02 DETAIL NO:



NOTES:

1. BEDDING MATERIAL SHALL BE CLEAN AND GRADED SAND UNLESS OTHERWISE SPECIFIED.
2. REFER TO SECTION 33-10-00 OF THE SAN BRUNO TECHNICAL SPECIFICATIONS FOR WARNING TAPE AND TRACER WIRE INSTALLATION AND SPECIFICATIONS
3. WARNING TAPE FOR BURIED SEWER OR STORM MAINS SHALL BE "BLUE" COLOR THE LENGTH OF THE TRENCH LABELLED "CAUTION: WATER PIPE BELOW".
4. IF THERE IS LESS THAN 30" OF COVER OVER THE PIPE, CAP TRENCH WITH 2 SACK CEMENT SLURRY.
5. BACKFILL MATERIAL SHALL BE APPROVED NATIVE SOIL, CLASS II AGGREGATE BASE OR CEMENT SLURRY IF SPECIFIED. BACKFILLING REQUIREMENTS SHALL BE IN ACCORDANCE WITH SECTION 31-23-33 OF THE SAN BRUNO TECHNICAL SPECIFICATIONS. 95% MINIMUM RELATIVE COMPACTION FOR NON-SLURRY BACKFILL. FOR SLURRY BACKFILL ALLOW A MINIMUM OF 24 HOURS CURE TIME BEFORE HOTMIX IS PLACED.
6. NEW PIPE SHALL MAINTAIN A 30" MINIMUM CLEARANCE FOR PARALLEL UTILITIES AND A 12" MINIMUM VERTICAL CLEARANCE FOR PERPENDICULAR (OR CROSSING) UTLITIES. FOR DETAILED CRITERIA, SEE SECTION 33-10-50 OF THE SAN BRUNO TECHNICAL SPECIFICATIONS
7. TRENCHES WITHIN 3' OF CURB & GUTTER OR VERTICAL CURB REQUIRE FULL REMOVAL AND REPLACEMENT OF ASPHALT BETWEEN TRENCH AND LIP OF GUTTER OR VERTICAL CURB.
8. FOR TRENCHES IN NON-PAVED AREAS, CONTRACTOR SHALL MATCH EXISITNG LANDSCAPE (GRASS, TOP SOIL, FLOWER BEDS, SHRUBS, TREES, ETC.) TO THE SATISFACTION OF THE CITY REPRESENTATIVE

City of San Bruno *Standard Detail*	TRENCH CONSTRUCTION FOR WATER MAINS	DATE: AUG 2011 DRAWN BY: JMH
	CITY ENGINEER: APPROVED BY: WING WONG R.C.E. C35688	ST-06B DETAIL NO:



NOTES:

1. REFER TO CITY STANDARD SPECIFICATIONS SECTION 33 10 00 WATER UTILITIES FOR COMPLETE HYDRANT SPECIFICATIONS
2. ALL BOLTS SHALL BE 5/8" STAINLESS STEEL TYPE 304/316 COATED WITH ANTI–SEIZE COMPOUND UNLESS OTHERWISE SPECIFIED.
3. ALL FITTINGS AND JOINTS SHALL BE EPOXY COATED. PIPE TO BE ENCASED IN TUBULAR POLYWRAP PROTECTION (8 MM MIN.)
4. THRUST BLOCKS SHALL BE PLACED AGAINST UNDISTURBED NATIVE SOIL. ALL BOLTS AND JOINTS SHALL BE LEFT EXPOSED AND FREE FROM POURED CONCRETE (SEE STANDARD DETAIL NO. W–07)
5. TRACER WIRE SHALL EXTEND INTO VALVE BOX AND BE FASTENED SECURELY.
6. HORIZONTAL PIPE MATERIAL SHALL BE DUCTILE IRON ANSI/AWWA C150/A21.51 CLASS 54
7. ALL FITTINGS MUST MEET AWWA STANDARD C153/A21.5–88. ALL GASKETS MUST MEET AWWA STANDARD C111/A21.11–85 AND NSF REQUIRMENTS.
8. VEHICULAR PROTECTION MAY BE REQUIRED

City of San Bruno *Standard Detail*	FIRE HYDRANT	DATE: AUG 2011 DRAWN BY: JMH
	CITY ENGINEER: APPROVED BY: WING WONG R.C.E. C35688	W–08 DETAIL NO:

4.5.2. (continued)

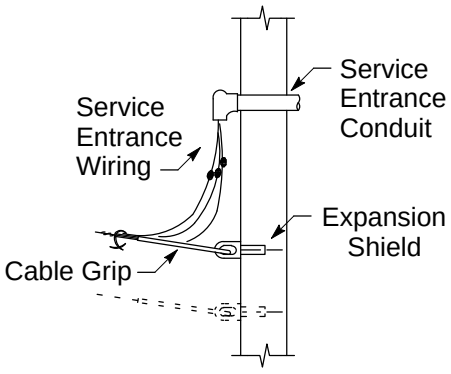


Figure 4-31
Service Drop Cable, 4/0 and Smaller, Triplex or Quadruplex

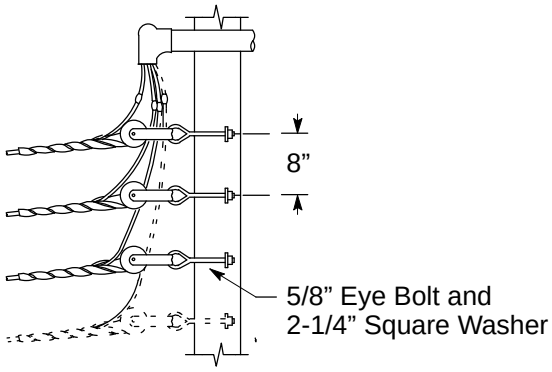


Figure 4-32
New Wall, 1/0 kcmil [1] to 397.5 kcmil Aluminum

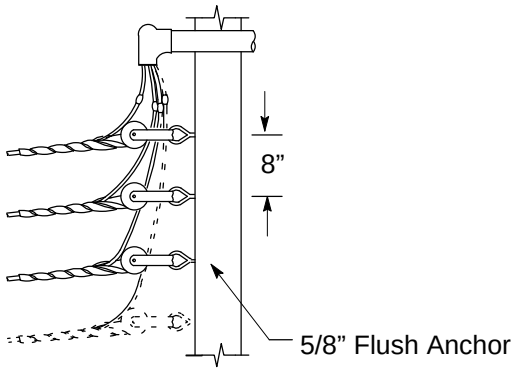


Figure 4-33
New or Existing Wall, 1/0 kcmil [1] to 397.5 kcmil Aluminum

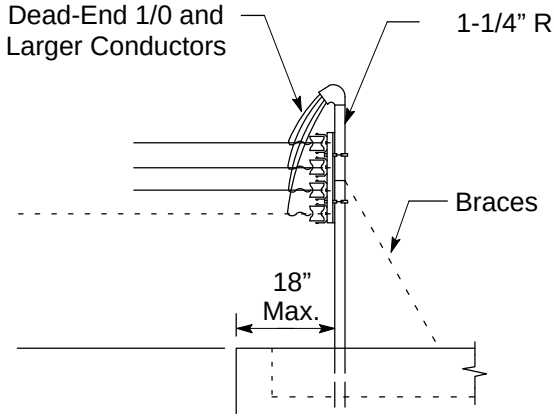


Figure 4-34
Open Wire Service, #4 to 397.5 kcmil [1] Aluminum

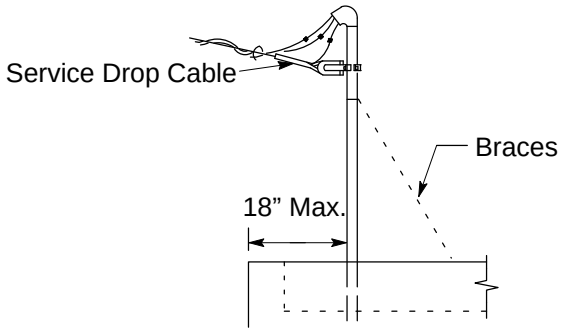


Figure 4-35
Service Drop Cable

Service to Nonresidential Premises

Note in reference to Figure 4-32, Figure 4-33, and Figure 4-34.

1. kcmil: a thousand circular mils