

PROJECT MANUAL INCLUDING SPECIFICATIONS FOR



HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT

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Volume 1 of 2

SAUSALITO-MARIN CITY SANITARY
DISTRICT

1 EAST ROAD, SAUSALITO, CA 94965

415-332-0244



TABLE OF CONTENTS

BIDDING REQUIREMENTS AND DOCUMENTS

NOTICE INVITING BIDS

INSTRUCTIONS TO BIDDERS

BIDDER'S CHECK LIST

BID LABEL

CERTIFICATION OF BIDDER'S EXPERIENCE AND
QUALIFICATIONS

BID

NON COLLUSION AFFIDAVIT

BID BOND

CONTRACTOR'S LICENSE INFORMATION

DESIGNATION OF SUBCONTRACTORS

WORKER'S COMPENSATION INSURANCE CERTIFICATION

DEBARMENT CERTIFICATION

BIDDER'S SIGNATURE PAGE

CONTRACT REQUIREMENTS AND DOCUMENTS

CONTRACT CHECK LIST

AGREEMENT

PERFORMANCE BOND

PAYMENT/LABOR AND MATERIALS BOND

MAINTENANCE BOND

ESCROW AGREEMENT FOR SECURITY DEPOSITS IN LIEU OF
RETENTION

GENERAL CONDITIONS

DIVISION 01 – GENERAL REQUIREMENTS

SECTION NO.	TITLE
01010	SUMMARY OF WORK
01014	PROTECTION OF THE ENVIRONMENT
01025	MEASUREMENT AND PAYMENT
01030	SPECIAL PROJECT CONSTRAINTS
01040	COORDINATION
01060	SAFETY AND REGULATORY REQUIREMENTS
01140	WORK RESTRICTIONS

01300	SUBMITTALS
01301	SCHEDULE OF VALUES
01310	PROGRESS SCHEDULES
01329	SAFETY PLAN
01354	HAZARDOUS MATERIAL PROCEDURES
01400	QUALITY CONTROL
01410	REGULATORY REQUIREMENTS
01455	SPECIAL TESTS AND INSPECTIONS
01500	CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS
01600	DELIVERY, STORAGE AND HANDLING
01605	PRODUCT REQUIREMENTS
01610	PROJECT DESIGN CRITERIA
01612	SEISMIC DESIGN CRITERIA
01650	FACILITY START UP
01700	CONTRACT CLOSE OUT
01720	RECORD DOCUMENTS
01730	OPERATING AND MAINTENANCE DATA
01740	WARRANTIES
01756	COMMISSIONING
01783	WARRANTIES AND BONDS

DIVISION 02 - SITE CONSTRUCTION

SECTION NO.	TITLE
02050	SOILS AND AGGREGATES FOR EARTHWORK
02084	PRECAST MANHOLES
02085	PRECAST CONCRETE VAULTS
02200	SITE CLEARING
02222	BUILDING DEMOLITION
02240	DEWATERING
02260	EXCAVATION SUPPORT AND PROTECTION
02312	CONTROLLED LOW STRENGTH MATERIAL (CLSM)
02314	LOW DENSITY CELLULAR CONCRETE FILL
02318	TRENCHING
02501	SEWER CLEANING AND CCTV INSPECTION
02552	TEMPORARY BYPASS PUMPING
02620	FILTER FABRIC
02820	FENCES AND GATES

DIVISION 03 - CONCRETE

SECTION NO.	TITLE
03055	ADHESIVE-BONDED REINFORCING BARS AND ALL THREAD RODS
03071	EPOXIES
03072	EPOXY RESIN/PORTLAND CEMENT BONDING AGENT
03102	CONCRETE FORMWORK
03154	HYDROPHILIC RUBBER WATERSTOP
03200	CONCRETE REINFORCING
03300	CAST-IN-PLACE CONCRETE
03366	TOOLED CONCRETE FINISHING
03600	GROUTING
03920	CONCRETE RESURFACING
03925	CONCRETE REPAIR AND COATING
03931	EPOXY INJECTION SYSTEM
03933	HYDROPHILIC FOAM POLYURETHANE RESIN INJECTION SYSTEM

DIVISION 05 - METALS

SECTION NO.	TITLE
05120	STRUCTURAL STEEL
05190	MECHANICAL ANCHORING AND FASTENING TO CONCRETE AND MASONRY
05500	METAL FABRICATIONS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION NO.	TITLE
7900	JOINT SEALANTS

DIVISION 08 - DOORS AND WINDOWS

SECTION NO.	TITLE
08110	HOLLOW METAL DOORS AND FRAMES
08320	FLOOR ACCESS DOORS
08710	DOOR HARDWARE

DIVISION 09 - FINISHES

SECTION NO.	TITLE
09910	PAINTING
09960	HIGH-PERFORMANCE COATINGS

DIVISION 11 - EQUIPMENT

SECTION NO.	TITLE
11290A	FLAP GATES
11312G	SUBMERSIBLE CENTRIFUGAL PUMPS

DIVISION 13 - INSTRUMENTATION AND CONTROLS

SECTION NO.	TITLE
13000	INSTRUMENT AND CONTROL SYSTEM
13470	PROGRAMMABLE LOGIC CONTROLLER SYSTEM
13475	CONTROL STRATEGIES

DIVISION 15 - MECHANICAL

SECTION NO.	TITLE
15050	COMMON WORK RESULTS FOR MECHANICAL EQUIPMENT
15052	COMMON WORK RESULTS FOR GENERAL PIPING
15061	PIPE SUPPORTS
15075	EQUIPMENT IDENTIFICATION
15076	PIPE IDENTIFICATION
15110	COMMON WORK RESULTS FOR VALVES
15114	CHECK VALVES
15115	GATE VALVES
15116	PLUG VALVES
15119	AIR AND VACUUM RELIEF VALVES
15120	PIPING SPECIALTIES
15121	PIPE COUPLINGS
15211	DUCTILE IRON PIPE: AWWA C151
15244	POLYVINYL CHLORIDE (PVC) PIPE: AWWA C900
15245	DRAIN, WASTE, AND VENT PIPING
15286	STAINLESS STEEL PIPE
15956	PIPING SYSTEMS TESTING
15958	MECHANICAL EQUIPMENT TESTING

DIVISION 16 - ELECTRICAL

SECTION NO.	TITLE
16000	REQUIREMENTS FOR ELECTRICAL WORK
16075	ELECTRICAL IDENTIFICATION
16080	PERMANENT DIESEL GENERATOR
16222	MOTORS
16422	MOTOR CONTROL
16920	600V MOTOR CONTROLLER
16938	POWER SYSTEM STUDY
16950	ELECTRICAL TESTING
16955	LOW VOLTAGE AUTOMATIC TRANSFER SWITCH

APPENDICES

APPENDIX A	GEOTECHNICAL INVESTIGATION REPORT
APPENDIX B	DISCHARGE LIMITS FOR NON-SANITARY WASTEWATER DISCHARGES INTO THE SMCSO
APPENDIX C	MARIN COUNTY AND CALTRANS ENCROACHMENT PERMITS
APPENDIX D	AGENCY STANDARD DETAILS

PROJECT PLANS

DWG NO.	TITLE
G01	COVER/VICINITY MAP/DRAWING INDEX
G02	NOTES AND ABBREVIATIONS
G03	LEGEND AND LINE WORK
G04	GENERAL SYMBOLS
G05	STRUCTURAL NOTES
TC01	TYPICAL DETAILS - CIVIL
TD01	TYPICAL DETAILS - CORROSION
TS01	TYPICAL DETAILS - STRUCTURAL
TS02	TYPICAL DETAILS - STRUCTURAL
TM01	TYPICAL DETAILS - MECHANICAL
TP01	TYPICAL DETAILS - PIPING
TP02	TYPICAL DETAILS - PIPING
D01	HIGHWAY BOOSTER PUMP STATION PLAN & SECTIONS DEMO
D02	HIGHWAY BOOSTER PUMP STATION DEMOLITION PHOTOS
C01	OVERALL SITE PLAN
C02	PAVING AND GRADING PLAN

C03	HIGHWAY BOOSTER PUMP STATION YARD PIPING
S01	STRUCTURAL PLAN AND DETAILS
S02	HIGHWAY BOOSTER PUMP STATION PLAN AND SECTIONS
M01	HIGHWAY BOOSTER PUMP STATION PLAN AND SECTIONS
E01	LEGEND AND NOTES
E02	SITE PLAN, MAIN POWER ONE-LINE DIAGRAM
E03	NEW RTU PANEL, SCADA WIRING DIAGRAMS
E04	PUMP STATION - POWER, LIGHTING AND SIGNAL PLANS
E05	SERVICE EQUIPMENT, STARTER ELEVATION, GROUNDING DETAIL
E06	CONTROL SCHEMATIC DIAGRAMS SHEET 1 OF 2
E07	CONTROL SCHEMATIC DIAGRAMS SHEET 2 OF 2
E08	CONSTRUCTION DETAILS
E09	DEMOLITION AND ELECTRICAL EQUIPMENT MODIFICATIONS
E10	TYPICAL DETAILS
I01	INSTRUMENTATION LEGEND AND NOTES
I02	HIGHWAY BOOSTER PUMP STATION
REF DWG 1	HIGHWAY BOOSTER STATION - PUMP PIT CONSTRUCTION DETAILS SITE PLAN, STRUCTURAL SECTIONS, PUMP OUTLINE
REF DWG 2	HIGHWAY BOOSTER STATION - PLASTIC FORCE MAIN INSERT
REF DWG 3	CONNECTION NORTH OF HELIPORT

Sausalito-Marín City Sanitary District

#1 East Rd
Sausalito, California 94965

HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT

NOTICE INVITING BIDS

1. The Sausalito-Marín City Sanitary District, California hereby invites bids for the project, in accordance with California Public Contract Code and other applicable law, and the following:
2. **All bids must be delivered to the Sausalito-Marín City Sanitary District, #1 East Road, Sausalito, California 94965 on or before 11:00 a.m., Pacific Standard Time, on Thursday, June 23, 2016. Bids will be opened and read publicly at that time. Bids must be made on the bid forms included in the bid package. Bids that are submitted late according to the official time kept by the District Clerk or a designee will be returned unopened. Bids submitted by facsimile or other electronic means will not be accepted. Bids that are incomplete or that otherwise do not conform to the requirements specified in the bid package may be deemed non-responsive.**
3. **Notice is hereby given of a pre-bid meeting at 9 a.m., Pacific Standard Time, on Wednesday, June 1, 2016. The pre-bid meeting will be held at 15 Shoreline Highway, Mill Valley, CA. Meet in the parking lot for the Buckeye Roadhouse restaurant. Attendance at a pre-bid meeting is MANDATORY to ensure all bidders are familiar with the project sites. Bidders shall complete the Bid Label as evidence that they visited the site.**
4. The project Contractor shall furnish all tools, equipment, apparatus, facilities, labor and material necessary to perform and complete in a good and workmanlike manner the construction of the **Highway Booster Pump Station Improvement Project** as shown in the project technical specifications and plans and in accordance with the contract documents. The work includes but is not limited to; 1) the conversion of the sewer pump station dry well into a pump station wet well, 2) installation of new piping and a manhole, 3) dewatering, cleaning and CCTV inspection of the station's force main, 4) installation of a permanent generator and pad, 5) installation of valving and a flow meter in underground vaults and additional work as needed to construct and inspect a complete and operational project as specified in these Contract Documents. All work shall be completed within **120 calendar days** of the project commencement date specified in the notice to proceed for the project. **Liquidated Damages apply for this project as defined in paragraph 4 of the Agreement.**
5. All of the project work is to be done in accordance with the bid packages on file in the District's office at Sausalito-Marín City Sanitary District, #1 East Rd, Sausalito, California 94965 and at the locations specified below. Requests for information on receiving bid packages should be directed to the Sausalito-Marín City Sanitary District, 415-332-0244. There will be a forty dollar (\$40) non-refundable charge for each bid package provided by

the District. Checks and money orders must be made payable to the Sausalito-Marín City Sanitary District. Cash will not be accepted. Bid packages will be mailed upon request and receipt of the non-refundable charge and the bidder's UPS or FedEx account number.

6. Complete bid packages are located at the following sites:

Bay Area Builders Exchange

<http://bayareabx.com/>

Phone 925-685-8630

aprilh@ccbx.com

iSqFt Plan Room

800-364-2059 ext. 8273

california@isqft.com

McGraw Hill Construction Dodge

Phone 626-932-6137

Fax 800-360-6397

catherine_cardona@mcgraw-hill.com

Napa Solano Builders Exchange

Phone 707-255-2515

Fax 707-255-2749

planroom@snbe.com

North Coast Builders Exchange

Phone 707-542-9502

Fax 707-542-2027

planroom@ncbeonline.com

Peninsula Builders Exchange

Phone 650-591-4486

Fax 650-591-8108

support@constructionplans.org

CMD

770-209-3396

Jeannie.kwan@cmdgroup.com

San Francisco Builders Exchange

Phone 415-282-8220

Fax 415-821-0363

djohnsonsf@sbcglobal.net

7. Questions concerning the project or the bid package must be submitted by facsimile (415-332-0453) or email (kevin@smcsd.net) to Kevin Rahman, Associate Engineer at least five (5) working days before the time specified for bid opening. Where appropriate, the District may respond to such questions by addenda transmitted to all bid package recipients.
8. In accordance with California Public Contract Code, all bids must be presented under sealed cover and include one of the following forms of bidder's security: cash, cashier's check made payable to the District, certified check made payable to the District, or a bidder's bond. The amount of bidder's security provided must equal at least ten (10) percent of the total of the bid price for the base bid and the additive or deductive items listed in this notice. The successful bidder must submit to the District complete, executed copies of all documents specified in the contract checklist included in the bid package within ten (10) working days of receiving written notice of award of the project. Bidder's security of any successful bidder that fails to do so will be forfeited to the District. The documents required pursuant to the contract checklist include, but are not limited to, a payment or labor and materials bond in an amount of at least 100 percent of the amount payable by the terms of the project contract and that satisfies the requirements of California Civil Code Section 3248, and a performance bond in an amount of at least 100 percent of the amount payable by the terms of the contract. All project bonds must be

executed by an admitted surety insurer in accordance with applicable law and acceptable to the District.

9. **Pursuant to California Public Contract Code Section 3300, a Class A California contractor's license is required to bid on the project.** In accordance with California Business and Professions Code Section 7028.15, all project work must be performed by properly licensed contractors and subcontractors with active licenses in good standing as of the date and time specified for bid opening. Bids that do not satisfy applicable licensing requirements will be considered non-responsive. Licenses must be issued by the Contractor's State License Board of California and must be maintained in good standing throughout the project term. In accordance with California Business and Professions Code Section 7030.5, bidders must verify their Contractor's License number and license expiration date on the bid forms under penalty of perjury. **In addition, all bidders must provide certification of bidder's experience and qualifications with their bids due to the location of work in the San Francisco Bay. (Forms are provided in the following pages.)**
10. In accordance with California Public Contract Code Section 6109, contractors and subcontractors who are ineligible to perform work on public works projects pursuant to California Labor Code Sections 1777.1 or 1777.7 may neither bid on, be awarded or perform work as a subcontractor on the project.
11. In accordance with California Labor Code Section 1771, not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the project is to be performed, and not less than the general prevailing rate of per diem wages for holiday and overtime work fixed as provided in the California Labor Code shall be paid to all workers engaged in performing the project. In accordance with California Labor Code Section 1770 and following, the Director of Industrial Relations has determined the general prevailing wage per diem rates for work in the locality in which the project is to be performed. In accordance with California Labor Code Section 1773, the District has obtained the general prevailing rate of per diem wages and the general rate for holiday and overtime work in the locality in which the project is to be performed for each craft, classification or type of worker needed to perform the project. In accordance with California Labor Code Section 1773.2, copies of the prevailing rate of per diem wages are on file at the District and will be made available on request. In accordance with California Labor Code Section 1777.1, contractors and subcontractors that are found guilty of willfully violating Chapter 1 of Part 7 of Division 2 of the Labor Code (except for Section 1777.5), or that are found guilty of such violations with intent to defraud, and entities in which such contractors or subcontractors have any interest, may be ineligible to bid on, be awarded, or perform project work as a subcontractor
12. In accordance with California Public Contract Code Section 3400, bidders may propose equals of products listed in the technical specifications or project plans by manufacturer name, brand or model number, unless the technical specifications or plans specify that the product is necessary to match others in use. Complete information for products proposed as equals must be submitted to the District's Office for review at least seven (7)

working days before the time specified for bid opening in accordance with the bidders instructions contained in the bid package.

13. In accordance with California Public Contract Code Section 22300, except where prohibited by federal regulations or policies, the successful bidder may, on request and at its expense, substitute securities in lieu of amounts withheld by the District from progress payments to ensure performance under the contract in accordance with the contract documents. Such securities will be subject to the terms of the escrow for security deposit agreement contained in the contract documents
14. The District reserves the right to reject any and all bids and/or to waive any bid irregularities to the extent permitted by law. If the District elects to award a contract for performance of the project, the contract will be awarded in accordance with California Public Contract Code Section 20162 and other applicable law to the responsible bidder submitting a responsive bid with the lowest total bid price for the base bid. All bids will remain valid for 90 days after the bid opening. Except as permitted by law and subject to all applicable remedies, including forfeiture of bidder's security, bidders may not withdraw their bid during the 90 day period after the bid opening.

Sausalito-Marín City Sanitary District
#1 East Rd
Sausalito, California 94965

INSTRUCTIONS TO BIDDERS

1. DEFINITIONS

- 1.1 Bid forms. The bid forms are the forms contained in Volume 1 of the bid package.
- 1.2 Bid package. A complete bid package consists of the following documents: Notice Inviting Bids, Certification of Bidder's Experience and Qualifications, Instructions to Bidders, Bidder's Check List, Bid Label, Bid, Non-collusion Affidavit, Bid Bond, Contractor License Information, Designation of Subcontractors, Workers Compensation Insurance Certification, Debarment Certification, Bidder's Signature Page, Contract Check List, Agreement, Performance Bond, Payment/Labor and Materials Bond, Maintenance Bond, Escrow for Security Deposit Agreement, General Conditions, General Requirements, and Project Plans and Technical Specifications.
- 1.3 Contract documents. The contract documents refer to all of the documents incorporated into the final Project contract as listed in the contract.
- 1.4 Project. The Project is the **HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT** as described in the Technical Specifications and Project Plans included in the project bid package.
- 1.5 Project Plans. The Project Plans are primarily graphic detailed requirements concerning the Project contained in the bid package.
- 1.6 Technical Specifications. The Technical Specifications provide detailed requirements concerning the Project and are contained within the Project Plans.
- 1.7 General Requirements. The General Requirements describe general procedures and constraints for completing the Project included in the bid package.

2. BIDDER'S REPRESENTATIONS

Each bidder by submitting a bid represents that:

- 2.1 The bidder has read and understands the bid package and the bid is in accordance with all of the requirements of the bid package and applicable law.
- 2.2 Neither the bidder nor any subcontractor included on the list of proposed subcontractors submitted with the bid are ineligible to perform work on public works projects pursuant to California Labor Code Sections 1777.1 or 1777.7.

- 2.3 The bidder understands that quantities of unit price items may vary from the estimates provided in the technical specifications.
 - 2.4 Representatives of the bidder have visited the Project site and have familiarized themselves with the conditions under which the Project work is to be performed so as to ensure that the Project work may be performed for the amount bid.
 - 2.5 The bidder has informed the District in writing no later than five (5) working days prior to the time specified for bid opening of any apparent conflicts, errors, or ambiguities contained in the bid package or between the contents of the bid package and the Project site.
3. PRE-BID COMMUNICATION AND INTERPRETATION OF THE BID PACKAGE
- 3.1 Any bidder that discovers any apparent conflicts, errors, or ambiguities contained in the bid package or between the contents of the bid package and the Project site, or that has questions or requires clarification concerning the bid package or its intent must inform the District in writing as soon as reasonably possible, but no later than five (5) working days before the date specified for bid opening. Such notice to the District must be sent to the address specified in the Notice Inviting Bids for questions concerning the bid package. Questions received less than five (5) working days before the time specified for opening bids may not be answered.
 - 3.2 Any interpretation, correction or change of the bid package prior to bid opening will be made by addendum signed by an authorized representative of the District and transmitted to all bid package recipients. No other interpretation or information concerning the bid package issued prior to the date specified for opening bids will be binding. All addenda signed by an authorized representative of the District and issued prior to the time and date specified for opening bids will form a part of the contract documents and must be acknowledged on the bid forms. Any changes, exceptions or conditions concerning the Project and/or the bid package submitted by any bidder as part of a bid may render that bid non-responsive.
 - 3.3 Questions concerning the project or the bid package shall be in writing, and may be submitted by facsimile or email to Kevin Rahman, Associate Engineer at least five (5) working days before the time specified for bid opening. The District's facsimile number is 415-332-0453. The email address is kevin@smcsd.net.
4. PRE-BID ACCESS TO THE PROJECT SITE
- 4.1 Prior to submitting a bid, it will be the sole responsibility of each bidder to conduct any additional examination, investigation, exploration, test, study or other inquiry and to obtain any additional information pertaining to the physical conditions (including surface, subsurface, and underground utilities) at or near the Project site that may affect the cost, progress, or

performance of the Project, and that the bidder deems are necessary to prepare its bid for performance of the Project in accordance with the bid package and contract documents. Bidders seeking any such additional examination or other inquiries or information concerning the Project will do so at the bidder's sole expense.

- 4.2 Bidders seeking to conduct any additional examination or other inquiry at the Project site must request site access from the District at least two (2) working days in advance. The location of any excavation, boring or other invasive testing will be subject to approval on behalf of the District and any other agencies with jurisdiction over such testing. Bidders may not conduct tests at the Project site prior to obtaining District approval. The District may require bidders to execute an access agreement prior to approving testing at the Project site. Once approved testing is complete, Bidders must fill all trenches or holes, restore all pavement to match existing structural section, and otherwise clean up and restore the test site to its pre-test condition.
- 4.3 Bidder's must visit the Project site prior to making a bid, and shall complete the Bid Label as evidence of this visit. Attendance at a pre-bid meeting is **MANDATORY** to ensure all bidders are familiar with the project site.

5. BIDDING PROCEDURE

- 5.1 Bids must be delivered to the Sausalito-Marin City Sanitary District, #1 East Rd, Sausalito, California 94965, no later than the time and date specified in the Notice Inviting Bids. Bids will be opened and read publicly at that time. Bids that are submitted late according to the official time kept by the District Clerk or a designee will be returned unopened. Telephones for use by bidders are not available at the District offices. Note that limited cell phone coverage may be experienced at the District's office.
- 5.2 In accordance with California Public Contract Code Section 20804.5, bids must be presented under sealed cover. A completed bid label form furnished with the bid forms must be affixed to and visible on the outside of the sealed bid cover at the time the bid is submitted. Bids must be submitted using the bid forms furnished with the bid package. Bids must include all documents listed in the Bidder's Checklist. Bids must bear the bidder's legal name and be signed by a representative authorized to bind the bidder. Bids must be typed or written in ink. Corrections may be made if initialed by the individual signing the bid. No oral or telegraphic modifications of bids, including facsimile modifications, will be considered. Bids that are incomplete or that are not presented on the bid forms furnished with the bid package may be deemed non-responsive.

- 5.3 Each bid must give the full business address of the bidder. Bids of partnerships must furnish the full name of all partners and must be signed in the partnership name by one of the members of the partnership, or by an authorized representative, followed by the printed name and title of the person signing. Bids of corporations must be signed with the legal name of the corporation, followed by the name of the state of incorporation and by the signature and designation of the president, secretary or other person authorized to bind the corporation. The name of each person signing shall also be typed or printed below the signature. Upon request of the District, bidders will furnish satisfactory evidence of the authority of the person signing the bid. Bids of joint ventures must include a certified copy of the legal agreement constituting the joint venture.
- 5.4 No person, firm, corporation, partnership or legal joint venture may submit more than one bid for the Project. However, a person, firm, corporation, partnership or legal joint venture that has submitted a subcontract proposal to a bidder, or that has quoted prices on materials to a bidder may submit a subcontract proposal, quote prices to other bidders and submit its own bid.
- 5.5 In accordance with California Public Contract Code Section 20170, all bids must include one of the forms of bidder's security specified in the Notice to Bidders in an amount of at least ten (10) per cent of the total of the bid prices for the base bid and those additive or deductive items specifically identified in the Notice to Bidders for the purpose of determining the lowest price bid. Bidders that elect to provide bidder's security in the form of a bid bond must execute a bid bond using the form provided in the bid forms. The bidder's security is tendered as a guarantee that the successful bidder, if awarded the Project contract, will execute and submit to the District all required bonds, certificates of insurance, completed contract forms and other documents listed in the Contract Check List and enter into a contract with the District within ten (10) working days of receipt of the Notice of Award. The bidder's security of any successful bidder that fails to do so will be forfeited to the District. All bidders' security not forfeited to the District will be returned once a successful bidder provides all required documents and enters a contract with the District in accordance with all applicable bid package requirements. Forfeiture of the bidder's security to the District will not waive or otherwise limit any other remedy available to the District under applicable law.
- 5.6 In accordance with California Business and Professions Code Section 7028.15, Public Contract Code Section 20103.5, and as specified in the Notice to Bidders, all Project work must be performed by properly licensed contractors and subcontractors with active licenses in good standing as of the date and time specified for bid opening, or, if the project involves federal funds, no later than the time the Project contract is awarded. Bidders must verify their Contractor's License number and license expiration date on the proposal cover page under penalty of perjury. Bids that do not satisfy

applicable licensing requirements will be considered non-responsive and rejected and may subject the bidder to criminal and/or civil penalties.

- 5.7 If the bid forms include a bidder's questionnaire, all bids must include a completed bidder's questionnaire on the forms provided. By submitting a bid, bidders authorize District representatives to verify any and all information provided on the bidder's questionnaire and agree to indemnify, defend and hold harmless the District and its officials, officers, employees, agents and volunteers to full the extent permitted by law from and against any claims, liability or causes of action, including, without limitation, legal fees and costs, arising out of verification of the information provided on the bidder's questionnaire, and/or arising out of use of information provided in the bidder's questionnaire to determine, in accordance with applicable law, the qualification of the bidder for performing the Project.
- 5.8 Bids may be withdrawn prior to the time set for bid opening by a written request signed by an authorized representative of the bidder filed with the District. The bid security submitted with bids so withdrawn will be returned to the bidder. Bidders that have withdrawn their bid in accordance with this provision may submit a new bid prior to the time set for bid opening in accordance with all applicable bid package requirements. Bids may not be withdrawn during the ninety day period after the time set for bid opening except as permitted by law pursuant to California Public Contract Code Section 5100 and following. Any other bid withdrawal will result in forfeiture of the bidder's bid security to the District.

6. BID PROTESTS

Any protest of the proposed award of Bid to the bidder deemed the lowest responsible bidder must be submitted in writing to the District, no later than 5:00 PM on the third (3rd) business day following the date of the Bid opening.

- 6.1 The initial protest must contain a complete statement of the basis for the protest.
- 6.2 The protest must state the facts and refer to the specific portion of the document or the specific statute that forms the basis for the protest. The protest must include the name, address, and telephone number of the person representing the protesting party.
- 6.3 The party filing the protest must concurrently transmit a copy of the initial protest to the bidder deemed the lowest responsible bidder.
- 6.4 The party filing the protest must have actually submitted a Bid on the Project. A subcontractor of a party filing a Bid on this Project may not submit a Bid Protest. A party may not rely on the Bid Protest submitted by another Bidder, but must timely pursue its own protest.

- 6.5 The procedure and time limits set forth in this Section are mandatory and are the Bidder's sole and exclusive remedy in the event of a Bid Protest. The Bidder's failure to fully comply with these procedures shall constitute a waiver of any right to further pursue the Bid Protest, including filing of a challenge of the award pursuant to the California Public Contracts Code, filing of a claim pursuant to the California Government Code, or filing of any other legal proceedings.
- 6.6 The District shall review all timely protests prior to formal award of the Bid. The District shall not be required to hold an administrative hearing to consider timely protest, but may do so at its option. At the time of the District Board's consideration of the award of the bid, the District Board shall also consider the merits of any timely protests. The District Board may either accept the protest and award the bid to the next lowest responsible bidder or reject the protest and award to the lowest responsible bidder. Nothing in this section shall be construed as a waiver of the District Board's right to reject all bids.
- 6.7 The District reserves the right to waive any bid irregularities not affecting the amount of the bid, except where such waiver would give the low bidder an advantage or benefit not allowed other bidders.

7. AWARD

- 7.1 In accordance with applicable law, the District reserves the right to reject any or all bids and to waive any informality in any bid. The District reserves the right to accept any portion of any bid, unless the bid package expressly provides that the award will be made as a whole. If the District elects to award a contract for performance of the Project, the contract will be awarded in accordance with California Public Contract Code and other applicable law to the responsible bidder submitting a responsive bid with the lowest total bid price for the base bid and the additive or deductive alternate items listed in the Notice Inviting Bids. In accordance with the contract documents and other applicable law, the District may add or deduct items of work from the Project after the lowest responsible bidder is determined.
- 7.2 The successful bidder must submit to the District complete, executed copies of all documents specified in the contract checklist included in the bid package within ten (10) working days of receiving written notice of award of the Project. Bidder's security of any successful bidder that fails to do so will be forfeited to the District.
- 7.3 The successful bidder and any subcontractors and others engaged in performance of the Project must have valid local business license(s), as applicable, before commencing work on the Project.
- 7.4 Upon verifying that the successful bidder has provided complete, executed copies of all documents specified in the contract checklist included in the bid package, an

authorized District representative will execute the Project contract, and the District will issue to the successful bidder a notice to proceed specifying the Project commencement date. The number of days within which the Project must be complete begins to run on the Project commencement date.

8. PRICING

- 8.1 If an inconsistency exists between the amount listed for a unit price in a bid and the total listed for that bid item (e.g., if the total listed for a bid item does not equal the unit price listed in the bid multiplied by the quantity listed), subject to applicable law, the unit price will be deemed to accurately reflect the bidder's intent concerning the bid item and the intended total for the bid item will be deemed to be the unit price as listed in the bid multiplied by the quantity listed.
- 8.2 If the Project bid price is a lump sum total made up of smaller individual bid item prices and an inconsistency exists between the lump sum total bid price and any individual bid item price, subject to applicable law, the individual bid item prices as listed in the bid will be deemed to accurately reflect the bidder's intended bid for the Project and the intended lump sum total bid for the Project will be deemed to be the sum of the individual bid item prices as listed in the bid, even if that sum is different from the amount actually listed as the lump sum total bid for the Project.
- 8.3 Any federal, state, or local tax payable on articles to be furnished for the Project shall be included in the lump sum total bid price and paid by the Contractor under the contract.

9. QUANTITIES

- 9.1 Quantities, including but not limited to, material or labor quantities, that are provided in the bid package concerning the Project are estimates only and are provided solely as a general indication of the Project scope. The District does not warrant that such quantity estimates provided in the bid package represent the actual quantities required to perform the Project in accordance with the contract documents. Such quantity estimates do not bind the District, and bidders should not rely on them in preparing their bids. Each bidder is solely responsible for determining the quantities on which to base their bids in light of information contained in the bid package, bidder investigation and analysis of the Project and the Project site, and any other analysis or expertise of the bidder concerning the Project.
- 9.2 The District may amend, decrease or increase the Project work in accordance with the bidding package and the contract documents. If the District amends, decreases or increases the Project work prior to award of the Project each bidder will be solely responsible for determining the revised quantities, if any, on which to base their bid in light of information contained in the bid package and any amendments or addenda to the bid package, bidder investigation and analysis of the Project as

amended, decreased or increased, the Project site, and any other analysis or expertise of the bidder concerning the Project.

10. SUBSTITUTION OF "OR EQUAL" ITEMS

- 10.1 In accordance with California Public Contract Code Section 3400, where the technical specifications or Project plans list products by manufacturer's name, brand or model number such information indicates the quality and utility of the items desired and does not restrict bidders to that manufacturer's name, brand or model number, unless the technical specifications or Project plans specify that the listed product is necessary to match others in use on a particular public improvement either completed or in the course of completion. Except where the Technical Specifications or Project plans indicate that a particular brand product is necessary to match others in use, when a manufacturer's name, brand or model number is listed, it shall be construed to be followed by the words "or equal" whether or not those words in fact follow the manufacturer's name, brand name or model number listed in the technical specifications or Project plans. Unless the technical specifications or Project plans indicate that a particular brand product is necessary to match others in use, bidders may propose equals of products listed by manufacturer name, brand name or model number.
- 10.2 Complete information for products proposed as equals must be submitted to the District for review at least ten (10) working days before the time specified for opening bids. To be considered, proposals concerning products proposed as equals must include sufficient information to permit the District to determine whether the products proposed as equals will satisfy the same performance requirements as products listed by manufacturer's name, brand or model number. Such performance requirements may include, but are not limited to, size, strength, function, appearance, ease of maintenance and repair, and useful life requirements. Proposals concerning products proposed as equals that are submitted less than ten (10) days before the time specified for opening bids will not be considered. Failure to bid products specified by manufacturer name, brand name or model number where the technical specifications or Project plans specify that a particular product is necessary to match others in use, or where no proposal concerning products proposed as equals has been submitted in accordance with this provision may render a bid non-responsive.

11. SUBCONTRACTING

- 11.1 Bids must be in accordance with the requirements of the Subletting and Subcontracting Fair Practices, Act, California Public Contract Code Section 4100 and following. Bids must include a completed list of proposed subcontractors on the form included in the bid package. In accordance with California Public Contract Code Section 4104, completed lists of proposed subcontractors must include the name, business location, the portion (type or trade), and dollar amount of the Project work to be subcontracted for each subcontractor that will perform a portion

of the Project work (including special fabrication and installation of a portion of the work) valued in excess of one half (½) of one (1) percent of the total Project bid price. If the Project work includes construction of streets or highways, the completed list of proposed subcontractors must include the subcontractor name, business location, type of work and dollar amount to be subcontracted for each subcontractor that will perform a portion of the Project work (including special fabrication and installation of a portion of the work) valued in excess of one half (½) of one (1) percent of the total Project bid price, or ten thousand dollars (\$10,000), whichever is greater. Bids that fail to include complete lists of proposed subcontractors in accordance with Public Contract Code Section 4100 and following and this provision may be deemed non-responsive.

- 11.2 In accordance with California Public Contract Code Section 4106, for any portion of the Project work with a value of more than one half (½) of one (1) percent of the total Project bid price for which no subcontractor is listed, or for which more than one subcontractor is listed, bidders certify by submitting their bids that they are qualified to perform that portion of the Project work and that they will perform that portion of the Project work with their own forces. Bidders may not substitute another subcontractor for a subcontractor listed in their bid except as permitted by the District in accordance with Section 4107 and following of the California Public Contract Code.

12. ASSIGNMENT

Bidders may not assign, sublet, sell, transfer, or otherwise dispose of their bid or any right, title or interest in their bid, or their obligations under their bid, without the written consent of an authorized representative of the District. Any purported assignment, subletting, sale, transfer or other disposition of a bid or any interest in a bid, or of any obligations under a bid without such written consent will be void and of no effect.

13. BONDS

The successful bidder must submit to the District a performance bond within ten (10) working days of receiving written notice of award. If the Project involves expenditures in excess of twenty five thousand dollars (\$25,000), the successful bidder must submit to the District a payment or labor and materials bond within ten (10) working days of receiving written notice of award. Prior to issuance of the final Project payment, the successful bidder must submit a warranty or maintenance bond. All bonds must be executed by corporate sureties who are admitted surety insurers in the State of California in accordance with applicable law and acceptable to the District. Individual sureties will not be accepted. All project bonds must be executed using the forms provided in the bid package.

- 13.1 In accordance with California Civil Code Section 3247, the payment or labor and materials bond must be in the amount of one hundred percent (100%) of the total amount payable by the terms of the Project contract and guarantee payment to persons listed in California Civil Code Section 3181

for work performed and for charges for materials, supplies, and equipment provided under the Project contract (including amounts due under or subject to the Unemployment Insurance Code) in accordance with the requirements of California Civil Code Section 3248.

- 13.2 The performance bond must be in the amount of one hundred (100) percent of the amount payable (total base bid) by the terms of the Project contract to guarantee the faithful performance of the Project work.
- 13.3 The warranty or maintenance bond must be in the amount of ten (10) percent of the final Project contract amount and guaranty the Project work against defects in materials, equipment, workmanship, or needed repair for one (1) year from the District's acceptance of the Project work.

14. LABOR LAWS

- 14.1 Bidders shall comply with applicable provisions of Chapter 1 of Part 7 of the California Labor Code, beginning with Section 1720.
- 14.2 In accordance with California Labor Code Section 1861, bids must include a workers compensation insurance certification on the form included in the bid package.
- 14.3 In accordance with California Labor Code Section 1771, not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the project is to be performed, and not less than the general prevailing rate of per diem wages for holiday and overtime work fixed as provided in the California Labor Code shall be paid to all workers engaged in performing the project.
- 14.4 In accordance with California Labor Code Section 1770 and following, the Director of Industrial Relations has determined the general prevailing wage per diem rates for work in the locality in which the project is to be performed. In accordance with California Labor Code Section 1773, the District has obtained the general prevailing rate of per diem wages and the general rate for holiday and overtime work in the locality in which the project is to be performed for each craft, classification or type of worker needed to perform the project. In accordance with California Labor Code Section 1773.2, copies of the prevailing rate of per diem wages are on file at the District and will be made available on request.
- 14.5 In accordance with California Labor Code Section 1777.1, contractors and subcontractors that are found guilty of willfully violating Chapter 1 of Part 7 of Division 2 of the Labor Code (except for Section 1777.5), or that are found guilty of such violations with intent to defraud, and entities in which such contractors or subcontractors have any interest, may be ineligible to bid on, be awarded, or perform project work as a subcontractor.

SAUSALITO-MARIN CITY SANITARY DISTRICT
#1 EAST ROAD
SAUSALITO, CALIFORNIA 94965
BIDDER'S CHECK LIST

All bidders must:

- _____ Attend the pre-bid conference on **Wednesday, June 1, 2016 at 9:00 a.m. at 15 Shoreline Highway, Mill Valley, CA (Buckeye Roadhouse Restaurant parking lot).**
- _____ Submit equal product proposals, if any, in accordance with the instructions to bidders included in the bid package at least 7 working days before the time specified for bid opening.
- _____ Include with your bid properly completed, accurate copies of the following documents in the following order using the forms included in the bid package:
 - _____ Bidder's check list
 - _____ Certification of Bidder's Experience and Qualifications
 - _____ Bid
 - _____ Initial quantities statement located below the Bid Tab
 - _____ Acknowledgement of each addendum issued by the District, if any, with complete, signed and dated copies of each addendum attached
 - _____ Executed bid bond
 - _____ Contractor licensing information
 - _____ Designation of subcontractors
 - _____ Workers compensation insurance certification
 - _____ Signed and notarized non-collusion affidavit
 - _____ Debarment certification
 - _____ Bidder's questionnaire, if any
 - _____ Executed bidder's signature page
- _____ Affix a property completed, signed and accurate bid label using the form included in the bid package to the sealed cover of your bid.
- _____ Arrange to have the sealed bid delivered to Kevin Rahman in the Sausalito Marin City Sanitary District offices at #1 East Road, Sausalito, California 94965 before 11:00 a.m., on Thursday, June 23, 2016.

Sausalito Marin City Sanitary District
Bidder's Check List

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SAUSALITO-MARIN CITY SANITARY DISTRICT
#1 EAST ROAD
SAUSALITO, CALIFORNIA 94965

BID LABEL

Sealed bid for the _____ Project.

Bidder: _____

By my signature below I certify under penalty of perjury under the laws of the State of California
that a representative of the above bidder visited the Project sites on

_____, _____, _____ at _____.

By: _____
(Official authorized to bind bidder)

Title: _____

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**CERTIFICATION OF BIDDER'S
EXPERIENCE AND QUALIFICATIONS**

(To Accompany Bid)

The undersigned Bidder certifies that it is, at the time of bidding, and shall be, throughout the period of the contract, licensed under the provisions of Chapter 9, Division 3, of the Business and Professions Code of the State of California, to do the type of work contemplated in the Contract Documents. Bidder further certifies that it is skilled and regularly engaged in the general class and type of work called for in the Contract Documents.

The Bidder represents that it is competent, knowledgeable, and has special skills concerning the nature, extent, and inherent conditions concerning the work to be performed. Bidder further acknowledges that there are certain inherent conditions existent in the construction of the particular facilities which may create, during the construction program, unsafe conditions hazardous to persons, property and the environment. Bidder expressly acknowledges that it is aware of such risks and that it has the skill and experience to foresee and to adopt protective measures to adequately and safely perform the construction work with respect to such hazards.

A. ESSENTIAL REQUIREMENTS FOR QUALIFICATION

If the answer to any of questions 1 through 4 is "no", or if the answer to any of questions 5 through 8 is "yes", the Bidder will be deemed ineligible or not responsible for purposes of the Contract.

1. Bidder possesses a valid and current California Contractor's license as required for the project for which it intends to submit a bid.
☐ Yes ☐ No
2. Bidder will comply with and provide all insurance as defined in paragraph 8.8 of the General Conditions.
☐ Yes ☐ No
3. Bidder has current Workers' Compensation insurance coverage as required by the Labor Code or is legally self-insured pursuant to Labor Code section 3700 et. seq.
☐ Yes ☐ No
4. Bidder has registered with the Department of Industrial Relations pursuant to Labor Code Section 1725.5.
☐ Yes ☐ No
5. Has your contractor's license been revoked at any time in the last five (5) years?
☐ Yes ☐ No
6. Has a surety firm completed a contract on your behalf, or paid for completion because your firm was default terminated by the project owner within the last five (5) years?

Sausalito-Marin City Sanitary District

CERTIFICATION OF BIDDER'S EXPERIENCE AND QUALIFICATIONS

- ☐ Yes ☐ No
7. At the time of submitting this qualification form, is your firm ineligible to bid on or be awarded a public works contract, or perform as a subcontractor on a public works contract, pursuant to either Labor Code section 1777.1 or Labor Code section 1777.7?
- ☐ Yes ☐ No
8. At any time during the last five (5) years, has your firm, or any of its owners or officers been convicted of a crime involving the awarding of a contract of a government construction project, or the bidding or performance of a government contract?
- ☐ Yes ☐ No

B. COMPANY EXPERIENCE

The Bidder has been engaged in the contracting business, under the present business name for _____ years and has experience in work of a nature similar to this project which extends over a period of _____ years (Bidder must show at least five (5) years of related experience).

The Bidder, as a Contractor, has never failed to satisfactorily complete a contract awarded to it, except as follows:

For the Owner to consider the Bidder properly experienced in work of similar nature to this project, the Bidder must list at least \$4 million in construction volume on no more than five (5) projects completed within the last five (5) years of the following types of projects:

1. Cleaning and CCTV inspection of sewers 6" or greater.
2. Sewer pump station or sewer treatment plant work.

The Bidder can include project(s) currently under construction, but only the total amount paid by the Owner(s) as of three (3) months prior to the bid date on uncompleted project(s) can be included in the construction volume for purposes of this certification. The Bidder is allowed to list up to a maximum of five (5) projects of the types listed above, that combined, will add up to at least the cost in completed volume of work listed above. Any projects listed below which are not as defined above will not be considered by the Owner in meeting this experience requirement.

Bidder also certifies that Bidder self-performed at least **forty percent (40%)** of the Work on each of the projects listed below. The Owner considers this level of past self-performance demonstrates a benefit to a Project in terms of better control of cost, schedule and safety.

If the Bidder is a Joint Venture of two or more companies, each participant in the Joint Venture shall meet this prior project experience requirement and provide project information for each Joint Venture participant in the format below.

1. **Project Name:** _____
Owner: _____
Construction Cost: \$ _____
Construction Time: _____ **Calendar Days**
Owner's Representative: _____
Owner's Telephone No.: _____
Date of Substantial Completion: _____

2. **Project Name:** _____
Owner: _____
Construction Cost: \$ _____
Construction Time: _____ **Calendar Days**
Owner's Representative: _____
Owner's Telephone No.: _____
Date of Substantial Completion: _____

3. **Project Name:** _____
Owner: _____
Construction Cost: \$ _____
Construction Time: _____ **Calendar Days**
Owner's Representative: _____
Owner's Telephone No.: _____
Date of Substantial Completion: _____

4. **Project Name:** _____
Owner: _____
Construction Cost: \$ _____
Construction Time: _____ **Calendar Days**
Owner's Representative: _____
Owner's Telephone No.: _____
Date of Substantial Completion: _____

5. **Project Name:** _____
Owner: _____
Construction Cost: \$ _____
Construction Time: _____ **Calendar Days**
Owner's Representative: _____
Owner's Telephone No.: _____
Date of Substantial Completion: _____

C. SUBCONTRACTOR EXPERIENCE

The Bidder's Subcontractor has been engaged in the contracting business, under the present business name for _____ years and has experience in work of a nature similar to this project which extends over a period of _____ years (Bidder's Subcontractor must show at least five (5) years of related experience).

The Bidder's Subcontractor has never failed to satisfactorily complete a project, except as follows:

For the Owner to consider the Bidder's Subcontractor properly experienced in work of similar nature to this project, the Bidder's Subcontractor must list at least \$2 million in construction volume on no more than five (5) projects completed within the last five (5) years for work directly associated with the work the Bidder has hired the subcontractor to perform on the Beach Force Main and Gravity Sewer Inspection Project.

If the subcontractor will be performing work on the force main, then they must demonstrate experience with the following:

1. Cleaning and CCTV inspection of sewers 6" or greater.
2. Sewer pump station or sewer treatment plant work.

The Bidder's Subcontractor can include project(s) currently under construction, but only the total amount paid by the Owner(s) as of three (3) months prior to the bid date on uncompleted project(s) can be included in the construction volume for purposes of this certification. The Bidder's Subcontractor is allowed to list up to a maximum of five (5) projects of the types listed above, that combined, will add up to at least the cost in completed volume of work listed above. Any projects listed below which are not as defined above will not be considered by the Owner in meeting this experience requirement.

Bidder also certifies that Bidder's Subcontractor self-performed at least **forty percent (40%)** of the Work on each of the projects listed below. The Owner considers this level of past self-performance demonstrates a benefit to a Project in terms of better control of cost, schedule and safety.

1. **Project Name:** _____
Owner: _____
Construction Cost: \$ _____
Construction Time: _____ **Calendar Days**
Owner's Representative: _____
Owner's Telephone No.: _____
Date of Substantial Completion: _____

2. **Project Name:** _____
 Owner: _____
 Construction Cost: \$ _____
 Construction Time: _____ **Calendar Days**
 Owner's Representative: _____
 Owner's Telephone No.: _____
 Date of Substantial Completion: _____

3. **Project Name:** _____
 Owner: _____
 Construction Cost: \$ _____
 Construction Time: _____ **Calendar Days**
 Owner's Representative: _____
 Owner's Telephone No.: _____
 Date of Substantial Completion: _____

4. **Project Name:** _____
- Owner:** _____
- Construction Cost: \$** _____
- Construction Time:** _____ **Calendar Days**
- Owner's Representative:** _____
- Owner's Telephone No.:** _____
- Date of Substantial Completion:** _____
5. **Project Name:** _____
- Owner:** _____
- Construction Cost: \$** _____
- Construction Time:** _____ **Calendar Days**
- Owner's Representative:** _____
- Owner's Telephone No.:** _____
- Date of Substantial Completion:** _____

D. SAFETY QUALIFICATION CRITERIA

The following information will be used to determine if you meet the minimum safety requirements for this project. To qualify to bid and be awarded the project, the contractor shall have a safety record that meets or exceeds one of the three following safety criteria:

1. If the Contractor's three-year average Workers' Compensation Experience Modification (EMR) is equal to or less than 100%, the contractor meets the minimum safety requirements for this project;
2. If the Contractor's three-year average EMR is greater than 100%, the Contractor's three-year average Recordable Incident Rate (RIR) must not be greater than 3.8 and three-year average Lost Time Incident Rate (LTIR) must not be greater than 1.7 to meet the minimum safety requirements for this project;
3. If the Contractor only meets either the three-year average RIR or LTIR value, the Contractor shall be required to hire at no additional cost to the District a mutually acceptable safety consultant who will prepare a project specific safety plan, conduct random weekly inspections of the Contractor's activities to ensure conformance with the safety plan and prepare and submit a weekly report to the District summarizing the results

of each inspection. The contractor shall adhere to the safety plan for the duration of the project. The contractor's activities shall be adjusted immediately to address any issues resulting from the weekly safety inspection.

Contractors that cannot meet any of the three safety criteria above are not eligible to work for the District.

The Bidder shall list its Experience Modification Rate, Lost time Incident Rate, and Recordable Incident Rate for the last three complete years (available from your insurance carrier).

<u>Year</u>	<u>EMR</u>	<u>RIR</u>	<u>LTIR</u>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
	_____AVG	_____AVG	_____AVG

To verify the above information, the Owner will contact the Bidder's Workers' Compensation Insurance carrier. The Bidder shall authorize its carrier to release this information. Failure to release this information will result in the bid being non-responsive and result in automatic disqualification of the bid.

Workers' Compensation Insurance Company: _____
Contact Person for Insurance Company: _____
Telephone Number: _____

Signed this _____ day of _____, 20 ____.

Name of Bidder

Contractor's License No.

Expiration Date

Signature of Bidder

Title of Signatory

Sausalito-Marín City Sanitary District
CERTIFICATION OF BIDDER'S EXPERIENCE AND QUALIFICATIONS

E. FINANCIAL QUALIFICATIONS

To be submitted within **five (5)** days following the bid opening date.

Provide evidence that the Bidder has sufficient financial resources to provide all work necessary to complete the project including construction, start-up, and warranty services.

A. Bidder must provide one or more of the following to assist the Owner in determining the Bidder's financial condition:

1. Copy of a reviewed or audited financial statement with accompanying notes and supplemental information. A financial statement that is not either reviewed or audited is not acceptable.
2. A certified Credit Report, current within 30 days of the date proposals are due. This credit report shall show a Dun & Bradstreet, or equal, credit risk category rating.
3. A letter from the Bidder's bank certifying their opinion of the Bidder's credit risk category rating and Bidder's current available line of credit.

B. Bidder must provide a letter from its Surety or Surety Broker which certifies that Bidder's current bonding capacity is sufficient for the bonding requirements for this Project.

C. Bidder shall identify any claims filed in court or arbitration against Bidder in the past five years which concerned Bidder's work on a construction project. For each claim, if any, the Bidder shall provide the project name, date of the claim, name of the claimant, a brief description of the nature of the claim, the court in which the case was filed and a brief description of the status of the claim (pending or, if resolved, a brief description of the resolution). Are there any pending claims against your company that should you lose the claim(s), would adversely affect your financial position or your ability to meet your obligations if awarded the contract for this project? If so, please explain.

Claims Filed Against Bidder

Project Name: _____

Date of Claim: _____

Claimant Name: _____

Court: _____

Status of Claim: _____

Explanation: _____

Bidder shall also identify any claims filed in court or arbitration by Bidder against a project owner in the past five years concerning work on a project or payment for a contract. For each claim, if any, the Bidder shall provide the project name, date of the claim, a brief description of the nature

of the claim, the court in which the case was filed and a brief description of the status of the claim (pending or, if resolved, a brief description of the resolution). Are there any pending claims filed by your company against a project owner that should you lose the claim(s), would adversely affect your financial position or your ability to meet your obligations if awarded the contract for this project? If so, please explain.

Claims Filed By Bidder

Project Name: _____

Date of Claim: _____

Claimant Name: _____

Court: _____

Status of Claim: _____

Explanation: _____

All financial information provided by Bidder that is marked "Confidential" or "Proprietary" shall be handled by the Owner in accordance with Section 00700- 4.5.10, Public Records Act.

The undersigned hereby states that all representations regarding the Bidder's Company Experience, and Safety Qualification Information are correct and true.

Signed this _____ day of _____, 20____

Bidder's Name

Authorized Signature

Date

Title of Signatory

*****END OF SECTION*****

Sausalito-Marín City Sanitary District
Marin County, California

BID

For the Construction of the

HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT

To the Honorable Board of Directors
Sausalito-Marín City Sanitary District
#1 East Road
Sausalito, CA 94965

Directors:

The undersigned, as bidder, declares that he/she has carefully examined the Notice Inviting Sealed Bids, Instructions to Bidders, Specifications and Plans, as well as the site and conditions affecting the work, and the bidder proposes and agrees that if this bid is accepted, he/she will contract with the Sausalito-Marín City Sanitary District to provide all necessary machinery, tools, labor and apparatus for construction and do all the work and furnish all the materials called for by the Contract Documents in the manner and time therein set forth required for the construction of the District project, complete and in operating condition.

Construction shall be in strict accordance with the Contract Documents, prepared therefore and adopted by the District Board, which Contract Documents are hereby made a part hereof.

The bidder proposes and agrees to contract with said District to furnish and perform all of the described work, including subsidiary obligations as defined in said Contract Documents, for the following prices, which include all applicable sales taxes, to-wit:

Item Number	Quantity	Unit	Description	Bid
1.	1	Lump Sum	Mobilization and Demobilization	
2.	1	Lump Sum	Sheeting, shoring, and bracing, or equivalent method for the protection of life and limb in trenches and open excavation, pursuant to California Labor Code §6707	
3.	1	Lump Sum	Installation of permanent generator and pad	
4.	1	Lump Sum	Force main cleaning and CCTV inspection for 400 LF of force main to tee near isolation valve (assume isolation valve seals to allow work)	

Sausalito-Marín City Sanitary District
BID

Item Number	Quantity	Unit	Description	Bid
5.	1	Lump Sum	Force main line stop, isolation valve installation and inspection of 20' of force main	
6.	1	Lump Sum	Grading and installation of base rock along access road and station facilities	
7.	1	Lump Sum	All other work specified in contract documents to complete the Highway Booster Pump Station Improvement Project	
TOTAL All work incidental thereto and connected				
BASE BID therewith for Bid Items 1 through 7: \$_____				

In submitting this bid, it is understood by the bidder that the right is reserved by the District to reject any and all bids and to waive any irregularities or informalities in any bid or in the bidding.

The undersigned acknowledges that bidder is skilled and experienced in the use and interpretation of plans and specifications and has carefully reviewed the plans and specifications for this project and has found them free of ambiguities and sufficient for bid purposes. Further, bidder has carefully examined the site of the work and, from his/her own observations, is satisfied as to the nature and location of the work, the character, quality and quantity of materials, and the difficulties likely to be encountered, and other items which may affect the performance of the work. The bid is based solely on these documents and observations and has not relied in any way on any explanation or interpretation, oral or written, from any other source.

The undersigned has checked carefully all the above figures and understands that the District will not be responsible for any errors or omissions on the part of the undersigned in making up this bid.

It is understood and agreed that the undersigned will complete the work of the contract within the time provided for in the Contract Documents and Specifications governing said work, and that liquidated damages shall apply as specified.

The undersigned bidder agrees that if notified of the acceptance of this bid within ninety (90) days of the time set for opening of bids, bidder will execute the contract for the above work and for the above-stated compensation, will furnish satisfactory bonds in the sum specified guaranteeing faithful performance and payment of bills, and will complete the work within the time provided for in the Contract Documents and Specifications covering the work.

The undersigned hereby certifies that this bid is genuine and not sham or collusive or made in the interest or in behalf of any persons not herein named and that the undersigned has not directly or indirectly induced or solicited any other bidder to put in a sham bid or any other person, firm, or corporation to refrain from bidding and that the undersigned has not in any manner sought by collusion to secure for himself/herself an advantage over any other bidder.

Sausalito-Marin City Sanitary District
 BID

Accompanying this bid is cash, a bid bond, certified check or cashier's check, payable to or in favor of the Sausalito-Marin City Sanitary District, which it is agreed (pursuant to the Instructions to Bidders) shall be forfeited to the District if the undersigned fails to execute a contract for the performance of this work embraced by this bid and to furnish the necessary bonds specified within ten (10) days after notification of the award to the undersigned.

In accordance with Section 7028.15 of the Business and Professions Code, it is a misdemeanor for any person to submit a bid to a public agency without having a Contractor's License. The Sausalito-Marin City Sanitary District will verify that the Contractor is properly licensed before awarding the contract.

The undersigned Contractor is 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 will comply with such provisions before commencing performance of the work of this contract.

Addenda Acknowledged

I hereby acknowledge receipt of the following addenda:

Addendum No. 1 _____ Addendum No. 2 _____ Addendum No. 3 _____

SIGNATURES

PRIME CONTRACTING FIRM ORGANIZATION

Type of Organization:

Corporation

Partnership

Individual

Names of individual members of the firm:

Name of Corporation President:

Name of Corporation Secretary:

Corporation is organized under the laws of the State of

FIRM:

BY:

Signature

()

Corporate

(Seal)

()

ADDRESS:

CITY:

TELEPHONE:

FAX:

CONTRACTOR'S LICENSE NO:

EXPIRATION DATE:

Note: If Bidder is a corporation, the legal name of the corporation shall be set forth above together with the signature of the officer or officers authorized to sign contracts on behalf of the corporation. If bidder is a co-partnership, the true name of the firm shall be set forth above together with the signature of the partner or partners authorized to sign contracts on behalf of the co-partnership; and if Bidder is an individual, his/her signature shall be placed above. If signature is an agent, other than an officer of a corporation or a member of a partnership, a Power of Attorney must be on file with the District prior to opening of Bids or submitted with the Bid; otherwise, the Bid will be disregarded as irregular and unauthorized.

Sausalito-Marín City Sanitary District
BID

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NON-COLLUSION AFFIDAVIT

The following Non-Collusion Affidavit is submitted by the Bidder in accordance with Section 7106 of the Public Contract Code of the State of California.

State of California)
) ss.
County of)

_____, being first duly sworn, deposes and says that he or she

is _____ of _____,

the party 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 the bidder has not directly or indirectly induced or solicited any other bidder to put in a 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; 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 the bid or any other bid, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bid, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, 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.

Subscribed and sworn to before me this

day of _____, 20____

Notary Public in and for the State of California

Sausalito-Marín City Sanitary District
Non Collusion Affidavit

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BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, _____ as Principal,
and _____ as Surety, are hereby held
and firmly bound unto the Sausalito-Marín City Sanitary District as OWNER in the penal sum
of _____ for the payment of which, well and truly to be
made, we hereby jointly and severally bind ourselves, successors and assigns.

Signed, this day of , 20____.

The Condition of the above obligation is such that, where the Principal has submitted to the Sausalito-Marín City Sanitary District a certain BID, attached hereto and hereby made a part hereof, to enter into a contract in writing for the construction of the HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT

NOW, THEREFORE;

- (a) If said BID shall be rejected, or
- (b) If said BID shall be accepted and the Principal shall execute and deliver a contract in the CONTRACT attachment hereto (properly completed in accordance with said BID) and shall furnish BONDS for faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said BID, then this obligation shall be void; otherwise the same shall remain in force and effect, it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its BOND shall be in no way impaired or affected by any extension of the time which the OWNER may accept such BID; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

Principal

Sausalito-Marín City Sanitary District
Bid Bond

By:

Surety

Business Address of Surety

Telephone Number of Surety

By:

Attorney-in-Fact

Note: Signature of person executing for Surety must be notarized and evidence of corporate authority attached.

The Contractor shall use this form of Bid Bond.

SAUSALITO-MARIN CITY SANITARY DISTRICT
#1 EAST ROAD
SAUSALITO, CALIFORNIA 94965

CONTRACTOR LICENSE INFORMATION

The bidder acknowledges that the license required for performance of the HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT is an A license.

The bidder holds the following California Contractors License(s):

1. License No. _____, Class _____, Expiration Date _____
2. License No. _____, Class _____, Expiration Date _____
3. License No. _____, Class _____, Expiration Date _____
4. License No. _____, Class _____, Expiration Date _____
5. License No. _____, Class _____, Expiration Date _____
6. License No. _____, Class _____, Expiration Date _____
7. License No. _____, Class _____, Expiration Date _____
8. License No. _____, Class _____, Expiration Date _____
9. License No. _____, Class _____, Expiration Date _____
10. License No. _____, Class _____, Expiration Date _____

Bidder's Taxpayer Identification No. _____

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DESIGNATION OF SUBCONTRACTORS

In compliance with the provisions of Sections 4100-4113 of the Public Contract Code of the State of California, and any amendments thereof, each Bidder shall set forth below: (1) the name and the location of the place of business of each subcontractor who will perform work or labor or render service to the Contractor in or about the construction of the work in an amount in excess of one-half of one percent ($\frac{1}{2}\%$) of the Contractor's total bid or \$10,000, whichever is greater, and (2) the portion of the work which will be done by each Subcontractor.

If the Contractor fails to specify a Subcontractor for any portion of the work to be performed under the contract, the Contractor shall be deemed to have agreed to perform such portion himself/herself, and he/she shall not be permitted to subcontract that portion of the work except under the conditions hereinafter set forth.

Subletting or subcontracting of any portion of the work as to which no Subcontractor was designated in the original bid shall be permitted in cases of public emergency or necessity, and then only after a finding reduced to writing as a public record of the Board of Directors of the District.

List below the name, location of the place of business and contractor's license number of each subcontractor and the portion of the work to be done by each subcontractor.

1.		
	Name of Subcontractor	Contractor's License No.
	Location of Business	Portion of Work
2.		
	Name of Subcontractor	Contractor's License No.
	Location of Business	Portion of Work
3.		
	Name of Subcontractor	Contractor's License No.
	Location of Business	Portion of Work
4.		
	Name of Subcontractor	Contractor's License No.
	Location of Business	Portion of Work
5.		
	Name of Subcontractor	Contractor's License No.

Sausalito Marin City Sanitary District
Designation of Subcontractors

	_____ Location of Business	_____ Portion of Work
6.	_____ Name of Subcontractor	_____ Contractor's License No.
	_____ Location of Business	_____ Portion of Work
7.	_____ Name of Subcontractor	_____ Contractor's License No.
	_____ Location of Business	_____ Portion of Work
8.	_____ Name of Subcontractor	_____ Contractor's License No.
	_____ Location of Business	_____ Portion of Work

SAUSALITO-MARIN CITY SANITARY DISTRICT
#1 EAST ROAD
SAUSALITO, CALIFORNIA 94965

WORKERS COMPENSATION INSURANCE CERTIFICATION

By submitting its bid the bidder certifies as follows:

I am aware of the provisions of California Labor Code Section 3700 which require every employer to be insured against liability for workmen's compensation or to undertake self-insurance in accordance with the provisions of the Labor Code, and I will comply with such provisions before commencing performance of the work of this Contract.

By: _____
(Official authorized to bind bidder)

Title: _____

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SAUSALITO-MARIN CITY SANITARY DISTRICT
#1 EAST ROAD
SAUSALITO, CALIFORNIA 94965

DEBARMENT CERTIFICATION

By submitting its bid the bidder certifies in accordance with California Public Contract Code Section 6109 that neither the bidder nor any subcontractor included on the list of proposed subcontractors submitted with the bid is ineligible to perform work on public works projects pursuant to California Labor Code Sections 1777.1 or 1777.7. In accordance with California Public Contract Code Section 6109, contractors and subcontractors who are ineligible to perform work on public works projects pursuant to California Labor Code Sections 1777.1 or 1777.7 may neither bid on, be awarded or perform as a subcontractor on public works projects.

By: _____
(Official authorized to bind bidder)

Title: _____

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SAUSALITO-MARIN CITY SANITARY DISTRICT
#1 EAST ROAD
SAUSALITO, CALIFORNIA 94965

BIDDER'S SIGNATURE PAGE

By my signature on this proposal I certify, under penalty of perjury under the laws of the State of California, that the information submitted with this proposal for the HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT which information includes, but is not limited to, the bidder's check list, bid label, proposal cover page and bid schedule, bid bond, contractor license information, list of proposed subcontractors, workers compensation insurance certification, non-collusion affidavit, and debarment certification are accurate, true and correct, and are submitted in accordance with the requirements of the bid package issued by the Sausalito-Marin City Sanitary District concerning the HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT and applicable law. By my signature on this proposal I further certify that I am legally authorized to bind the bidder in accordance with the requirements of the bid package.

Date: _____

(Typed or printed name)

(Signature)

(Bidder)

Bidder business address (street, city, state and zip code)

Bidder Business phone: () _____

Bidder Business fax: () _____

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Sausalito-Marín City Sanitary District
#1 East Road
Sausalito, California 94965

CONTRACT CHECK LIST

Complete, accurate, executed copies of the following documents must be submitted to the Sausalito-Marín City Sanitary District in accordance with the bid package issued by the District for the HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT within ten (10) working days of receiving written notice of award of the project. The bidder's security of any successful bidder that fails to do so will be forfeited to the District.

_____ Contract Check List

_____ Agreement

_____ General Conditions

_____ Performance Bond

_____ Payment Bond

_____ Certificates of Insurance and Endorsements

_____ Escrow for Deposit Agreement, if applicable

_____ Contractor Safety Manual Acknowledgement Form

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Sausalito-Marín City Sanitary District
#1 East Road
Sausalito, California 94965

AGREEMENT

The Sausalito-Marín City Sanitary District, ("District") enters into this agreement, dated for reference purposes only, with _____ ("Contractor").

A. RECITALS

- A. NOTICE INVITING BIDS. The District gave notice inviting bids to be submitted by _____, 20____, for the HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT by published notice and/or posting in accordance with California Public Contract Code Section 20804 and other applicable law.
- B. BID OPENING. On _____, 20____, District representatives opened the bids for the HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT and read the bids aloud.
- C. PROJECT AWARD. On _____, 20____, the District Board awarded the HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT to the Contractor and directed District staff to send the Contractor written notice of award of the project. The District Board conditioned award of the project on the Contractor's providing executed copies of all documents specified in the contract check list included in the bid package within ten (10) working days of receiving written notice of award of the project.
- D. REQUIRED DOCUMENTS. The Contractor has provided the District executed copies of all documents specified in the contract checklist included in the bid package within ten (10) working days of receiving written notice of award.

AGREEMENT TERMS

The District and the Contractor agree as follows:

1. THE WORK. The Contractor shall furnish all equipment, tools, apparatus, facilities, material labor, and skill necessary to perform and complete in a good and workmanlike manner the HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT, ("Work") as shown in the Technical Specifications and Project Plans in accordance with the Contract Documents and applicable law.

Sausalito-Marín City Sanitary District
Agreement

2. LOCATION OF WORK. The Work will be performed at the locations shown on project drawing G-1 in Sausalito and Fort Baker National Park.
3. TIME FOR COMPLETION. The Contractor must complete the Work in accordance with the Contract Documents. All work shall be completed within **100 calendar days** of the project commencement date specified in the notice to proceed for the project.
4. REMEDIES FOR TIMELY COMPLETION THE WORK.
 - 4.1 **LIQUIDATED DAMAGES:** If the Contractor fails to fully perform the Work in accordance with the Contract Documents by the Time for Completion, as such time may be amended by change order or other modification to this agreement in accordance with its terms, and/or if the Contractor fails, by the Time for Completion, to fully perform all of the Contractor's obligations under this agreement that have accrued by the Time for Completion, the Contractor will become liable to the District for all resulting loss and damage in accordance with the Contract Documents and applicable law. The District's remedies for the Contractor's failure to perform include, but are not limited to, assessment of liquidated damages of **Five Hundred Dollars (\$500) per calendar day** in accordance with California Government Code Section 53069.85 and the Contract Documents, and/or obtaining or providing for substitute performance in accordance with the Contract Documents.
5. CONTRACT PRICE AND PAYMENT. As full compensation in consideration of completion of the Work in accordance with the Contract Documents and in consideration of the fulfillment of all of the Contractor's obligations under the Contract Documents, the District will pay the Contractor in lawful money of the United States the total price of \$_____ (the "Contract Price") as specified in the Contractor's completed Bid Schedule dated _____, _____, and attached to and incorporated in this agreement. Payment to the Contractor under this agreement will be for Work actually performed in accordance with the Contract Documents and will be made in accordance with the requirements of the Contract Documents and applicable law. The District will have no obligation to pay the Contractor any amount in excess of the Contract Price unless this agreement is first modified in accordance with its terms. The District's obligation to pay the Contractor under this agreement is subject to and may be offset by charges that may apply to the Contractor under this agreement. Such charges include but are not limited to, charges for liquidated damages and/or substitute performance in accordance with the Contract Documents.
6. PREVAILING WAGES. In accordance with California Labor Code Section 1771, 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 to be performed, and not less than the general prevailing rate of per diem wages for holiday and overtime work fixed as provided in the California Labor Code must be paid to all workers engaged in performing the Work. In accordance with California Labor Code Section 1770 and following, the Director of Industrial Relations has

Sausalito-Marín City Sanitary District
Agreement

determined the general prevailing wage per diem rates for the locality in which the Work is to be performed. In accordance with California Labor Code Section 1773, the District has obtained the general prevailing rate of per diem wages and the general rate for holiday and overtime work in the locality in which the Work is to be performed for each craft, classification or type of worker needed to perform the project. In accordance with California Labor Code Section 1773.2, copies of the prevailing rate of per diem wages are on file at the District Public Works Department and will be made available on request. Throughout the performance of the Work the Contractor must comply with all provisions of the Contract Documents and all applicable laws and regulations that apply to wages earned in performance of the Work.

7. THE CONTRACT DOCUMENTS. This agreement consists of the following documents ("Contract Documents"), all of which are incorporated into and made a part of this agreement as if set forth in full. In the event of a conflict between or among the Contract Documents, precedence will be in the following order:
 - 7.1 This agreement and change orders and other amendments to this agreement signed by authorized representatives of the District and the Contractor.
 - 7.2 The General Conditions and change orders and other amendments to the General Conditions signed by authorized representatives of the District and the Contractor.
 - 7.3 The General Requirements, addenda to the General Requirements signed by authorized representatives of the District and issued prior to bid opening, Equal Product Proposals accepted by the District and signed by authorized District representatives prior to bid opening, and change orders and other amendments to the General Requirements signed by authorized representatives of the District and the Contractor.
 - 7.4 The Project Plans and Technical Specifications, addenda to the Project Plans and Technical Specifications signed by authorized representatives of the District and issued prior to bid opening, Equal Product Proposals accepted by the District and signed by authorized District representatives prior to bid opening, and change orders and other amendments to the Project Plans and Technical Specifications signed by authorized representatives of the District and the Contractor.
 - 7.5 Notice Inviting Bids.
 - 7.6 Certification of Bidder's Experience and Qualifications.
 - 7.7 Instructions to Bidders.
 - 7.8 The successful bidder's completed Bid.
 - 7.9 The successful bidder's completed Contractor License Information.

Sausalito-Marín City Sanitary District
Agreement

- 7.10 The successful bidder's completed List of Proposed Subcontractors.
 - 7.11 The successful bidder's Workers Compensation Insurance Certification.
 - 7.12 The successful bidder's completed Non-collusion Affidavit.
 - 7.13 The successful bidder's Debarment Certification.
 - 7.14 The successful bidder's completed Certificates of Insurance and Endorsements.
 - 7.15 The successful bidder's executed Performance Bond.
 - 7.16 The successful bidder's executed Payment Bond.
 - 7.17 The Maintenance Bond form included in the bid package that the Contractor must execute prior to release of final payment under the Contract.
 - 7.18 The successful bidder's Qualification Statement, if any.
 - 7.19 The successful bidder's signed Signature Form.
8. INTERPRETATION OF CONTRACT DOCUMENTS. Any question concerning the intent or meaning of any provision of the Contract Documents, including, but not limited to, the Project Plans and Technical Specifications, must be submitted to the District, or his/her designee, for issuance of an interpretation and/or decision by the District in accordance with the requirements of the Contract Documents. Interpretations or decisions by any other person concerning the Contract Documents will not be binding on the District. The decision of the District, or his/her designee, shall be final.
9. ASSIGNMENT PROHIBITED. The Contractor may not assign part or all of this agreement, or any moneys due or to become under this agreement, or any other right or interest of the Contractor under this agreement, or delegate any obligation or duty of the Contractor under this agreement without the prior written approval of an official authorized to bind the District and an authorized representative of Contractor's surety or sureties. Any such purported assignment or delegation without such written approval on behalf of the District and the Contractor's sureties will be void and a material breach of this agreement subject to all available remedies under this agreement and at law and equity.
10. CERTIFICATION RE CONTRACTOR'S LICENSE. By signing this Agreement the Contractor certifies that the Contractor holds a valid Class A license issued by the California State Contractors Licensing Board, and that the Contractor understands that failure to maintain its license in good standing throughout the performance of the Work may result in discipline and/or other penalties pursuant to the California Business and

Sausalito-Marín City Sanitary District
Agreement

Professions Code, and may constitute a material breach of this agreement subject to all available remedies under this agreement and at law and equity.

11. SEVERABILITY. If any term or provision or portion of a term or provision of this Agreement is declared invalid or unenforceable by any court of lawful jurisdiction, then the remaining terms and provisions or portions of terms or provisions will not be affected thereby and will remain in full force and effect.

Executed on _____, _____, by

CONTRACTOR

DISTRICT

By: _____

By: _____

Title: _____

Title: _____

[Attach Notary Page]

Attest:

By: _____

Sausalito-Marín City Sanitary District
Agreement

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Sausalito-Marín City Sanitary District
#1 East Road
Sausalito, California 94965

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS the Board of Sausalito-Marín City Sanitary District has awarded to _____ (designated as the "PRINCIPAL") a contract for the HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT, which contract and all of the contract documents as defined therein (designated as the "Contract") are hereby made a part hereof; and

WHEREAS, said PRINCIPAL is required under the terms of the Contract to furnish a bond for the faithful performance of the Contract;

NOW, THEREFORE, WE, the PRINCIPAL and _____ as surety (designated as "SURETY"), an admitted surety insurer authorized to do business in the State of California, are held and firmly bound unto the District (designated as "OBLIGEE"), in the penal sum of _____ dollars (\$ _____), lawful money of the United States for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, and administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that, if the above bound PRINCIPAL, his or its heirs, executors, administrators, successors, or assigns, shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions and agreements in the Contract and any alteration thereof made as therein provided, on his or their part to be kept and performed at the time and in the manner therein specified and in all respects according to their true intent and meaning, and shall defend, indemnify and save harmless the OBLIGEE, its officials, officers, employees, volunteers and agents, as therein stipulated, then this obligation shall become null and void, otherwise it shall be and remain in full force and virtue.

And the said SURETY, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder or to the specifications or the plans accompanying the same or to any other part of the contract documents, as defined therein, shall in any way affect said SURETY's obligation on this bond, and the SURETY does hereby waive notice of any such change, extension of time, alteration or addition.

Sausalito-Marín City Sanitary District
Performance Bond

And the said SURETY, for value received, hereby stipulates and agrees that upon termination of the Principal's control of Work for any of the reasons specified in Sections 11.1.1.1 through 11.1.1.5 of the General Conditions of the Contract, the OBLIGEE reserves the right to refuse tender of the PRINCIPAL by the SURETY to complete the Contract work.

If any action shall be brought by the OBLIGEE upon this bond, a reasonable attorney's fee, to be fixed by the court, shall be and become a part of the OBLIGEE's judgment in any such action.

IN WITNESS WHEREOF, the above-bound parties have executed this instrument under their several seals this _____ day of _____, _____, the name and corporate seals of each corporate party being hereto affixed and these presents duly signed by their undersigned representatives, pursuant to authority of their governing bodies.

(Corporate Seal)

PRINCIPAL

(Acknowledgement)

By: _____
Title: _____

(Corporate Seal)

SURETY

(Acknowledgement)

By: _____
(Attorney-in-fact)
Title: _____

(NOTE TO SURETY COMPANY: A certified copy of unrevoked resolution of authority for the attorney-in-fact must be submitted with and attached to the executed bid bond.)

Sausalito-Marín City Sanitary District
Performance Bond

Sausalito-Marín City Sanitary District
#1 East Road
Sausalito, California 94965

PAYMENT/LABOR AND MATERIALS BOND

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS the Board of the Sausalito-Marín City Sanitary District has awarded to _____, (designated as the "PRINCIPAL") a contract for the HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT, which contract and all of the contract documents as defined therein (designated as the "Contract") are hereby made a part hereof; and

WHEREAS, pursuant to California Civil Code Section 3247, the PRINCIPAL is required, before entering upon the performance of the Contract, to file a payment bond with and have such bond approved by the officer or public entity by whom the Contract is awarded; and

WHEREAS, pursuant to California Civil Code Section 3248, such payment bond must be in a sum not less than one hundred percent (100%) of the total amount payable by the terms of the Contract, and must satisfy the other requirements specified in that section; and

WHEREAS, the PRINCIPAL is required in accordance with the Contract to furnish a payment bond in connection with the Contract to secure payment of claims of laborers, mechanics and materialmen employed on work under the Contract in accordance with applicable law;

NOW, THEREFORE, THESE PRESENTS WITNESSETH:

That the PRINCIPAL and the undersigned _____, as surety (designated as "SURETY"), an admitted surety insurer authorized to do business in the State of California are held and firmly bound unto all laborers, material men, and all other persons named in California Civil Code Section 3181 in the sum of _____ Dollars (\$ _____), lawful money of the United States, being a sum not less than one hundred percent of the total amount payable by the terms of the Contract, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, or assigns, jointly and severally, by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that if the PRINCIPAL or any of the PRINCIPAL's subcontractors, or the heirs, executors, administrators, successors, or assigns of any, all, or either of them, shall fail to pay any persons named in California Civil Code Section 3181, or fail to pay for any labor, materials, provisions, provender, or other supplies used in, upon,

Sausalito-Marín City Sanitary District
Payment Bond

for or about the performance of the work contracted to be done, or for any work or labor thereon of any kind, or fail to pay amounts due under the Unemployment Insurance Code with respect to such work or labor, or fail to pay for any amounts required to be deducted, withheld, and paid over to the Employment Development Department from the wages of employees of the PRINCIPAL or any subcontractors of the PRINCIPAL pursuant to Section 13020 of the Unemployment Insurance Code with respect to such work or labor, that the SURETY will pay for the same in an amount not exceeding the amount herein above set forth, and also, in case suit is brought upon this bond, will pay a reasonable attorney's fee to be awarded and fixed by the Court; otherwise this obligation shall be void.

It is hereby expressly stipulated and agreed by the said Surety, for value received, that this bond shall inure to the benefit of any and all of the persons named in Section 3181 of the California Civil Code so as to give a right of action to them or their assigns in any suit brought upon this bond.

It is hereby further expressly stipulated and agreed by the said Surety, for value received, that no change, extension of time, alteration or addition to the terms of the Contract or the specifications or drawings accompanying the same or to any other part of the contract documents, as defined therein, shall in any manner affect the obligations of the SURETY on this bond, and SURETY does hereby waive notice of any such change, extension, alteration, or addition.

IN WITNESS WHEREOF, the above-bound parties have executed this instrument under their several seals this _____ day of _____, _____, the name and corporate seals of each corporate party being hereto affixed and these presents duly signed by their undersigned representatives, pursuant to authority of their governing bodies.

(Corporate Seal)

PRINCIPAL

(Acknowledgement)

By: _____
Title: _____

(Corporate Seal)

SURETY

(Acknowledgement)

By: _____
(Attorney-in-fact)
Title: _____

(NOTE TO SURETY COMPANY: A certified copy of unrevoked resolution of authority for the attorney-in-fact must be submitted with and attached to the executed bid bond.)

Sausalito-Marín City Sanitary District
#1 East Road
Sausalito, California 94965

MAINTENANCE BOND

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS the Board of the Sausalito-Marín City Sanitary District has awarded to _____, (designated as the "PRINCIPAL") a contract for HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT, which contract and all of the contract documents as defined therein (designated as the "Contract") are hereby made a part hereof; and

WHEREAS, the PRINCIPAL is required under the terms of the Contract to furnish a bond for the correction of any defects due to defective materials or workmanship in the work performed under the Contract.

NOW, THEREFORE, we the PRINCIPAL and the undersigned _____, as surety (designated as "SURETY"), an admitted surety insurer authorized to do business in the State of California, are held and firmly bound unto the Sausalito-Marín City Sanitary District, (designated as the "OBLIGEE"), in the penal sum of _____ Dollars (\$_____), lawful money of the United States, being a sum not less than ten percent (10%) of the final Contract price, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH that if, during a maintenance period of one (1) year from the date of acceptance by the OBLIGEE of the contracted work, the PRINCIPAL upon receiving written notice of a need for repairs which are directly attributable to defective materials or workmanship, shall diligently take the necessary steps to correct said defects within seven (7) days from the date of said notice, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

If any action shall be brought by the OBLIGEE upon this bond, a reasonable attorney's fee, to be fixed by the Court, shall be and become a part of OBLIGEE's judgment in any such action.

No right of action shall accrue on this bond to, or for the use of, any person or corporation other than the OBLIGEE named herein or the heirs, executors, administrator or successor of the OBLIGEE.

IN WITNESS WHEREOF, the above bound parties have executed this instrument under their seals this _____ day of _____, the name and corporate seals of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Sausalito-Marín City Sanitary District
Maintenance Bond

(Corporate Seal)

PRINCIPAL

(Acknowledgement)

By: _____
Title: _____

(Corporate Seal)

SURETY

(Acknowledgement)

By: _____
(Attorney-in-fact)
Title: _____

(NOTE TO SURETY COMPANY: A certified copy of unrevoked resolution of authority for the attorney-in-fact must be submitted with and attached to the executed bid bond.)

Sausalito-Marín City Sanitary District
#1 East Road
Sausalito, California 94965

**ESCROW AGREEMENT FOR
SECURITY DEPOSITS IN LIEU OF RETENTION**

This Escrow Agreement is made and entered into by and between Sausalito-Marín City Sanitary District, whose address is #1 East Road, Sausalito, California

94965, hereinafter called "District", _____, whose address is
_____, hereinafter called "Contractor", and
_____, whose address is
_____, hereinafter called "Escrow Agent"

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

1. Pursuant to Section 22300 of the Public Contract Code of the State of California, Contractor has the option to deposit securities with Escrow Agent as a substitute for retention earnings required to be withheld by District pursuant to the Construction Contract entered into between the District and Contractor for the project entitled HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT in the amount of \$ _____ dated _____ (hereinafter referred to as the "Contract"). Alternatively, on written request of the Contractor, the District shall make payments of the retention earnings directly to the Escrow Agent. When Contractor deposits the securities as substitute for Contract earnings, the Escrow Agent shall notify the District within 10 days of the deposit. The market value of the securities at the time of the substitution shall be at least equal to the cash amount then required to be withheld as retention under the terms of the Contract between the District and Contractor. Securities shall be held in the name of _____ and shall designate the Contractor as the beneficial owner.
2. The District shall make progress payments to the Contractor for such funds which otherwise would be withheld from progress payments pursuant to the Contract provisions, provided that the Escrow Agent holds securities in the form and amount specified above.
3. When the District makes payment of retentions earned directly to the Escrow Agent, the Escrow Agent shall hold them for the benefit of the Contractor until such time as the escrow created under this contract is terminated. The Contractor may direct the investments of the payments into securities. All terms and conditions of this agreement and the rights and responsibilities of the parties shall be equally applicable and binding when the District pays the 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 the District. These expenses and payment terms shall be determined by the District, Contractor and Escrow Agent.

Sausalito-Marín City Sanitary District
Escrow Agreement

5. The interest earned on the securities or the money market accounts held in escrow and all interest earned on that interest shall be for the sole account of the Contractor and shall be subject to withdrawal by contractor at any time and from time to time without notice to the District.
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 District to the Escrow Agent that District consents to the withdrawal of the amount sought to be withdrawn by Contractor.
7. The District shall have a right to draw upon the securities in the event of default by the Contractor. Upon seven day's written notice to the Escrow Agent from the District of the default, the Escrow Agent shall immediately convert the securities to cash and shall distribute the cash as instructed by the District.
8. Upon receipt of written notification from the District certifying that the Contract is final and complete, and that the 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 monies and securities on deposit and payments of fees and charges.
9. Escrow Agent shall rely on the written notifications from the District and the Contractor pursuant to Sections (4) to (6) inclusive, of this agreement and the District and Contractor shall hold Escrow Agent harmless from Escrow Agent's release and disbursement of the securities and interest as set forth above.
10. The names of the persons who are authorized to give written notice or to receive written notice on behalf of the District and on behalf of Contractor in connection with the foregoing, and exemplars of their respective signatures, are as follows:
 On behalf of District: _____ On Behalf of Contractor _____

 Title

 Title

 Name

 Name

On behalf of Escrow Agent:

 Title

 Name

 Signature

 Address

At the time the Escrow Account is opened, the District and Contractor shall deliver to the Escrow Agent a fully executed counterpart of this Agreement.

IN WITNESS WHEREOF, the parties have executed this Agreement by their proper officers on the date first set forth above.

District:

Contractor:

Title

Title

Name

Name

Signature

Signature

Address

Address

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Sausalito-Marín City Sanitary District
#1 East Road
Sausalito, California 94965

GENERAL CONDITIONS

1. DEFINITIONS:

The following terms as used in any agreement of which these General Conditions are a part are defined as follows:

- 1.1 Agreement: The agreement between the District and Contractor concerning the Project, as evidenced by and comprised of the Contract Documents. The agreement is also referred to as the “contract” within the Contract Documents.
- 1.2 Architect or Engineer: The person or persons so specified on the title sheet of the Technical Specifications and/or Project Plans.
- 1.3 Bid Package: All of the documents listed as comprising the entire Bid Package as specified in the Instructions to Bidders and representing the full set of documents made available to bidders on the Project.
- 1.4 District: Sausalito-Marín City Sanitary District
- 1.5 Contract Documents: All those documents listed in the Project agreement as comprising the entire agreement between the District and the Contractor.
- 1.6 Contractor: The successful bidder for the Project and party to the Project agreement with the District as specified in the Project agreement.
- 1.7 Days: Unless otherwise specified in the Contract Documents, days mean calendar days.
- 1.8 Project: HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT as described in the contract documents.
- 1.9 Construction Manager: The District, or the District’s authorized representative for administration and overall management of the Project agreement and Work. The Construction Manager is the official point of contact between the District, the Architect and/or Engineer, and the Contractor.
- 1.10 Project Plans: The primarily graphic detailed requirements concerning the Project contained in the Bid Package and any addenda to the Project Plans signed by authorized District representatives and issued prior to bid opening, Equal Product Proposals accepted by the District and signed by authorized District

representatives prior to bid opening, and change orders and other amendments to the Project Plans signed by authorized representatives of the District and the Contractor in accordance with the requirements of the Contract Documents.

- 1.11 Resident Engineer: The party or parties charged by the District with observing the Work for compliance with the requirements of the Contract Documents and applicable laws and regulations. The Resident Engineer acts under the direction of the District and shall coordinate with the Construction Manager and Architect and/or Engineer as directed by the District in accordance with the Contract Documents.
- 1.12 Subcontractor: A person, firm or corporation that is obligated as a party to a contract with the Contractor to perform part of the Project work. For purposes of these General Conditions Subcontractors include, but are not limited to, those that are obligated as parties to a contract with the Contractor to specially fabricate and install a portion of the Project Work according to the Project Plans.
- 1.13 Technical Specifications: The detailed Project requirements contained within the Project Plans and any addenda to the Technical Specifications signed by authorized District representatives and issued prior to bid opening, Equal Product Proposals accepted by the District and signed by authorized District representatives prior to bid opening, and change orders and other amendments to the Technical Specifications signed by authorized representatives of the District and the Contractor in accordance with the requirements of the Contract Documents..
- 1.14 Work: The furnishing of all equipment, tools, apparatus, facilities, material, labor and skill necessary to perform and complete in a good and workmanlike manner the Project as shown in the Project Plans and Technical Specifications in accordance with the Contract Documents and applicable law.
- 1.15 Written Notice: Will be deemed to have been duly served for purposes of these General Conditions and any agreement of which they are a part if delivered in person to the individual or to a member of the firm or to any office of the corporation for whom the notice is intended, or if sent by registered or certified mail to the last known business address known to the party giving notice. Unless otherwise specified in the Contract Documents, the last known address of the Contractor shall be that listed in the Contractor's completed Bid.

2. SCOPE OF WORK

- 2.1 Documents Furnished by District. The District will furnish to the Contractor, free of charge, one (1) set of reproducible Project Plans and Technical Specifications and five (5) sets of prints of the Project Plans and Technical Specifications for execution of the Work. Throughout the performance of the Work the Contractor

must keep one copy of the Project Plans and Technical Specifications in good order and available for review by the Construction Manager, the Engineer, the Architect, and any other District contractors or representatives.

2.2 Ownership of Documents Furnished by District. All documents furnished by the District, including, but not limited to, the, Project Plans and Technical Specifications, and any copies, are the property of the District. Documents furnished by the District may not to be used on any other work. All documents furnished by the District must be returned to District upon completion of the Work.

2.3 Project Plans and Technical Specifications.

2.3.1 The Project Plans and Technical Specifications are complementary and intended to mutually describe the Work necessary to complete the Project in accordance with the Contract Documents.

2.3.2 In general, the Project Plans indicate dimensions, position and kind of construction, and the Technical Specifications indicate qualities and methods. Any Work indicated on the Project Plans and not mentioned in the Technical Specifications or vice versa must be furnished as though fully set forth in both. Work that is not particularly detailed, marked or specified shall be the same as similar Work that is detailed, marked or specified. The Contractor must furnish items necessary for the operation of equipment depicted in the Project Plans or specified in the Technical Specifications that are suitable to allow such equipment to function properly at no extra charge.

2.3.3 The Contractor must notify the Construction Manager and the Engineer/Architect as soon as possible of any apparent errors or inconsistencies, including, but not limited to, typographical or notational errors in the Project Plans, Technical Specifications, and/or in work done by others affecting the Work. The Construction Manager will issue instructions concerning any such apparent errors or inconsistencies. If the Contractor proceeds with Work impacted by apparent errors or inconsistencies without instructions from the Construction Manager, the Contractor shall do so at its sole risk and shall have all of the obligations and the District shall have all of the rights and remedies specified in Section 11 concerning any resulting damage or defect.

2.3.4 The General Conditions apply with equal force to all of the Work, including extra work authorized by the Construction Manager in accordance with the Contract Documents. The Contractor must submit any required shop diagrams and/or drawings by the times and in the quantities indicated in the Technical Specifications. Any such shop diagrams and/or drawings must show completely the Work to be done, expanding on the Project Plans concerning details not previously shown, field conditions and the condition

of the Work. Architect or Engineer review of such shop diagrams and/or drawings will concern conformance with the requirements of the Contract Documents only. The Architect or Engineer assumes no responsibility for the correctness or accuracy of the dimensions or any other contents of any shop diagrams and/or drawings submitted by the Contractor. The Contractor must check all dimensions at the Work site. Shop diagrams and/or drawings must be clearly marked with the name of the Project and the name of the Contractor, subcontractor or supplier making the submittal, and must be stamped and signed by the Contractor and submitted under a signed transmittal letter from the Contractor certifying that all dimensions have been checked at the Work site. These requirements are mandatory. The Architect or Engineer will not review shop diagrams and/or drawings that do not satisfy these requirements. The Contractor will be responsible for any and all discrepancies between dimensions of the actual Project site and/or Work and those shown on shop diagram and/or drawings submitted by the Contractor, and for any other errors contained in or resulting from such shop diagrams and/or drawings, including, but not limited to, errors in material and/or equipment quantities and any resulting errors, delays or additional cost in the performance of the Work. The Contractor will have all of the obligations and the District will have all of the rights and remedies that are specified in Section 11 concerning any discrepancies or errors in shop diagrams and/or drawings submitted by the Contractor, and concerning any resulting errors, delays or additional costs in the performance of the Work.

3. CONTROL OF WORK AND MATERIAL

- 3.1 Construction Manager's Status. The Construction Manager will administer the Project in accordance with the Contract Documents. After execution of the agreement and issuance of the Notice to Proceed, all correspondence and/or instructions concerning the Project between the Contractor and/or District shall be forwarded through the Construction Manager. Except as otherwise provided in the Contract Documents, the Construction Manager will not be responsible for and will not have control or charge of construction means, methods, techniques, or procedures or for safety precautions in connection with the Work. The Construction Manager, however, will have authority to reject materials and/or workmanship that do not conform to the requirements of the Contract Documents. The Construction Manager will also have the authority to require inspection or testing of the Work.
- 3.2 Architect or Engineer's Status. The Architect or Engineer will advise the Construction Manager concerning decisions on all claims of the Contractor and all other matters relating to the execution and progress of the Work or the interpretation of the Contract Documents. The Architect or Engineer will also advise the Construction Manger concerning Work that does not conform to the Contract Documents. Whenever, in the Architect's or Engineer's opinion, it is necessary or advisable in accordance with the Contract Documents, the Architect

or Engineer may recommend to the Construction Manager inspection or testing of the Work, whether or not such Work is then fabricated, installed or completed.

3.3 Inspection and Testing of Work and Material.

- 3.3.1 The District, the Construction Manager, the Architect or Engineer and their representatives will have access to the Work at all times wherever it is in preparation or progress. The Contractor must provide proper facilities for such access and for inspection.
- 3.3.2 The Contractor must inspect all materials as delivered and promptly return all defective materials without waiting for their rejection by the Construction Manager or Architect or Engineer.
- 3.3.3 If the Construction Manager, the Contract Documents, or any laws, ordinances, or any public authority require any Work to be tested or approved, the Contractor must give the Construction Manager timely notice of the Contractor's readiness for inspection. Inspections will be promptly made, and where practicable, at the source of supply. Any work subject to such testing that is covered up without timely notice to the Construction Manager or without the approval or consent of the Construction Manager must, if required by the Construction Manager, be uncovered for examination at the Contractor's expense. The Contractor will have all of the obligations and the District will have all of the rights and remedies that are specified in Section 11 concerning any work subject to testing that is covered up without timely notice to the Construction Manager and that is not uncovered for examination at the Contractor's Expense if required by the Construction Manager.
- 3.3.4 Tests of materials or qualification tests required by the Contract Documents must be made in accordance with the Contract Documents and the requirements of the California Building Standards Code as adopted by the District and other applicable law. Copies of all testing reports shall be distributed as required in the Contract Documents.
- 3.3.5 The District or its representatives may order re-examination of questioned Work. If ordered to do so, the Contractor must uncover such Work. If such Work is found to be according to the Contract Documents, the District shall pay the cost of uncovering and restoring the Work, unless such Work was subject to testing and covered up without timely notice to or approval of the Construction Manager. If re-examined Work is found not in accordance with the Contract Documents, the Contractor must pay the cost of uncovering and restoring the Work. The Contractor will have all of the obligations and the District will have all of the rights and remedies that are specified in Section 11 concerning any re-examined Work not in accordance with the

Contract Documents that the Contractor fails to uncover and restore at the Contractor's expense.

3.3.6 The Contractor must replace or correct without charge any material or workmanship found not to conform to the requirements of the Contract Documents, unless the District consents to accept such material or workmanship with an appropriate adjustment in the Contract Price. The Contractor must promptly segregate and remove non-conforming material from the Work site. The Contractor will have all of the obligations and the District will have all of the rights and remedies that are specified in Section 11 concerning any failure by the Contractor to replace or correct without charge any material or workmanship that does not conform to the requirements of the Contract Documents and that the District has not consented to accept.

3.4 Samples Furnished by the Contractor. The Contractor must furnish all samples for approval as directed in sufficient time to permit the Architect or Engineer to examine, approve and select samples before they are required by the progress of the Work. Portions of the Work for which samples are required and for which the Architect or Engineer has selected samples must be in accordance with such approved samples. Samples must be sent prepaid to the office of the Construction Manager or to such place as the Construction Manager may direct.

3.5 Materials and Substitutions.

3.5.1 Materials used for the Work must be new and of the quality specified. When not particularly specified, materials must be the best of their class or kind. The Contractor must, if required, submit satisfactory evidence as to the kind and quality of materials.

3.5.2 If the Contractor submitted complete information to the District for products proposed as equals in accordance with the Bid Package, and the District approved such products proposed as equals in writing, the Contractor may either furnish such products approved as equals, or furnish the products listed by manufacturer name, brand or model number in the Technical Specifications or Project Plans. The District retains the right, in its sole discretion, to accept or reject any other proposed substitution. To be considered, proposals concerning products proposed as equals must include sufficient information to permit the District to determine whether the products proposed as equals will satisfy the same performance requirements as products listed by manufacturer's name, brand or model number. Such performance requirements may include, but are not limited to, size, strength, function, appearance, ease of maintenance and repair, and useful life requirements. If the District does not accept a proposed substitution, the Contractor must furnish the product specified in the Technical Specifications or Project Plans for the Contract Price, regardless

of whether the product is specified by manufacturer's name, brand or model number, or otherwise.

3.5.3 During the performance of the Work, including off-hours and weekends, all materials must be neatly stacked, properly protected from the weather and other adverse impacts, and placed so as to avoid interference with efficient progress of the Work, with other activities of the District, or with the use of existing District facilities by the public. All materials must be delivered so as to ensure efficient and uninterrupted progress of the Work. Materials must be stored so as to cause no obstruction and so as to prevent overloading of any portion of the Work. The Contractor will be responsible for damage or loss of materials delivered to and/or stored at the Work site due to weather or other causes. The Contractor must promptly remove from the Work site all materials rejected by the District or its representatives as failing to conform to the requirements of the Contract Documents, whether such non-conforming materials have been incorporated in the Work or not. If the District or its representatives so direct, the Contractor must promptly replace and re-execute Work performed by the Contractor and order the replacement and re-execution of Work performed by subcontractors using non-conforming materials with materials that satisfy the requirements of the Contract Documents without expense to the District. The Contractor will bear the expense of making good all Work destroyed or damaged by such removal. The Contractor will have all of the obligations and the District will have all of the rights and remedies that are specified in Section 11 concerning any failure by the Contractor to replace or re-execute Work using non-conforming materials, and/or to make good all work destroyed or damaged by such removal and/or execution.

3.6 Audit and Examination of Records. The District may examine and audit at no additional cost to the District all books, estimates, records, contracts, documents, bid documents, bid cost data, subcontract job cost reports and other Project related data of the Contractor, subcontractors engaged in performance of the Work, and suppliers providing supplies, equipment and other materials required for the Work, including computations and projections related to bidding, negotiating, pricing or performing the Work or contract modifications and other materials concerning the Work, including, but not limited to, Contractor daily logs, in order to evaluate the accuracy, completeness, and currency of cost, pricing, scheduling and any other project related data. The Contractor will make available all such Project related data at all reasonable times for examination, audit, or reproduction at the Contractor's business office at or near the Work site, and at any other location where such Project related data may be kept until three years after final payment under the Agreement. Pursuant to California Government Code Section 8546.7, if the amount of public funds to be expended is in excess of \$10,000, this Agreement shall be subject to the examination and audit of the State Auditor, at the request of the District, or as part of any audit of the District, for a period of three (3) years after final payment under the Agreement.

- 3.7 Advertising. No advertising signs of any kind may be displayed on the Work site, or on fences, offices or elsewhere adjacent to the Work site.

4. CHANGES IN WORK

- 4.1 District Directed Change Orders. The District may at any time during the progress of the Work direct any amendments to the Work or any of the Contract Documents, including, but not limited to the Technical Specifications, or Project Plans. Such amendments will in no way void the agreement, but will be applied to amend the Contract Price, if such amendments affect the Contract Price, the Project schedule, if such amendments affect the Project schedule, or any other provision of the Contract Documents based on a fair and reasonable valuation of the amendment in accordance with this Section 4.
- 4.2 Writing Requirement. Change orders and other amendments to the Technical Specifications, the Project Plans, or other Contract Documents may be made only by in writing executed by authorized representatives of the District and the Contractor.
- 4.3 Contractor Proposed Change Orders. Unless the Construction Manager otherwise authorizes or the District and the Contractor otherwise agree, change order proposals submitted by the Contractor must be submitted to the Construction Manager no later than the time of the proposed change.
- 4.4 All Change Orders. All change order proposals must be submitted on completed Change Order forms provided in the Contract Documents. All such change order proposals must itemize all cost impacts of the proposed change order and include a total price for that change order and the amended Contract Price that would become effective upon execution of the change order. All change order proposals must specify any change in the Project schedule, or in any project milestone including, but not limited to, the Time for Completion, under the change order. It is understood that change orders that do not specify a change in any milestone, including, but not limited to, the Time for Completion, may be accomplished by the Time for Completion then in effect.
- 4.5 Change Order Pricing. Change order pricing will be governed by the following:
- 4.5.1 Unit prices specified in the Contract Documents will apply to cost impacts involving items for which the Contract Documents specify unit prices.
- 4.5.2 Cost impacts involving items for which no unit prices are specified will be calculated by adding the itemized actual direct cost that would be added or reduced under the change order and an allowance for indirect costs in accordance with this Section. Itemization for direct costs for required labor must include the classifications of labor required, the total hours required

for each classification, the hourly rate for each classification and other labor related costs such as liability and workers compensation insurance, social security, retirement and unemployment insurance. All other cost impacts for which no unit prices are specified must be itemized as appropriate, including the cost of tools, vehicles, phones and other equipment, and the cost of all required materials or supplies. Indirect costs added under a change order may not exceed an allowance of fifteen (15) percent of the total of combined Contractor and subcontractor direct costs added under the change order. Such allowance covers Contractor overhead and profit under the change order and includes the cost of insurance in addition to that required pursuant to Section 8.8, bond premiums, superintendent labor, clerical labor, home office expenses, worksite office expenses, and utility costs under the change order. Such costs may not be itemized as direct costs under a change order. Indirect costs deducted under a change order will be calculated in exactly the same way as indirect costs added under a change order, except indirect costs deducted under a change order may not exceed an allowance of seven and a half (7.5) percent of the total of combined Contractor and subcontractor direct costs deducted under the change order.

- 4.6 Liability Under Unapproved Change Orders. The Contractor shall be solely responsible for any and all losses, costs, or liabilities of any kind incurred by the Contractor, any subcontractor engaged in the performance of the Work, any party supplying material or equipment for the Work or any third party that are incurred pursuant to Contractor-proposed change orders prior to issuance of an approved change order executed in accordance with this Section 4. The Contractor will have all of the obligations and the District will have all of the rights and remedies that are specified in Section 11 concerning any work or resulting losses, costs, or liabilities pursuant to a Contractor proposed change order before issuance of an approved change order executed in accordance with this Section 4.
- 4.7 Changes Subject to Contract Documents. Any changes in the Work and/or the Contract Documents pursuant to change orders and any other amendments issued in accordance with the Contract Documents, including this Section 4, will in all respects be subject to all provisions of the Contract Documents, including, but not limited to, the Technical Specifications and the Project Plans, except as modified by such change orders or amendments.
- 4.8 Change Order Disputes.
 - 4.8.1 Disputed District Directed Change Orders. If the Contractor disputes a District directed change order following a reasonable effort by the District and the Contractor to resolve the dispute including, at a minimum, a meeting between appropriate representatives of the Contractor and the District, the Contractor must commence performing the Work consistent with the disputed change order within five (5) working days of the last

meeting between representatives of the Contractor and the District to resolve the dispute, or within the time specified in the disputed District directed change order, whichever is later. In performing Work consistent with a disputed District-directed change order pursuant to this provision the Contractor will have all of the Contractor's rights concerning claims pursuant to the Contract Documents and applicable law.

- 4.8.2 Disputed Contractor Proposed Change Orders. If the District disputes a Contractor proposed change order, the District and the Contractor will use reasonable efforts to resolve the dispute including, at a minimum, holding a meeting between appropriate representatives of the Contractor and the District. Regardless of and throughout any such efforts to resolve the dispute the Contractor must continue performing the Work irrespective of and unmodified by the disputed change order. In continuing to perform the Work, the Contractor will retain all of the Contractor's rights under contract or law pertaining to resolution of disputes and protests between contracting parties. Disputes between the District and the Contractor concerning any Contractor-proposed change order or other amendment do not excuse the Contractor's obligation to perform the Work in accordance with the Contract Documents excluding such Contractor-proposed change order or other amendment by the Time for Completion or waive any other Project milestone or other requirement of the Contract Documents.

5. TRENCHING AND UTILITIES

- 5.1 Excavation More Than Four Feet Deep. In accordance with California Public Contract Code Section 7104, if the Work involves excavation more than four feet deep the Contractor must promptly notify the District in writing before disturbing: any material that the Contractor believes may be hazardous waste, as defined in Section 25117 of the Health and Safety Code, that is required to be removed to a Class I, Class II or Class III disposal site in accordance with provisions of existing law; any subsurface or latent physical conditions at the Work site differing from those indicated; or any unknown physical conditions at the Work site of any unusual nature, different materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents. The District will promptly investigate any such conditions for which notice is given. If the District finds that the conditions do materially differ, or involve hazardous waste, and would cause a decrease or increase in the cost or time of performance of the Work, the District will issue a change order pursuant to Section 4 of these General Conditions. If a dispute arises between the District and the Contractor concerning whether the conditions materially differ, or involve hazardous waste, or cause a decrease of increase in the cost or time of performance, the Contractor will not be excused from any completion date provided in the Contract Documents, but shall proceed with all Work to be performed. The Contractor will retain all rights under contract or law pertaining to resolution of disputes and protests between contracting parties.

- 5.2 Excavation of Five Feet or More. In accordance with California Labor Code Section 6705, contractors performing contracts exceeding \$25,000 in cost and involving excavation five or more feet deep must submit for the District's acceptance, prior to excavation, a detailed plan showing the design of shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground during excavation. If the plan varies from the shoring system standards, it must be prepared by a registered civil or structural engineer.
- 5.3 Utility Relocation Costs.
- 5.3.1 In accordance with California Government Code Section 4215, the District assumes the responsibility for the timely removal, relocation or protection of existing main or trunkline utility facilities located on the Work site if such utilities are not identified by the District in the Technical Specifications and/or Project Plans. The District will compensate the Contractor for the costs of locating, repairing damage not due to the Contractor's failure to exercise reasonable care, and removing or relocating existing main or trunkline utility facilities located at the Work site and not identified with reasonable accuracy in the Technical Specifications and/or Project Plans. The District will also compensate the Contractor for the cost of equipment on the Project necessarily idled during such work. The Contractor will not be assessed liquidated damages for Work completion delays caused by the District's failure to provide for removal or relocation of such main or trunkline utility facilities.
- 5.3.2 Nothing in this provision or the Contract Documents will be deemed to require the District to indicate the presence of existing service laterals or appurtenances whenever the presence of such utilities on the Work site can be inferred from the presence of other visible facilities, such as buildings, meter and junction boxes, on or adjacent to the Work site; provided, however, that nothing in this provision or the Contract Documents shall relieve the District from identifying main or trunklines in the Technical Specifications and/or Project Plans.
- 5.3.4 Nothing in this provision or the Contract Documents will preclude the District from pursuing any appropriate remedy against the utility for delays, which are the responsibility of the utility.
- 5.3.5 Nothing in this provision or the Contract Documents will be construed to relieve the utility from any obligation as required either by law or by contract to pay the cost of removal or relocation of existing utility facilities.
- 5.3.6 If the Contractor while performing the Work discovers utility facilities not identified by the District in the Technical Specifications and/or Project

Plans, the Contractor must immediately notify the District and utility in writing.

- 5.3.7 Either the District or the utility, whichever owns existing main or trunkline utility facilities located on the Work site, shall have sole discretion to effect repairs or relocation work or to permit the Contractor to perform such repairs or relocation work at a reasonable price.

6. PROJECT FACILITIES

- 6.1 Work Site Offices. Any Work site office facilities used by the Contractor and/or its privities must conform to all applicable codes, ordinances and regulations. The cost of such Work site office facilities shall be paid from the included in the Contract Price.
- 6.2 District Rights of Access and Ownership. The District and its authorized representatives will at all reasonable times while such office facilities are located at the Work site (including, at a minimum, all times during which the Work is performed), have access to any such Work site office facilities used by the Contractor and/or its privities. With respect to the right of access of the District and its authorized representatives, neither the Contractor nor its privities shall have a reasonable expectation of privacy pursuant to the Fourth Amendment to the United States Constitution or other applicable law concerning such Work site office facilities used by the Contractor and/or its privities. Without exception, any and all Project related materials located at such Work site facilities will be deemed at all times to be District property subject to inspection and copying by the District and its authorized representatives at all reasonable times while such facilities are located at the Work site (including, at a minimum, all times during which the Work is performed). Any interference by the Contractor or its privities with the District's rights of access and/or ownership pursuant to this Section 6 will constitute a material breach of the Agreement subject to any and all remedies available pursuant to the Contract Documents and at law and equity.

7. PROSECUTION AND PROGRESS OF THE WORK

- 7.1 Liquidated Damages. Time is of the essence in the Agreement. The District and the Contractor agree that it will be difficult and/or impossible to determine the actual damage which the District will sustain in the event of the Contractor's failure to fully perform the Work or to fully perform all of the Contractor's obligations that have accrued pursuant to the Agreement by the Time for Completion. Accordingly, the District and the Contractor agree in accordance with California Government Code Section 53069.85 that the Contractor will forfeit and pay to the District liquidated damages in the sum of **\$500 per day** for each and every calendar day completion of the Work and/or performance of all of the Contractor's obligations that have accrued pursuant to the Agreement is delayed beyond the Time for Completion. The District and the Contractor further agree in accordance with

California Government Code Section 53069.85 that the liquidated damages sum specified in this provision is not manifestly unreasonable under the circumstances existing at the time the Agreement was made, and that the District may deduct liquidated damages sums in accordance with this provision from any payments due or that may become due the Contractor under the Agreement.

- 7.2 No Damage for Delay Beyond District and Contractor Control. The Contractor will not be held responsible for delays in performance of the Work caused by delay beyond the control of both District and Contractor, such as by strikes, lockouts, or labor disturbances that are not within the control of the contractor to resolve, lack or failure of transportation, or acts of other government entities. This provision will not apply where the delay would not have occurred but for a previous contractor caused delay in the prosecution of the Work. The District will not be liable to the Contractor, any subcontractor or other entity engaged in the performance of the Work, any supplier, or any other person or organization, or to any surety or employee or agent of any of them, for damages arising out of or resulting from (i) delays beyond the control of the District and the Contractor including but not limited to fires, floods, epidemics, abnormal weather conditions, earthquakes and acts of God or acts or neglect by utility owners or other contractors performing other work, or (ii) delays caused by the District, its officials, officers, employees, agents, or volunteers, or delays caused by the Construction Manager or the Architect or Engineer, which delays are reasonable under the circumstances involved and/or are within the contemplation of the District and the Contractor. An extension of the Time for Performance in an amount equal to the time loss due to such delay(s) will be the Contractor's sole and exclusive remedy for such delay(s).
- 7.3 No Damage for Contractor Caused Delay. Contractor shall not be entitled to additional compensation for extended field or home office overhead, field supervision, costs of capital, interest, escalation charges, acceleration costs or other impacts for any delays to the extent such delays are caused by the failure of the Contractor or any subcontractor or other entity engaged in performance of the Work to perform the Work in accordance with the Contract Documents. Contractor may be eligible for additional compensation in excess of the Contract Price for delays caused by the District and/or its privities.
- 7.4 No Damage for Other Delay. Contractor will not be entitled to damages for delay to the Work caused by the following, which the District and Contractor agree will be deemed for purposes of California Public Contract Code Section 7102 either not caused by the District, and/or within the contemplation of the District and the Contractor, and/or reasonable under the circumstances:
- 7.4.1 Exercise of the District's right to sequence the Work in a manner that would avoid disruption to the District and other contractors based on: the failure of the Contractor or any subcontractor or other entity engaged in the performance of the Work to perform the Work in accordance with the Contract Documents, enforcement by the District or any other

governmental agency of competent jurisdiction of any government act or regulation, or enforcement by the District of any provisions of the Agreement.

7.4.2 Requests for clarification or information concerning the Contract Documents or proposed change orders or modifications to the Contract Documents, including extensive and/or numerous such requests for clarification or information or proposed change orders or modifications, provided such clarifications or information or proposed change orders or modifications are processed by the District or its representatives in a reasonable time in accordance with the Contract Documents.

7.5 Delays Caused by the District and/or Its Privities. Either the District or the Contractor may propose a change in the Time for Completion for delays that are purported to be caused by the District and/or its privities and that are not reasonable under the circumstances involved and/or that are not within the contemplation of the District and the Contractor. Such proposed changes in the Time for Completion will constitute change order proposals subject to Section 4. In accordance with Section 4, the District and the Contractor may agree upon pricing for the cost impacts, if any, resulting from such delays. If such pricing is in anticipation of cost impacts that may, but have not yet occurred, the District will be obligated to pay the Contractor for such anticipated impacts in accordance with the Agreement and any applicable, approved change orders only to the extent the Contractor actually incurs the anticipated cost impacts. Notwithstanding anything to the contrary in Section 4.5.2, the District and the Contractor may agree to a daily rate or cap or lump sum that will apply to the cost impacts, if any, resulting from delay purportedly caused by the District and/or its privities subject to this provision. However, if such daily rate or cap or lump sum is in anticipation of cost impacts that have not yet occurred, the District will be obligated to pay such daily rate or cap or lump sum only to the extent the Contractor actually incurs such cost impacts.

7.6 Weather Delays. Extensions of the Time for Completion will not be allowed for weather conditions that are consistent with the following list of anticipated rain days based on historical weather data of the National Oceanographic and Atmospheric Administration of the U.S. Department of Commerce for the record station that is nearest or most applicable to the Work site. Extensions of the Time for Completion for delays due to adverse weather will be allowed only if the number of rain days exceeds those listed in the following table and the Contractor can verify to the District's reasonable satisfaction that such adverse weather caused actual delay in the timely completion of the Work. No extensions of the Time for Completion will be granted for rain days in addition to those listed in the following table that merely result in delays that do not or would not, themselves, result in failure to complete the Work by the Time for Completion. Anticipated rain days are as follows: January, [9]; February, [6]; March, [5]; April, [4]; May, [3]; June, [0]; July, [0]; August, [0]; September, [0]; October, [3]; November, [4]; December, [9].

7.7 Delay Claims. Whenever the Contractor claims a delay for which the Time for Completion may be extended, the Contractor must request an extension of time within five (5) days of the start of the delay. The request must be in writing and describe in detail the cause for the delay, and, if possible, the foreseeable extent of the delay.

7.8 Contractor Coordination of the Work.

7.8.1 The District reserves the right to do other work in connection with or in the vicinity of the Project by contract or otherwise, and Contractor shall at all times conduct the Work so as to impose no hardship on the District, others engaged in the Work or other contractors working at the Work site. The Contractor will adjust, correct and coordinate the Work with the work of others so that no delays result in the Work or other work at or near the Work site.

7.8.2 If any part of the Work depends for proper execution or results upon the work of the District or any other contractor, the Contractor will, before proceeding with such Work, promptly report to the District any apparent discrepancies or defects in such other Work. Failure of the Contractor to promptly report any apparent discrepancy or defect will be deemed an acceptance of the District's or other contractor's Work as fit and proper.

7.8.3 The Contractor will anticipate the relations of the various trades to the progress of the Work and will ensure that required anchorage or blocking is furnished and set at proper times. Anchorage and blocking necessary for each trade shall be part of the Work except where stated otherwise.

7.8.4 The Contractor will provide proper facilities at all times for access of the District, the Construction Manager, Architect or Engineer, and other authorized District representatives to conveniently examine and inspect the Work.

8. CONTRACTOR RESPONSIBILITIES

8.1 Eligibility. By executing the Agreement, the Contractor certifies that the Contractor is not ineligible to perform work on public works projects pursuant to California Labor Code Sections 1777.1 or 1777.7. In accordance with California Public Contract Code Section 6109(a), contractors who are ineligible to perform work on public works projects pursuant to California Labor Code Sections 1777.1 or 1777.7 may neither bid on, be awarded or perform the Work. The Contractor shall hold harmless and indemnify the District from and against any and all damages, costs, and liability arising from or as a consequence of any violation of Public Contract Code Section 6109.

- 8.2 Supervision of the Work. The Contractor will be solely responsible for the performance of the Work, including portions of the Work to be performed by subcontractors. The Contractor is charged with ensuring that all orders or instructions from the District, Construction Manager or Architect/Engineer are disseminated to and followed by all subcontractors engaged in performance of the Work. The Contractor will supervise the Work using the Contractor's best skill and attention. At any time during the progress of the Work, the District, the Construction Manager, or the Architect/Engineer may require the Contractor and/or subcontractors engaged in performance of the Work to attend a project meeting and the Contractor will attend, and ensure the attendance of any subcontractors whose attendance is required by the District and/or advisable in light of the matters to be addressed at the meeting.
- 8.3 Contractor's Superintendent. The Contractor will keep on the Work, throughout its progress, a competent, English speaking superintendent and any necessary assistants, all satisfactory to the District. The superintendent may not be changed without the consent of the District. The superintendent will represent the Contractor and all directions given by the District to the superintendent will bind the Contractor in accordance with the Agreement. Superintendent time included in Contractor's completed bid schedule and/or in approved change orders, if any, must be included in Contractor's approved overhead rate and may not be charged as a direct cost.
- 8.4 Competent Employees. The Contractor must at all times enforce strict discipline and good order among the Contractor's employees and may not employ on the Work any unfit person or anyone not skilled in the Work assigned, or anyone incompetent or unfit for the duties of that person. When the District determines that a Contractor employee does not satisfy the requirements of this provision, upon notice from the District, the Contractor must ensure that employee performs no further Work and is no longer present at the Work site. Any such Contractor employee may not again be employed on the Work without District approval.
- 8.5 Items Necessary for Proper Completion of the Work. Except as otherwise noted in the Contract Documents, the Contractor will provide and pay for all labor, materials, equipment, permits, fees, licenses, facilities and services necessary for the proper execution and timely completion of the Work in accordance with the Contract Documents.
- 8.6 Construction Reports. The Contractor must submit daily construction reports detailing the daily progress of the Work to the Construction Manager on a weekly basis.
- 8.7 Subcontracting.
- 8.7.1 By executing the Agreement, the Contractor certifies that no subcontractor included on the list of proposed subcontractors submitted with the

Contractor's bid is ineligible to perform work on public works projects pursuant to California Labor Code Sections 1777.1 or 1777.7. In accordance with California Public Contract Code Section 6109(a), subcontractors who are ineligible to perform work on public works projects pursuant to California Labor Code Sections 1777.1 or 1777.7 may neither bid on, be awarded or perform as a subcontractor on the Work. In accordance with California Public Contract Code Section 6109(b), any contract on a public works project entered into between a contractor and a debarred subcontractor is void as a matter of law. The Contractor will ensure that no debarred subcontractor receives any public money for performing the Work, and any public money that may have been paid to a debarred subcontractor for the Work is returned to the District. The Contractor will be responsible for payment of wages to workers of a debarred subcontractor who has been allowed to perform the Work.

- 8.7.2 The Agreement and the performance of the Work are subject to the requirements of the Subletting and Subcontracting Fair Practices Act codified at California Public Contract Code Section 4100 and following. If the Contractor fails to specify a subcontractor or specifies more than one subcontractor for the same portion of the Work in excess of one-half of 1 percent of the Contractor's total bid, the Contractor agrees that the Contractor is fully qualified to perform that portion of the Work with the Contractor's own forces, and that the Contractor will perform that portion of the Work with the Contractor's own forces. If after award of the Agreement the Contractor subcontracts, except as provided for in California Public Contract Code Sections 4107 or 4109, any such portion of the Work, the Contractor will be subject to the penalties set forth in California Public Contract Code Sections 4110 and 4111, including cancellation of the Agreement, assessment of a penalty of up to 10 percent of the amount of the subcontract, and disciplinary action by the Contractors State License Board.
- 8.7.3 No contractual relationship exists between the District and any subcontractor engaged in performance of the work.
- 8.7.4 Incorporation of Contract Documents. The Contractor must incorporate the Contract Documents in each contract with a subcontractor engaged in the performance of the Work. The Contractor shall be solely responsible for any delay or additional costs incurred as a result of its failure to provide adequate or accurate project information to a subcontractor that results in improper submittals and/or work, or time or other impacts is the sole responsibility of the Contractor. The Contractor will have all of the obligations and the District will have all of the remedies that are specified in Section 11.

- 8.7.5 Coordination of Subcontract Work: The Contractor is responsible for scheduling the Work of subcontractors so as to avoid delay or injury to either Work or materials.

8.8 Insurance.

- 8.8.1 All required insurance shall be provided in the form of "occurrence"-type policies underwritten by admitted insurers in the State of California with a rating of A or better from the current year Best Rating Guide. All policies must be issued at the expense of the Contractor and must be maintained at the Contractor's expense throughout the performance of the Work.

- 8.8.2 The Contractor and any subcontractors engaged in performance of the Work must secure payment of workers compensation in accordance with California Labor Code Section 3700 and other applicable law. The Contractor must verify that all Subcontractors comply with this requirement.

- 8.8.3 Within ten (10) working days following notice of award the Contractor must submit to the District along with executed copies of all other documents specified in the Contract Check List certificates of insurance and endorsements evidencing that the Contractor has in effect and will maintain throughout the performance of the Work the following kinds and amounts of insurance:

- 8.8.3.1 Worker's Compensation Insurance. Workers Compensation and Employers Liability insurance as required by any applicable law, regulation or statute, including the provisions of Division IV of the Labor Code of the State of California, and any act or acts amending it. Such insurance must cover the full liability of the Contractor. The Contractor's Employer's Liability Insurance must be in an amount no less than \$1,000,000.00 per claim.

- 8.8.3.2 Commercial General Liability and Automobile Liability Insurance. Coverage for liability because of Bodily Injury and property Damage including, but not limited to the following coverage:

Completed Operations and Products Liability
Bodily Injury
Personal Injury
Broad Form Property Damage Liability
Contractual Liability insuring the obligations assumed
by the Contractor under the Contract Documents
Automobile Liability, including owned, non-owned and
hired automobiles

Coverage for the XCU hazards of Explosion, Collapse
and Underground

8.8.3.3 Commercial Umbrella Policy. The Commercial policy is to insure losses above General liability, Employers liability, and auto liability limits.

8.8.3.4 Not Used (Builder's Risk)

8.8.4 The insurance furnished by the Contractor must be primary in the amount of any loss.

8.8.5 The limits of the insurance required above will be at least:

Comprehensive General Liability

Bodily Injury Liability	\$2,000,000	each occurrence
	\$1,000,000	each aggregate
Property Damage Liability	\$2,000,000	each occurrence
	\$1,000,000	each aggregate

Comprehensive Automobile Liability

Bodily Injury Liability	\$1,000,000	each person
	\$1,000,000	each occurrence
Property Damage Liability	\$1,000,000	each occurrence

Commercial Umbrella Policy \$1,000,000

Builders Risk issued for the value of the Contract Price:

8.8.6 For each insurance policy required under the Agreement except for the required workers compensation insurance policy, the Contractor must provide endorsements that add the Sausalito-Marin City Sanitary District as an additional insured. For any work performed within the City of Sausalito the Contractor must provide endorsements that add City of Sausalito as an additional insured. Such endorsements must: provide that the insurance required to be furnished by the Contractor will be primary as regards the District, and that the District's insurance will be excess of and not contribute to the insurance required to be furnished by the Contractor; that the District will receive 30 day written notice of any reduction or cancellation of such insurance required to be furnished by the Contractor; and include a severability of interest clause acceptable to the District. Said

Sausalito-Marin City Sanitary District
General Conditions

endorsement shall be at least as broad as Insurance Services Office form number CG2010 (Ed. 11/85).

8.9 Indemnities.

- 8.9.1 The Contractor will take all responsibility for the Work, and will bear all losses and damages directly or indirectly resulting to the Contractor, any subcontractors engaged in performance of the Work, the District, its officials, officers, employees, agents, volunteers and consultants, and to third parties on account of the performance or character of the Work, unforeseen difficulties, accidents, or occurrences of other causes predicated on active or passive negligence of the Contractor or of any subcontractor engaged in performance of the Work. To the fullest extent permitted by law the Contractor will indemnify, defend and hold harmless the District, its officials, officers, employees, agents, volunteers and consultants from and against any or all loss, liability, expense, claims, costs (including costs of defense), suits, and damages of every kind, nature and description (including, but not limited to, penalties resulting from exposure to hazards in violation of the California Labor Code) directly or indirectly arising from the performance of the Work ("Claims").
- 8.9.2 The Contractor will indemnify, defend and hold harmless the District, the District's officials, officers, employees, volunteers, agents and the Construction Manager and Engineer for all liability on account of any patent rights, copyrights, trade names or other intellectual property rights that may apply to the Contractor's performance of the Work. The Contractor will pay all royalties or other charges as a result of intellectual property rights that may apply to methods, types of construction, processes, materials, or equipment used in the performance of the Work, and will furnish written assurance satisfactory to the District that any such charges have been paid.
- 8.9.3 The Contractor assumes all liability for any accident or accidents resulting to any person or property as a result of inadequate protective devices for the prevention of accidents in connection with the performance of the Work. The Contractor will indemnify, defend, and hold harmless the District and its officials, officers, employees, agents, volunteers and consultants from such liability.
- 8.9.4 Approval of the Contractor's certificates of insurance and/or endorsements does not relieve the Contractor of liability under this Section 8.9. The Contractor will defend, with legal counsel reasonably acceptable to the District, any action or actions filed in connection with any Claims and will pay all related costs and expenses, including attorney's fees incurred. The Contractor will promptly pay any judgment rendered against the District, its officials, officers, employees, agents, volunteers or consultants for any

Claims. In the event the District, its officials, officers, employees, agents, volunteers or consultants is made a party to any action or proceeding filed or prosecuted against Contractor for any Claims, Contractor agrees to pay the District, its officials, officers, employees, agents, volunteers and consultants any and all costs and expenses incurred in such action or proceeding, including but not limited to, reasonable attorneys' fees.

8.9.5 In accordance with California Civil Code Section 2782(a), nothing in the Agreement will be construed to indemnify the District for its sole negligence, willful misconduct, or for defects in design furnished by District. In accordance with California Civil Code Section 2782(b), nothing in the Agreement will be construed to impose on the Contractor or to relieve the District from liability for the District's active negligence. By execution of the Contract Documents the Contractor acknowledges and agrees that the Contractor has read and understands the insurance and other requirements of Agreement, and this Section 8.9, which is a material element of consideration.

8.10 Licenses/Permits. The Contractor must obtain all licenses, permits and other approvals required for the performance of the Work. District will obtain the conditional Caltrans Encroachment Permit. Contractor will be required to submit insurance, bonds, Traffic Control Plans and SWPPP to Caltrans. Permit fees will be paid by the District. All other work shall be performed without additional expense to the District.

8.11 California Labor Code Requirements.

8.11.1 In accordance with California Labor Code Section 1810, eight (8) hours of labor in performance of the Work shall constitute a legal day's work under the Agreement.

8.11.2 In accordance with California Labor Code Section 1811, the time of service of any worker employed in performance of the Work is limited to eight hours during any one calendar day, and forty hours during any one calendar week, except in accordance with California Labor Code Section 1815, which provides that work in excess of eight hours during any one calendar day and forty hours during any one calendar week is permitted upon compensation for all hours worked in excess of eight hours during any one calendar day and forty hours during any one calendar week at not less than one-and-one-half times the basic rate of pay.

8.11.3 The Contractor and its subcontractors will forfeit as a penalty to the District \$25 for each worker employed in the performance of the Work for each calendar day during which the worker is required or permitted to work more than eight (8) hours in any one calendar day, or more than forty (40) hours

in any one calendar week, in violation of the provisions of California Labor Code Section 1810 et seq.

8.11.4 In accordance with California Labor Code Section 1773.2, the District has determined the general prevailing wages in the locality in which the Work is to be performed for each craft or type of work needed to be as published by the State of California Department of Industrial Relations, Division of Labor Statistics and Research, a copy of which is on file in the District and shall be made available on request. The Contractor and subcontractors engaged in the performance of the Work shall pay no less than these rates to all persons engaged in performance of the Work.

8.11.5 In accordance with California Labor Code Section 1775, the Contractor and any subcontractors engaged in performance of the Work must comply Labor Code Section 1775 which establishes a penalty of up to \$50 per day for each worker engaged in the performance of the Work that the Contractor or any subcontractor pays less than the specified prevailing wage. The amount of such penalty shall be determined by the Labor Commissioner. The Contractor or subcontractor shall pay the difference between the prevailing wage rates and the amount paid to each worker for each calendar day or portion thereof for which each worker was paid less than the prevailing wage rate. If a subcontractor worker engaged in performance of the Work is not paid the general prevailing per diem wages by the subcontractor, the Contractor is not liable for any penalties therefore unless the Contractor had knowledge of that failure or unless the Contractor fails to comply with all of the following requirements:

8.11.5.1 The contract executed between the Contractor and the subcontractor for the performance of part of the Work must include a copy of the provisions of California Labor Code Sections 1771, 1775, 1776, 1777.5, 1813, and 1815.

8.11.5.2 The Contractor must monitor payment of the specified general prevailing rate of per diem wages by the subcontractor by periodic review of the subcontractor's certified payroll records.

8.11.5.3 Upon becoming aware of a subcontractor's failure to pay the specified prevailing rate of wages, the Contractor must diligently take corrective action to halt or rectify the failure, including, but not limited to, retaining sufficient funds due the subcontractor for performance of the Work.

8.11.5.4 Prior to making final payment to the subcontractor, the Contractor must obtain an affidavit signed under penalty of perjury from the subcontractor that the subcontractor has paid the specified general prevailing rate of per diem wages employees engaged in

the performance of the Work and any amounts due pursuant to California Labor Code Section 1813.

- 8.11.6 In accordance with California Labor Code Section 1776, the Contractor and each subcontractor engaged in performance of the Work, must keep accurate payroll records showing the name, address, social security number, work classification, straight time and overtime hours worked each day and week, and the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed in performance of the Work. Each payroll record must contain or be verified by a written declaration that it is made under penalty of perjury, stating that the information contained in the payroll record is true and correct and that the employer has complied with the requirements of Sections 1771, 1811, and 1815 for any work performed by the employer's employees on the public works project. The payroll records required pursuant to California Labor Code Section 1776 must be certified and must be available for inspection by the District and its authorized representatives, the Division of Labor Standards Enforcement, and the Division of Apprenticeship Standards of the Department of Industrial Relations and must otherwise be available for inspection in accordance with California Labor Code Section 1776.
- 8.11.7 In accordance with California Labor Code Section 1777.5, the Contractor, on behalf of the Contractor and any subcontractors engaged in performance of the Work, will be responsible for ensuring compliance with California Labor Code Section 1777.5 governing employment and payment of apprentices on public works contracts.
- 8.11.8 In case it becomes necessary for the Contractor or any subcontractor engaged in performance of the Work to employ on the Work any person in a trade or occupation (except executive, supervisory, administrative, clerical, or other non manual workers as such) for which no minimum wage rate has been determined by the Director of the Department of Industrial Relations, the Contractor must pay the minimum rate of wages specified therein for the classification which most nearly corresponds to Work to be performed by that person. The minimum rate thus furnished will be applicable as a minimum for such trade or occupation from the time of the initial employment of the person affected and during the continuance of such employment.
- 8.11.9 In accordance with California Labor Code Section 1720.9, "ready-mixed concrete" drivers are considered subcontractors. The Contractor, on behalf of the Contractor and any subcontractors engaged in performance of the Work, will be responsible for ensuring compliance with California Labor Code Section 1720.9 Department of Industrial Relations registration and collecting certified payroll.

- 8.12 Laws and Ordinances. The Contractor and all subcontractors engaged in the performance of the Work must conform to the following specific rules and regulations as well as all other laws, ordinances, rules and regulations that apply to the Work. Nothing in the Technical Specifications or Project Plans is to be construed to permit Work not conforming to these codes:

National Electrical Safety Code, U. S. Department of Commerce
National Board of Fire Underwriters' Regulations
California Building Standards Code as adopted by the District
Manual of Accident Prevention in Construction, latest edition, published by
A.G.C. of America
Industrial Accident Commission's Safety Orders, State of California
Regulations of the State Fire Marshall (Title 19, California Code of Regulation)
and Applicable Local Fire Safety Codes
Labor Code of the State of California - Division 2, Part 7, Public Works and Public
Agencies.

- 8.13 Guaranty. The Contractor guarantees all of the Work for one year from the date the District accepts the Work. Upon receiving written notice of a need for repairs which are directly attributable to defective materials or workmanship the Contractor must make good any defects arising or discovered in any part of the Work by diligently commencing the necessary repairs within seven (7) days from the date of notice from the District. If the Contractor fails to make good any defects in the Work in accordance with this provision, in addition to any other available remedy under the contract or at law or equity, the District may make good or have made good such defects in the Work and deduct the cost from amounts that may be due or become due the Contractor, and/or call on the Contractor's maintenance bond for the cost of making good such defects and for the District's reasonable legal costs, if any, of recovering against the bond. The Contractor shall remain responsible for repairing any Work found to be defective regardless of when such defect is discovered by the District.

- 8.14 Safety.

8.14.1 In accordance with generally accepted construction practices and applicable law, the Contractor will be solely and completely responsible for conditions of the Work site, including safety of all persons and property during performance of the Work. This requirement will apply continuously and not be limited to normal working hours. For purposes of California Labor Code Section 6400 and related provisions of law the Contractor and the Contractor's privities and any other entities engaged in the performance of the Work will be "employers" responsible for furnishing employment and a place of employment that is safe and healthful for the employees, if any, of such entities engaged in the performance of the Work. Neither the

District nor its officials, officers, employees, agents, volunteers or consultants will be “employers” pursuant to California Labor Code Section 6400 and related provisions of law with respect to the Contractor, the Contractor’s privities or other entities engaged in the performance of the Work.

- 8.14.2 Review and observation by the District, the Construction Manager, the Architect or Engineer, and/or other representatives of the District of the Contractor's performance of the Work will not constitute review of the adequacy of the Contractor's safety measures in, on, or near the Work site. Such reviews and observations do not relieve the Contractor of any of the Contractor’s obligations under the Contract Documents and applicable law to ensure that the Work site is maintained and the Work is performed in a safe manner.
- 8.14.3 The Contractor will be solely responsible for the implementation and maintenance of safety programs to ensure that the Work site is maintained and the Work is performed in a safe manner in accordance with the Contract Documents and applicable law.
- 8.14.4 Within ten (10) working days following notice of award the Contractor must submit to the District a copy of the Contractor’s Safety Plan.
- 8.14.5 The Contractor must furnish and place proper guards and systems for the prevention of accidents, including, but not limited to, those systems required pursuant to Title 8, Section 1670 and following of the California Code of Regulations concerning safety belts and nets. The Contractor must provide and maintain any other necessary systems or devices required to secure safety of life or property at the Work site in accordance with accepted standards of the industry and applicable law. The Contractor must maintain during all night hours sufficient lights to prevent accident or damage to life or property.
- 8.14.6 The Contractor is responsible for the prevention of accidents on work under its direction and for complying with Federal, State, and local safety requirements, including District’s “Contractor Safety Handbook” guidelines. The District’s “Contractor Safety Handbook” is available for Contractor review at the office of the Owner. The Contractor shall execute the acknowledgement form within the District’s Contractor Safety Handbook prior to receiving the Notice to Proceed.

8.14.7 CONFINED SPACE PROCEDURES

The District has adopted its own safety program for confined space entry, which is consistent with General Industrial Safety Order (GISO) Section 5157. While working on this project, the Contractor

and all subcontractors shall comply with the District's Safety Manual confined space entry procedures for all permit space entries.

8.14.8 HAZARDOUS MATERIALS EXPOSURE

The Contractor shall so perform its work as not to expose personnel to, or to discharge into the atmosphere from any source whatever, smoke, dust, asbestos, toxic chemicals, or other air contaminants in violation of the laws, rules, and regulations of the governmental entities having jurisdiction. Contractor or subcontractors removing 100 or more square feet of asbestos must be "Certified" in accordance with state law. All work involving exposure to asbestos and all other hazardous materials shall be performed with protection of personnel in compliance with all applicable regulations and safety requirements.

8.14.9 SPECIFIC SAFETY REQUIREMENTS

The Contractor shall:

1. Notify its employees, vendors and subcontractors of the job safety requirements.
2. Ensure that its employees, vendors, and subcontractors have the safety training and equipment appropriate for the job.
3. Provide its employees, vendors, and subcontractors with the appropriate MSDS sheets and instructions required for the job.
4. All of the above shall be in accordance with the Contractor's Safety program.

8.14.10 SUBMITTALS

Before work is started, the Contractor shall submit his/her safety program and those of all listed subcontractors. Each element shall include requirements for personal protective equipment and training.

8.14.11 SCAFFOLDING, SHORING AND BRACING

The Contractor shall furnish and maintain all scaffolding, shoring and bracing required in the prosecution of the work of building construction and trenching. All such auxiliary construction shall be made and maintained in accordance with any and all statutes, laws, ordinances, rules or regulations of the State of California or other authorities or insurance companies having jurisdiction there over.

The Contractor's attention is called to Section 6700 and following of the Labor Code, which is the section covering trench safety, which is included as a part of this Contract.

The Contractor shall submit to the District specific plans to show details of provision for scaffolding, rigging and fall protection. This in no way relieves the Contractor from the requirement of maintaining safety in all operations performed by him or his subcontractors. The detailed plan showing design of bracing, sloping or other provisions shall be prepared by a registered Civil or Structural Engineer as required. Acceptance by the District or its designated agent only constitutes acknowledgment of the submission and does not constitute review or approval of the design, design assumptions, or criteria, completeness of submissions, applicability to areas of intended use, nor implementation of the plans, which are solely the responsibility of the Contractor and his registered engineer.

In accordance with Section 6705 of the Labor Code, the Contractor shall submit to the District specific plans to show details of provision for worker protection from caving ground. This in no way relieves the Contractor from the requirement of maintaining safety in all operations performed by him or his subcontractors. The detailed plan showing design of shoring, bracing, sloping or other provisions shall be prepared by a registered Civil or Structural Engineer as required. Acceptance by the District or its designated agent only constitutes acknowledgment of the submission and does not constitute review or approval of the design, design assumptions, or criteria, completeness of submissions, applicability to areas of intended use, nor implementation of the plans, which are solely the responsibility of the Contractor and his registered engineer.

- 8.15 Assignment of Unfair Business Practice Claims. In accordance with California Public Contract Code Section 7103.5, the Contractor and any subcontractors offer and agree to assign to the District all rights, title, and interest in and to all causes of action the Contractor or any subcontractors may have under Section 4 of the Clayton Act (15 U.S.C. § 15) or under the Cartwright Act (Chapter 2 (commencing with § 16700) of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, services or materials pursuant to this contract. This assignment shall be made and become effective at the time the District tenders final payment to the Contractor, without further acknowledgement by the parties.

9. MEASUREMENT AND PAYMENT

- 9.1 F.O.B. All shipments must be F.O.B. destination to the Work site and/or other sites indicated in the Contract Documents. The Contract Price is all-inclusive (including

sales tax). There shall be no additional compensation paid for containers, packing, unpacking, drayage or insurance.

9.2 Payment

- 9.2.1 On or about the first day of each calendar month the Contractor will submit to the Construction Manager a verified application for payment and schedule of values supported by a statement showing all materials actually installed during the preceding month and the cost of labor actually expended in the performance of the Work. Unless otherwise provided in the Contract Documents, no allowances or payments will be made for material or equipment not placed at the Work site.
- 9.2.2 To be eligible for payment the Contractor's applications for payment must include certified payroll reports prepared in accordance with California Labor Code Section 1776 and the Agreement for each employee of the Contractor and any subcontractors engaged in the performance of the Work during the preceding months, applications for payment will not be processed without certified payroll reports.
- 9.2.3 In accordance with California Public Contract Code Section 20104.50, the District will review applications for payment as soon as practicable after receipt. Any application or part of an application that is determined to be improper will be returned to the Contractor as soon as practicable, but no later than seven (7) days after receipt by the District, along with a written description of the reasons why the application is improper. The Contractor's failure to submit a schedule in the time specified in Section 3.8, or its submission of a schedule to which the District has taken any uncorrected exception, shall serve as a basis for returning an application for payment in its entirety.
- 9.2.4 Unless the Contractor has elected to post securities in lieu of retention in accordance with California Public Contract Code Section 22300 and the Agreement, and the Contractor and the District have executed an escrow agreement in accordance with the Public Contract Code and the Agreement, the District will make progress payments to the Contractor in accordance with applicable law in the amount of ninety (90) percent of the value of the labor actually performed and the material incorporated in the Work as specified in Contractor's verified application for payment upon approval by the District's authorized representative(s). Payment of progress payments will not be construed as acceptance of the Work performed. If the Contractor has elected to post securities in lieu of retention in accordance with Public Contract Code Section 22300 and the Agreement and the Contractor and the District have executed an escrow agreement in accordance with the Public Contract Code and the

Agreement, the District will make payments to the Contractor or the Contractor's escrow agent in accordance with such escrow agreement.

9.2.5 The District will pay the Contractor's final invoice in accordance with applicable law and this Section 9 following acceptance of the Work provided that:

9.2.5.1 The Contractor has furnished evidence satisfactory to the District that all claims for labor and material have been paid, or the time for filing valid stop notices has passed and no stop notices have been filed, or all stop notices filed have been released by valid release or release bond acceptable to the District.

9.2.5.2 No claim has been presented to the District by any person based upon any acts or omissions of the Contractor or any subcontractor engaged in the performance of the Work.

9.2.5.3 No other claim or dispute exists under the Agreement or applicable law concerning payment of the Contractor's final invoice and/or release of the Agreement retention.

9.2.5.4 The Contractor has filed with the District the Maintenance Bond provided in the Contract Documents with duly notarized signatures of an authorized representative of the Contractor and an attorney-in-fact of an admitted surety insurer acceptable to the District and such Maintenance Bond binds the Contractor as Principal and the Surety in accordance with its terms in the amount of 10% of the final Contract Price.

9.2.5.5 The Contractor's application for final payment contains a written waiver of all claims against the District of which the Contractor may not yet asserted at the time of the submission of the application for final payment.

9.2.6 In accordance with California Public Contract Code Section 20104.50, if the District fails to make a progress payment within thirty (30) days of receipt of an undisputed, properly submitted application for payment, the District will pay the Contractor interest equivalent to the legal rate set forth in subdivision (a) of California Code of Civil Procedure Section 685.010. The number of days available to the District to make a payment without incurring an interest obligation pursuant to this provision and California Public Contract Code Section 20104.50 will be reduced by the number of days, if any, by which the District has delayed return of an application for payment beyond the seven day return requirement set forth in Section 9.2.5.

9.3 Non-Allowable Direct Charges. The following costs are not allowable direct charges under the Agreement. The following costs may only be paid under the Agreement, if at all, as part of any allowance for contractor overhead and/or profit established under the Agreement.

9.3.1 Labor costs in excess of applicable prevailing wages pursuant to the Agreement and applicable law, liability and workers compensation insurance, social security, retirement and unemployment insurance and other employee compensation and benefits pursuant to bona fide compensation plans in effect at the time specified for the opening of Project bids for contractor and subcontractor employees engaged in the performance of the Work. However, in no event will allowable direct labor charges under the agreement include employee bonuses, employee vehicles or vehicle allowances, employee telephones or telephone allowances, or employee housing or housing allowances, whether or not such benefits are part of a bona fide compensation plan in effect at the time specified for the opening of Project bids.

9.3.2 Superintendent labor and clerical labor.

9.3.3 Bond premiums

9.3.4 Insurance in excess of that required under Section 8.8

9.3.5 Utility costs

9.3.6 Work Site office expenses

9.3.7 Home office expenses.

9.4 Retention. The District or its agent may, in accordance with the Contract Documents and applicable law, withhold any payment of monies due or that may become due the Contractor because of:

9.4.1 Defective work not remedied or uncompleted work.

9.4.2 Claims filed or reasonable evidence indicating probable filing of claims.

9.4.3 Failure to properly pay subcontractors or to pay for material or labor.

9.4.4 Reasonable doubt that the Work can be completed for the balance then unpaid.

9.4.5 Damage to another contractor.

- 9.4.6 Damage to the District.
- 9.4.7 Damage to a third party.
- 9.4.8 Delay in the progress of the Work, which, in the District's judgment, is due to the failure of the Contractor to properly expedite the Work.
- 9.4.9 Liquidated damages or other charges that apply to the Contractor under the Agreement.
- 9.4.10 Any other lawful basis for withholding payment under the contract.
- 9.5 Securities in Lieu of Retention.
 - 9.5.1 In accordance with Public Contract Code Section 22300, except where federal regulations or policies do not permit substitution of securities, the Contractor may substitute securities for any moneys withheld by the District to ensure performance of the Work. At the Contractor's request and expense, securities equivalent to the amount withheld will be deposited with the District, or with a state or federally chartered bank in California as the escrow agent, who will then pay those moneys to the Contractor under the terms of an Escrow for Security Deposit agreement. The Escrow for Security Deposit agreement is provided in the Contract Documents. Upon satisfactory completion of the Work, the securities will be returned to the Contractor.
 - 9.5.2 Alternatively, at the Contractor's request and expense, the District will pay retentions earned directly to the escrow agent. At the Contractor's expense, the Contractor may direct investment of the payments into securities. Upon satisfactory completion of the Work, the Contractor will receive from the escrow agent all securities, interest, and payments received by the escrow agent from the District pursuant to this provision and the terms of the Escrow for Security Deposit agreement. The Contractor will, within 20 days of receipt of payment, pay to each subcontractor the respective amount of interest earned, less costs of retention withheld from each Subcontractor, on monies withheld to ensure the Contractor's performance of the Work.
 - 9.5.3 Securities eligible for investment in accordance with this provision include those listed in Government Code Section 16430, 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 the Contractor and the District.

- 9.5.4 The Contractor will be the beneficial owner of any securities substituted for moneys withheld and will receive any interest thereon.

10. PROJECT ACCEPTANCE AND CLOSEOUT

- 10.1 Occupancy. The District reserves the right to occupy or use any part or parts or the entire of the Work before the Work is fully performed. Subject to applicable law, exercising this right will in no way constitute acceptance of any part of the Work so occupied or used or acceptance of the entire Work, nor will such occupancy or use in any way affect the times when payments will become due the Contractor, nor will such occupancy or use in any way prejudice the District's rights under the Agreement, any Agreement bonds, or at law or equity. Occupancy or use shall not waive the District's rights to assess liquidated damages in accordance with Section 7 after the date of such occupancy or use.
- 10.2 Work Completion and Final Inspection. When the Contractor considers the Work is completed, the Contractor will submit written certification to the Construction Manager specifying that: the Contract Documents have been reviewed; the Work has been inspected for compliance with the Contract Documents; the Work has been completed in accordance with the Contract Documents; and that equipment and systems have been tested in the presence of the District's representative and are operational. The District and/or the District's authorized representatives will make an inspection to verify that the Work is complete and will notify the Contractor in writing of any incomplete or deficient Work. The Contractor will take immediate steps to remedy the stated deficiencies and give notice of correction to the Construction Manager. Upon receiving a notice of correction, the District or the District's authorized representatives will re-inspect the Work. The Contractor must correct all punch list items within 15 working days after the issuance of the punch list. Before acceptance of the Work the Contractor must submit: one set of reproducible mylars of the Project Record Drawings (As-Built), and any equipment operating and maintenance instructions and data, warranties.
- 10.3 Work Acceptance.
- 10.3.1 All finished Work will be subject to inspection and acceptance or rejection by the District, the Construction Manager, and the Architect or Engineer and other government agencies having jurisdiction over the Work. Final acceptance of the Work will be at the discretion of the District.
- 10.3.2 The District will accept the Work in writing only when the Work has been completed to the District's reasonable satisfaction. Progress payments will in no way be construed as acceptance of any part of the Work.
- 10.3.3 In evaluating the Work, no allowance will be made for deviations from the Technical Specifications, Project Plans or other Contract Documents

unless already approved in writing in accordance with the requirements of Section 4, above.

- 10.3.4 The fact that the Work and materials have been observed from time to time and that progress payments have been made does not relieve the Contractor of the responsibility of replacing and making good any defective or omitted work or materials in accordance with the requirements of the Contract Documents.

11. REMEDIES AND DISPUTES

- 11.1 Failure to Correct Work. Within ten (10) working days of receiving written notice from the District describing Work that is defective or that is otherwise not in accordance with the requirements of the Agreement and/or applicable law and directing that such Work be corrected, the Contractor and/or the Contractor's sureties must give the District written notice of the intent of the Contractor and/or the Contractor's sureties to correct such Work and commence correction of such Work in accordance with the District's notice and the Agreement. If the Contractor and/or the Contractor's sureties do not give the District written notice of intent to correct such Work and commence correction of such Work within ten (10) working days of receipt of the District's notice, then the District may correct such work and/or have such work corrected for the account and at the expense of the Contractor and/or its sureties, and the Contractor and/or its sureties will be liable to the District for any resulting excess cost. The District may, in addition to all other remedies that the District may have under the Agreement and at law or equity, deduct any such excess cost of completing the Work from amounts that are due or that may become due the contractor.

11.2 Termination.

- 11.2.1 In accordance with California Public Contract Code Section 7105, in addition to all other available remedies that the District may have under the Agreement, and at law or equity, the District may terminate the Contractor's control of the Work:

- 11.2.1.1 If the Contractor or any of its subcontractors engaged in the performance of the Work fails to timely perform the Work and/or any of the Contractor's material obligations under the Contract Documents, including but not limited to submission of an acceptable schedule, that have accrued except for due to reasons beyond the control of the Contractor pursuant to the Contract Documents.

- 11.2.1.2 If the Contractor is adjudged bankrupt, or if it should make a general assignment for the benefit of creditors, or if a receiver should be appointed on account of its creditors.
 - 11.2.1.3 If the Contractor or any of the subcontractors engaged in the performance of the Work persistently or repeatedly refuses or fails to supply enough properly skilled workmen or proper materials for the timely completion of the Work.
 - 11.2.1.4 If the Contractor fails to make prompt payment to subcontractors engaged in the performance of the Work or for material or labor used in the performance of the Work in accordance with the Contract Documents and applicable law.
 - 11.2.1.5 If the Contractor or any subcontractors engaged in the performance of the Work persistently disregards laws or ordinances applicable to the performance of the Work, or the instructions of the District, the Construction Manager, the Architect, or other authorized representatives of the District.
 - 11.2.1.6 For any reason or for no reason, at the District's sole discretion.
- 11.2.2 If the District intends to terminate the Contractor's control of the Work for any of the reasons specified in Sections 11.2.1.1 through 11.2.1.5, above, the District will immediately serve written notice to the Contractor and its sureties in accordance with the Contract Documents. Notice of the District's intent to terminate the Contractor's control of the Work will be given by registered or certified mail and specify the grounds for termination, the required cure and the time by which the cure must be effected. Upon receipt of notice of the District's intent to terminate the Contractor's control of the Work for any of the reasons specified in provisions 11.2.1.1 through 11.2.1.5, above, the Contractor will have ten (10) days from receipt of the notice or a longer time specified in the notice to cure its default. If the Contractor does not affect the required cure by the time specified in the notice, the District will issue a written notice of termination to the Contractor and its sureties by registered or certified mail. The notice of termination will specify: that upon receipt of the notice the Contractor's right to perform or complete the Work, including on behalf of the Contractor's sureties, is terminated; that the Contractor's sureties will have the right to take over and complete the Work and perform all of the Contractor's remaining obligations that have accrued under the Agreement; and that if the Contractor's sureties do not both give the District written notice of their intention to take over and perform the Agreement and commence completion of the Work and performance of all of the Contractor's remaining obligations that have accrued under the Agreement within ten (10) days after receipt of notice of termination

that the District may declare the Contractor's sureties in default and take over the completion of the Work or have the Work completed for the account and at the expense of the Contractor and its sureties, and the Contractor and its sureties will be liable to the District for any resulting excess cost. The District may, in addition to all other available remedies that the District may have under the Contract Documents and at law or equity, deduct any such excess cost of completing the Work from amounts that are due or that may become due the Contractor.

- 11.2.3 Upon termination of the Contractor's control of the Work for any of the reasons specified in Sections 11.2.1.1 - 11.2.1.5, the Contractor will, if so directed by the District, immediately remove from the Work site any and all materials and personal property belonging to the Contractor which have not been incorporated in the Work and the Contractor and its sureties will be liable upon their bond for all damages caused the District by reason of the Contractor's failure to complete the Work.
- 11.2.4 Upon termination of the Contractor's control of the Work for any of the reasons specified in provisions 11.2.1.1 through 11.2.1.5, above, the District reserves the right to refuse tender of the Contractor by any surety to complete the Work.
- 11.2.5 If the District completes or has completed any portion of, or the whole of the Work, following termination of the Contractor's control of the Work for any of the reasons specified in Sections 11.2.1.1 through 11.2.1.5, above, the District will neither be liable for nor account to the Contractor or the Contractor's sureties in any way for the time within which, or the manner in which such Work is performed, or for any changes made in such Work or for the money expended in satisfying claims and/or suits and/or other obligations in connection with completing the Work. If, following termination of the Contractor's control of the Work for any of the reasons specified in Sections 11.2.1.1 through 11.2.1.5, above, the unpaid balance of the Contract Price exceeds the expense of completing the Work, including compensation for additional legal, managerial and administrative services and all other amounts due for the completion of the Work and/or satisfaction of claims of the District and/or others arising out of the Agreement and any other charges that apply to the Contractor under the Agreement, the difference will be paid to the Contractor. If such expenses of completing the Work exceed the unpaid balance of the Contract Price, the Contractor or its sureties will pay the difference to the District.
- 11.2.6 If the Agreement or Contractor's control of the Work is terminated for any reason, no allowances or compensation will be granted for the loss of any anticipated profit by the Contractor.

- 11.2.7 In accordance with California Government Code Section 4410, in the event a national emergency occurs, and public work being performed by contract is stopped, directly or indirectly, because of the freezing or diversion of materials, equipment or labor, as the result of an order or a proclamation of the President of the United States, or of an order of any federal authority, and the circumstances or conditions are such that it is impracticable within a reasonable time to proceed with a substantial portion of the work, then the District and the Contractor may, by written agreement, terminate the Agreement. In accordance with California Government Code Section 4411, such an agreement will include the terms and conditions of the termination of the contract and provision for the payment of compensation or money, if any, which either party will pay to the other or any other person, under the facts and circumstances in the case. Compensation to the Contractor will be determined on the basis of the reasonable value of the work done, including preparatory work. As an exception to the foregoing, in the case of any fully completed separate item or portion of the Work for which there is a separate contract price, the contract price shall control. The parties may in any other case adopt the contract price as the reasonable value of the work or any portion of the work done.

11.3 Disputes.

- 11.3.1 In accordance with California Public Contract Code Section 20104.2, the following procedures apply to claims of \$375,000 or less between the Contractor and the District:

11.3.1.1 The claim shall be in writing and include the documents necessary to substantiate the claim. Claims must be filed on or before the date of final payment. Nothing in this subdivision is intended to extend the time limit or supersede notice requirements otherwise provided by contract for the filing of claims.

11.3.1.2 For claims of less than fifty thousand dollars (\$50,000), the District shall respond in writing to any written claim within 45 days of receipt of the claim, or may request, in writing, within 30 days of receipt of the claim, any additional documentation supporting the claim or relating to defenses to the claim the District may have against the Contractor.

11.3.1.2.1 If additional information is thereafter required, it shall be requested and provided pursuant to this subdivision, upon mutual agreement of the District and the Contractor.

- 11.3.1.2.2 The District's written response to the claim, as further documented, shall be submitted to the Contractor within 15 days after receipt of the further documentation or within a period of time no greater than that taken by the Contractor in producing the additional information, whichever is greater.
- 11.3.1.3 For claims of over fifty thousand dollars (\$50,000) and less than or equal to three hundred seventy-five thousand dollars (\$375,000), the District shall respond in writing to all written claims within 60 days of receipt of the claim, or may request, in writing, within 30 days of receipt of the claim, any additional documentation supporting the claim or relating to defenses to the claim the District may have against the Contractor.
 - 11.3.1.3.1 If additional information is thereafter required, it shall be requested and provided pursuant to this subdivision, upon mutual agreement of the District and the Contractor.
 - 11.3.1.3.2 The District's written response to the claim, as further documented, shall be submitted to the Contractor within 30 days after receipt of the further documentation, or within a period of time no greater than that taken by the Contractor in producing the additional information or requested documentation, whichever is greater.
- 11.3.1.4 If the Contractor disputes the District's written response, or the District fails to respond within the time prescribed, the Contractor may so notify the District, in writing, either within 15 days of receipt of the District's response or within 15 days of the District's failure to respond within the time prescribed, respectively, and demand an informal conference to meet and confer for settlement of the issues in dispute. Upon a demand, the District shall schedule a meet and confer conference within 30 days for settlement of the dispute.
- 11.3.1.5 Following the meet and confer conference, if the claim or any portion remains in dispute, the Contractor 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 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 the Contractor submits

his or her written claim pursuant to subdivision (a) 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.

11.3.1.6 This article does not apply to tort claims and nothing in this article is intended nor shall be construed to change the time periods for filing tort claims or actions specified by Chapter 1 (commencing with Section 900) and Chapter 2 (commencing with Section 910) of Part 3 of Division 3.6 of Title 1 of the Government Code.

11.3.2 In accordance with California Public Contract Code Section 20104.4, the following procedures apply to civil actions to resolve claims of \$375,000 or less between the District and the Contractor:

11.3.2.1 Within 60 days, but no earlier than 30 days, following the filing or responsive pleadings, the court shall submit the matter to non-binding mediation unless waived by mutual stipulation of both parties. The mediation process shall provide for the selection within 15 days by both parties of a disinterested third person as mediator, shall be commenced within 30 days of the submittal, and shall be concluded within 15 days from the commencement of the mediation unless a time requirement is extended upon a good cause showing to the court or by stipulation of both parties. If the parties fail to select a mediator within the 15-day period, any party may petition the court to appoint the mediator.

11.3.2.2 If the matter remains in dispute, the case shall be submitted to judicial arbitration pursuant to Chapter 2.5 (commencing with Section 1141.10) of Title 3 of Part 3 of the Code of Civil Procedure, notwithstanding Section 1141.11 of that code. The Civil Discovery Act of 1986 (Article 3 (commencing with Section 2016) of Chapter 3 of Title 3 of Part 4 of the Code of Civil Procedure) shall apply to any proceeding brought under this subdivision consistent with the rules pertaining to judicial arbitration.

11.3.2.2.1 Notwithstanding any other provision of law, upon stipulation of the parties, arbitrators appointed for purposes of this article shall be experienced in construction law, and, upon stipulation of the parties, mediators and arbitrators shall be paid necessary and reasonable hourly rates of pay not to exceed their customary rate, and such fees and expenses

shall be paid equally by the parties, except in the case of arbitration where the arbitrator, for good cause, determines a different division. In no event shall these fees or expenses be paid by state or county funds.

11.3.2.2.2 In addition to Chapter 2.5 (commencing with Section 1141.10) of Title 3 of Part 3 of the Code of Civil Procedure, any party who after receiving an arbitration award requests a trial de novo but does not obtain a more favorable judgment shall, in addition to payment of costs and fees under that chapter, pay the attorney's fees of the other party arising out of the trial de novo.

11.3.2.3 The court may, upon request by any party, order any witnesses to participate in the mediation or arbitration process.

11.3.3 In accordance with California Public Contract Code Section 20104.6:

11.3.3.1 The District shall not fail to pay money as to any portion of a claim, which is undisputed except as otherwise provided in the contract.

11.3.3.2 In any suit filed under Public Contract Code Section 20104.4 concerning this contract, the District shall pay interest at the legal rate on any arbitration award or judgment. Such interest shall accrue from date the suit was filed.

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SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

- 1.01 DESCRIPTION: This Section covers a summary of the Work and requirements supplementary to those of the Conditions of the Contract and other Sections of the specifications.

WORK UNDER THIS CONTRACT. The work includes furnishing all labor, materials and equipment for the HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT including but not limited to; 1) the conversion of the sewer pump station dry well into a pump station wet well, 2) installation of new piping and a manhole, 3) dewatering, cleaning and CCTV inspection of the station's force main, 4) installation of a permanent generator and pad, 5) installation of valving and a flow meter in underground vaults and additional work as needed to construct and inspect a complete and operational project as specified in these Contract Documents.

- 1.02 NOT USED

- 1.03 OWNER SUPPLIED ITEMS – NOT USED

- 1.04 CONTRACTOR USE OF SITE AND PREMISES

- A. Limit use of site and premises to allow Owner occupancy and Work by other Contractors. The Contractor shall cooperate fully with the Owner and other Contractors to provide continued access to their respective work sites. The Contractor's failure to do so shall not constitute the basis for delay claims by the Contractor.
- B. Liquidated Damages apply for this project as defined in paragraph 4 of the Agreement.

- 1.05 ANTICIPATED CONCURRENT WORK

- A. District operations shall be accommodated at all times.
- B. The District's system integrator (Calcon Systems) shall be accommodated at all times.

- 1.06 PRECONSTRUCTION CONFERENCE

- A. Refer to Section 01040 for required attendees. Scheduling and location of the Pre-Construction Conference shall be confirmed with the Owner no more than five (5) days after the Notice to Proceed.

- 1.07 STORM WATER POLLUTION PREVENTION PROGRAM (SWPPP)

- A. It is the responsibility of the Contractor to provide a SWPPP to the District for approval in advance of all work.

END OF SECTION 01010

Sausalito-Marín City Sanitary District
Protection of The Environment

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SECTION 01014

PROTECTION OF THE ENVIRONMENT

PART 1 GENERAL

1.01 general

- A. The Contractor shall maintain all work areas within and outside the project boundaries free from environmental pollution that would be in violation to any federal, state, or local regulations.**

PART 2 PROTECTION OF THE ENVIRONMENT

2.01 WATERWAYS

- A. The Contractor shall observe the rules and regulations of the State of California and agencies of the United States government prohibiting the pollution of stream or river waters by the dumping of any refuse, rubbish, or debris therein.

2.02 AIR QUALITY

- A. Air pollution due to construction operations shall be minimized by wetting down bare soils during windy periods, use of properly operating combustion emission control devices on construction vehicles and equipment used by contractors, and by shutting down motorized equipment not actually in use.
- B. Trash burning will not be permitted on the construction site.
- C. If temporary heating devices are necessary for protection of the work, such devices shall be of an approved type that will not cause pollution of the air.

2.03 CONSTRUCTION NOISE

- A. The Contractor shall conduct all work, using appropriate construction methods and equipment, and furnish and install acoustical barriers, all as necessary so that no noise emanating from the process or any related tool or equipment will exceed legal noise levels. Contractor shall have machinery equipped with mufflers that meet the provisions of the State Resources Code and the Vehicle Code.

2.04 NIGHTTIME WORK

- A. If the Contractor desires to perform any work outside of normal construction hours, Contractor shall obtain all necessary permits from the appropriate agencies and make all necessary arrangements prior to commencing. The Contractor shall be responsible for all overtime costs for District staff during these work hours.

END OF SECTION 01014

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Sausalito-Marín City Sanitary District
Protection of The Environment

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SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 ADMINISTRATIVE SUBMITTALS

- A. Schedule of Values: Submit schedule on a form acceptable to the Owner's Representative.
- B. Schedule of Estimated Progress Payments:
 - 1. Submit with initially acceptable schedule of values.
 - 2. Submit adjustments thereto upon request by the Owner's Representative.
- C. Application for Payment: In accordance with Paragraph 9.2 of the General Conditions and as specified herein.
 - 1. Final Application for Payment: As specified in Paragraph 9.2.5 of the General Conditions and as specified herein.

1.02 SCHEDULE OF VALUES

- A. Reference Section 01301, Schedule of Values.
- B. Format:
 - 1. Reflect schedule of values format included in conformed Proposal, specified allowances, and alternates. Provide separate value for each item or task on the progress schedule. List each item of equipment separately.
 - 2. An unbalanced or front-end loaded schedule will not be acceptable.
 - 3. List separately such items as Bonds and insurance premiums, mobilization, demobilization and contract closeout, facility startup, and other appropriate Division 1 activities.
 - 4. Include proportional amount of Contractor's overhead and profit in each line item.
 - 5. List separately an item for monthly schedule update.

1.03 SCHEDULE OF ESTIMATED PROGRESS PAYMENTS

- A. Show estimated payment requests throughout Contract Times and aggregating initial Contract Price.
- B. Base estimated progress payments on initially acceptable progress schedule. Adjust to reflect subsequent adjustments in progress schedule and Contract Price as reflected by modifications to the Contract Documents.

- C. Submit adjusted payment schedule with each Application for Payment.

1.04 APPLICATION FOR PAYMENT

- A. Reference Paragraph 9 of the General Conditions.
- B. Transmittal Summary Form:
 - 1. Provided by Owner's Representative.
 - 2. Attach one Summary Form with each detailed Application for Payment for each schedule.
 - 3. Include Request for Payment of Materials and Equipment on Hand as applicable.
 - 4. Execute certification by authorized officer of Contractor.
- C. Use detailed Application for Payment Form suitable to Owner's Representative.
 - 1. Provide separate form for each schedule as applicable.
 - 2. Include accepted schedule of values for each schedule or portion of Work, the unit price breakdown for Work to be paid on unit price basis, a listing of Owner-selected equipment, if applicable, and allowances, as appropriate.
 - 3. Form(s) to conform to the examples furnished by Owner's Representative for Lump Sum Work and materials on hand.
- D. Preparation:
 - 1. Round values to nearest dollar.
 - 2. List each Change Order and Written Amendment executed prior to date of submission as separate line item. Totals to equal those shown on the Summary Sheet for each schedule as applicable.
 - 3. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form, a listing of materials on hand, and such supporting data as may be requested by Owner's Representative.

1.05 MEASUREMENT-GENERAL

- A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and specifications as specified in National Institute of Standards and Technology, Handbook 44.

1.06 PAYMENT

- A. General: See General Conditions, Paragraph 9.2.
- B. Payment for all Work shown or specified in the Contract Documents is included in the Contract Price. No measurement or payment will be made for individual items.

1.07 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

- A. Payment will not be made for following:
1. Loading, hauling, and disposing of rejected material.
 2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
 3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
 4. Material not unloaded from transporting vehicle.
 5. *Defective Work* not accepted by Owner.
 6. Material remaining on hand after completion of Work.

1.08 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

- A. Partial Payment: Reference Paragraph 9.2 of the General Conditions. No partial payments will be made for mechanical, electrical, or interface equipment delivered or stored unless acceptable final operation and maintenance manuals are delivered to Owner's Representative.
- B. Final Payment: Reference Paragraph 9.2.5 of the General Conditions. Final Payment will be made only for materials incorporated in Work; remaining materials, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

1.09 FINAL APPLICATION FOR PAYMENT

- A. Reference Paragraph 9.2.5 of the General Conditions, Section 01700, Contract Closeout, and as may otherwise be required in Contract Documents.
- B. Prior to submitting final application, make acceptable delivery of required documents.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 MEASUREMENT AND PAYMENT

- A. HIGHWAY BOOSTER PUMP STATION IMPROVEMENT PROJECT:
1. BID ITEM NO. 1: MOBILIZATION AND DEMOBILIZATION (LUMP SUM)
 - A. Payment for mobilization and demobilization will be made at the lump sum price named in the Bid Schedule under Item 1, which shall constitute full compensation for completion of mobilization based on Section 11 of the Caltrans

Standard Specifications. Mobilization includes mobilization and demobilization necessary for each component of the project.

- B. Mobilization and demobilization of a boat and all related appurtenances as necessary for access to the work is included in the individual bid items and is not included here.
- C. Progress payments for work under this Bid Item shall be paid based upon the estimated percent completion of the necessary mobilization and demobilization work for this project.
- D. In no case may the contract price for mobilization exceed 10 percent of the original contract amount.

2. BID ITEM NO. 2: (LUMP SUM)

- A. Payment for installation of an equipment pad, stationary generator and security fencing will be made at the lump sum price named in the Bid Schedule under Item 2, which shall constitute full compensation for completion as shown in the drawings and described fully in the contract specifications including, but not limited to, excavation, dewatering, forming, concrete and rebar installation, fence installation and generator procurement and installation. This bid item also includes restoring any features of the property that were affected by construction.
- B. Progress payments for work under this Bid Item shall be paid based upon the estimated percent completion of this item.

3. BID ITEM NO. 3: FORCE MAIN CLEANING AND INSPECTION (LINEAR FEET)

- A. Payment for CCTV inspection of force main will be made at the unit per linear feet price named in the Bid Schedule under Item 3, which shall constitute full compensation for furnishing labor, materials, tools, equipment, and incidentals and for doing the work involved in CCTV inspection, complete in place, including, but not limited to, preparing DVDs complete, as shown and specified in the Contract, in these specifications, and as directed by the District.
- B. Progress payments for work under this Bid Item shall be paid based upon the measure of linear feet of each pipe diameter and type initially inspected and, if necessary, re-inspected with CCTV after flushing and/or cleaning determined by measurement along the centerline of such pipe. Payment will be based upon the product of the foregoing measured quantity and the unit price shown in the bid schedule.
- C. Linear feet of pipeline is based on a horizontal projection of pipeline alignment, as described by stationing. True lengths of the pipe will be longer in the field where the pipe goes uphill or downhill.

4. BID ITEM NO. 4: FORCE MAIN LINE STOP, ISOLATION VALVE INSTALLATION AND CLEANING AND INSPECTION (LUMP SUM)
 - A. Payment for CCTV inspection of force main, including performing a line stop and installation of an isolation valve, will be made at the lump sum price named in the Bid Schedule under Item 4, which shall constitute full compensation for furnishing labor, materials, tools, equipment, and incidentals and for doing the work involved in CCTV inspection, complete in place, including, but not limited to, preparing DVDs complete, as shown and specified in the Contract, in these specifications, and as directed by the District. Linear feet is not used for this Bid Item due to the short length of pipe to be inspected.
 - B. Progress payments for work under this Bid Item shall be paid based upon the estimated percent completion of this item.
 - C. CCTV inspection for this section must be performed after performing a line stop and prior to installing the isolation valve in order to facilitate access. Contractor shall coordinate work with station flows and monitoring to ensure all incoming sewer is contained within sewer facilities and temporary containment as necessary.
5. BID ITEM NO. 5: (LUMP SUM)
 - A. Payment for grading and installation of base rock along the access road and around station facilities will be made at the lump sum price named in the Bid Schedule under Item 5, which shall constitute full compensation for completion as shown in the drawings and described fully in the contract specifications. This bid item also includes restoring any features of the property that were affected by construction.
 - B. Progress payments for work under this Bid Item shall be paid based upon the estimated percent completion of this item.
6. BID ITEM NO. 6: (LUMP SUM)
 - A. Payment for all other work specified, including but not limited to underground piping, vaults and equipment, installation of a manhole, conversion of the station dry well into a wet well, abandonment of the station dry well, and all appurtenant work will be made at the lump sum price named in the Bid Schedule under Item 6, which shall constitute full compensation for completion as shown in the drawings and described fully in the contract specifications. This bid item also includes restoring any features of the property that were affected by construction.
 - B. Progress payments for work under this Bid Item shall be paid based upon the estimated percent completion of this item.

Payment for construction of work identified above, will be made at the bid price in the Bid Schedule under Total Base Bid, which price shall constitute full compensation for completion of all such work as required per the Contract Documents.

Sausalito-Marín City Sanitary District
Measurement and Payment

3.02 ADJUSTMENT OF QUANTITY AND PAYMENT AMOUNT

- A. The quantities shown in the bid schedule are for bid purposes only. Additive or deductive quantities of the work will be adjusted by the Owner. For lump sum items, payment for quantity adjustments will be based on unit price breakdowns provided with the Schedule of Values. Final amount of payment will be adjusted based on actual quantity of work installed or completed multiplied by the bid price for each bid item, or based on the unit price breakdowns provided with the Schedule of Values.

END OF SECTION 01025

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SECTION 01030

SPECIAL PROJECT CONSTRAINTS

PART 1 GENERAL

1.01 GENERAL: The Contractor is cautioned that the Work locations is in the vicinity of waste water facilities with continuous conveyance of a raw wastewater. Construction activities shall be performed safely and shall not limit or obstruct District operations.

A. General Shutdown/Operational Constraints:

1. Shutdowns of the sewer force main for any period of time will require District operators to be notified in advance. The duration of shutdown will be determined by flow and wet well capacity. Any planned shutdowns longer than one (1) hour will require the use of a Baker tank or similar to contain all sewage. The contents of the tank may be returned to the station wet well after the shutdown.
2. Shutdowns of the gravity pipeline will require bypass pumping. Bypass pumping requires continuous monitoring as well as redundancy &/or contingency plans.
3. Owner operation and maintenance personnel will cooperate in every way that is practical to facilitate Contractor's operations. However, certain shutdowns and connections may only be permissible at times other than normal working hours such as nights or weekends. No additional compensation will be paid to the Contractor because of these constraints.
4. No shutdowns shall be allowed to start on Fridays, Saturdays, Sundays, or holidays, unless it is so directed or approved in writing by the Owner.
5. Shutdowns shall generally be scheduled during normal working hours, from 7:00am to 3:00pm.
6. Prior to initiating any shutdown, the Contractor shall develop and submit a plan in accordance with Section 01300. The plan shall contain sufficient detail to demonstrate that the Contractor can complete the required work safely in accordance with the specified time limits.

1.02 SUBMITTALS

A. All submittals shall be done in accordance with Section 01300, Submittals. The submittals included in this Section 01030 are:

1. Plan for stockpiling and/or disposal of excavated materials

2. All Shutdown Plans
3. Emergency response plan outlining steps to be taken in the event of an unplanned sewage or other environmentally hazardous liquid spill during the work.
4. Spill prevention plan outlining steps to be taken to prevent hazardous spills during the course of the work.

1.03 NOT USED

1.04 TRAFFIC CONTROL

- A. The Contractor shall maintain access to pump station facilities at all times and shall conduct operations in such a manner as to leave access unobstructed and in a condition satisfactory for vehicular travel during construction or non-construction hours.
- B. The Contractor shall not impede or block parking at the Buckeye Roadhouse parking lot which serves as the entrance to the pump station. All vehicles entering or leaving the pump station shall be coordinated with the Buckeye Roadhouse parking attendants.
- C. Note that the Buckeye Roadhouse parking lot becomes very crowded between the hours of 10:00 AM and 2:00 PM. Contractor shall coordinate work which requires large vehicles to avoid these hours as practical. In addition, the parking attendants shall be notified in advance if during business hours.

PART 2 PRODUCTS

2.01 STORAGE OF MATERIALS AND EQUIPMENT

- A. No public or private property adjacent to the site shall be used for storage or disposal of the Contractor's equipment and materials, and excess excavated material, unless prior written approval is obtained from the legal owner.

PART 3 EXECUTION

3.01 CONVENIENCE AND ACCESS

- A. The Contractor shall conduct the operation so as to cause minimum obstruction or inconvenience to the District staff and neighboring facilities. Staff must be able to access the District's facilities at all times.
- B. The Contractor shall cooperate with the collection and removal of trash and debris both in and adjacent to the construction site.

END OF SECTION 01030

SECTION 01040 COORDINATION

PART 1 GENERAL

1.01 SUBMITTALS

- A. Photographs and other records of examination, as required herein.

1.02 OTHER WORK

- A. Coordination of Owner's Work by Others: Reference Paragraph 7.8 of the General Conditions and Section 01010 for coordination of Owner's work by others, if any, and coordinate Contractor's Work with Owner or Owner's designated coordinator.
- B. It is anticipated that work will be performed concurrently at the pump station site by others, including District forces and other contractors, during scheduled performance of Work under these Contract Documents including, but not limited to, the following:
 - 1. Testing and commissioning of the stationary generator.
 - 2. Programming and testing of control panel by the District's system integrator.
 - 3. PG&E forces required to convert station to 480V service.
 - 4. Pump commissioning.
 - 5. Operator training.
 - 6. Various operator required access for station maintenance.

1.03 PROJECT MEETINGS

- A. General:
 - 1. Owner: Schedule physical arrangements for meetings throughout progress of Work, prepare meeting agenda with Contractor input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes within 7 days after each meeting to participants and parties affected by meeting decisions.
 - 2. Representatives of Owner, Contractor, and Subcontractors shall attend meetings, as needed, or as requested by Owner.
- B. Preconstruction Conference:
 - 1. As set forth in Section 01010, Summary of Work, a preconstruction conference will be held at site.

2. Attendees may include but not be limited to:
 - a. Owner's representatives.
 - b. Contractor's office representative.
 - c. Contractor's resident superintendent.
 - d. Contractor's quality control representative.
 - e. Contractor's safety program representative.
 - f. Subcontractors' representatives whom Contractor may desire or Owner may request to attend.
 - g. Utility agencies' representatives (as required)
 - h. Others as appropriate.

C. Progress Meetings:

1. Owner will schedule regular progress meetings at site, conducted weekly or as needed to review Work progress, progress schedule, Submittals submissions schedule, Application for Payment, contract modifications, and other matters needing discussion and resolution.
2. Attendees will include:
 - a. Owner's representative(s).
 - b. Contractor, and appropriate Subcontractors and Suppliers.
 - c. Others as appropriate.

D. Quality Control and Coordination Meeting(s):

1. Scheduled by Owner on regular basis and as necessary to review test and inspection reports, and other matters relating to quality control of Work and work of other contractors.
2. Attendees will include Owner's Representatives, Contractor, Contractor's designated quality control representative, selected Subcontractors and Suppliers, and other equipment item suppliers.

E. Pre-installation Meetings:

1. When required, or as called out in individual Specification sections, convene at site prior to commencing Work of that section.
2. Require attendance of entities directly affecting, or affected by, Work of that section.
3. Notify Owner's Representative four (4) days in advance of meeting date.

4. Provide suggested agenda to Owner's Representative to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.
- F. Other Meetings: In accordance with Contract Documents and as may be required by Owner.

1.04 SEQUENCE OF WORK

- A. Include the Milestones and sequences of Work specified herein as a part of the progress schedule required under Section 01310, PROGRESS SCHEDULES.
- B. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of Owner's operations.
- C. Coordinate proposed Work with the Owner's facility operations personnel before effecting unit shutdowns. Under no circumstances cease Work at the end of a normal working day if such actions may inadvertently cause a cessation of any facility operating process, in which case, remain onsite until necessary repairs are complete.
- D. Do not close lines, divert flow, open switches, or take other action which would affect the operation of existing systems, except as specifically required by the Contract Documents and after approval of Owner. Such actions will be considered by Owner upon 48 hours written notice to Owner unless otherwise specified.
- E. See Specification Section 01030 – Special Constraints for further information regarding sequence of work.

1.05 ADJACENT FACILITIES AND PROPERTIES

- A. Examination:
 1. After Effective Date of the Agreement and before Work at site is started, Contractor and Owner shall make thorough examination of pre-existing conditions including existing buildings, structures, pipelines, and other improvements in vicinity of Work, as applicable, which might be impacted or potentially damaged by construction operations.
 2. Contractor shall take two (2) sets of photographs of preexisting conditions prior to the start of the work. One set of photographs shall be given to the Owner. Periodic reexamination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions. Include public roads and improvements to adjacent private property as part of preexisting condition documentation.
 3. Record observations for signature of Owner's Representative and Contractor.

Sausalito-Marín City Sanitary District
Coordination

B. Documentation:

1. Submit two copies of photographs, videotapes and other records documenting examination for Owner's Representative's signature. Owner's Representative will review, sign, and return one record copy of every observation document and photograph to Contractor to be kept on file in Contractor's field office as site records.
2. These observations and photographs and videotapes are intended for use as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of Contractor's operations, and are for protection of Contractor and Owner.

1.06 OWNER'S OCCUPANCY

- A. Owner will occupy the premises during the entire period of construction for the conduct of its normal operations. Cooperate with Owner in all construction operations to minimize conflict and to facilitate Owner usage.

1.07 RELOCATION OF EXISTING FACILITIES

A. Minor Relocations:

1. During construction, minor relocations of Work may be necessary.
2. Provide complete relocation of existing structures and Underground Facilities; including piping utilities, equipment, structures, electrical conduit wiring, electrical duct banks, and other necessary items.
3. Use only new materials for relocated facilities. Match materials of existing facilities, unless otherwise shown or specified.
4. Perform relocations to minimize downtime of existing facilities. Install new portions of existing facilities in their relocated position prior to removal of existing facilities, unless otherwise accepted by Owner.

- B. Relocation of services conveying hazardous or toxic materials shall comply with all regulatory requirements for handling of these materials including, but not limited to, requirements of OSHA, PSM, EPA, AQMD, and UFC.

1.08 PHYSICAL CONDITIONS

- A. Exercise reasonable care to verify locations of existing subsurface structures and underground facilities, proceeding in accordance with Paragraph 5.3 of the General Conditions.

- B. Thoroughly check immediate and adjacent areas subject to excavation by visual examination (and by electronic metal and pipe detection equipment, as necessary) for indications of subsurface structures and underground facilities.
- C. Make exploratory excavations where existing Underground Facilities or structures may potentially conflict with proposed Underground Facilities or structures. Conduct exploratory excavations in presence of Owner's Representative and sufficiently ahead of construction to avoid possible delays to Contractor's Work.

1.09 REFERENCE POINTS AND SURVEYS

- A. Location and elevation of bench marks, as applicable, are shown on Drawings.
- B. Dimensions for lines and elevations for grades of structures, appurtenances, and utilities are indicated on Drawings, together with other pertinent information required for laying out Work. If conditions vary from those indicated, notify Owner immediately, who will make minor adjustments required.
- C. Owner's Representative may perform checks to verify accuracy of Contractor's layout Work and that completed Work complies with Contract Documents.
- D. Any existing survey points or other control markers destroyed without proper authorization shall be replaced by owner of the survey points or control markers at the Contractor's expense.
- E. Contractor's Responsibilities:
 - 1. Provide survey and layout as required.
 - 2. Locate and protect reference points prior to starting Work at site.
 - 3. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.
 - 4. In event of discrepancy in data provided by Owner, request clarification before proceeding with Work.
 - 5. Preserve and leave undisturbed control staking until Owner has completed checks it deems necessary.
 - 6. Re-establish reference points resulting from destruction by Contractor's operations.
 - 7. Retain professional land surveyor or civil engineer registered in California who shall perform or supervise engineering surveying necessary for additional construction staking and layout.
 - 8. Maintain complete accurate log of survey Work as it progresses as a Record Document.
 - 9. Submit documentation, as requested.
 - 10. Provide competent employee(s), tools, stakes, and other equipment and materials as Owner may require to:

- a. Check layout, survey, and measurement Work performed by others.
- b. Measure quantities for payment purposes.
- c. Cooperate with Owner so that checking and measuring may be accomplished with least interference to Contractor's operations.

1.10 SPILLS, OVERFLOWS, LEAKS, ILLEGAL DISCHARGES

- A. If an overflow, spill, discharge, or leak occurs due to the Contractor's operations or neglect, and any fine is levied against the Owner, the fine shall be considered direct damages caused by the Contractor. Further, if the Contractor exceeds his allotted time for any shutdown or bypass, and the Owner is thereby required to expend additional time and expenses to maintain compliance with plant discharge requirements or inspect the Contractor's work, the Contractor shall be solely liable for all such extra costs. The Contractor shall be responsible for the clean up of any spills caused by his operation.
- B. The above requirements shall be distributed, and be applicable, to all of the Contractor's Subcontractors working on the project site.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 PERMIT ACQUISITION

- A. The District shall obtain the conditional Caltrans Encroachment Permit and provide to the Contractor. Contractor shall be responsible for obtaining the final Caltrans permit by submitting insurance, bonds, traffic control plans, and SWPPP to Caltrans. District will pay any permit fees.

END OF SECTION 01040

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SECTION 01060

SAFETY AND REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 CONTRACTOR'S RESPONSIBILITY FOR SAFETY

- A. See General Conditions, Section 00700, Paragraph 6.11 for Safety and Protection requirements.
- B. The Contractor shall at its own cost do whatever Work is necessary for safety and be solely and completely responsible for conditions of the jobsite, including safety of all persons (including employees) and property during the Contract period. This requirement shall apply continuously and not be limited to normal working hours.

1.02 FEDERAL, STATE, AND LOCAL SAFETY REQUIREMENTS

- A. Safety provisions shall conform to the Federal and State Departments of Labor Occupational Safety and Health Act (OSHA), and all other applicable federal, state, county, and local laws, ordinances, codes, the requirements set forth herein, and any regulations that may be specified in other parts of these Contract Documents. Where any of these are in conflict, the more stringent requirement shall be followed. The Contractor's failure to thoroughly familiarize itself with the aforementioned safety provisions shall not relieve Contractor from compliance with the obligations and penalties set forth therein.

1.03 SAFE ACCESS BY FEDERAL, STATE, AND LOCAL GOVERNMENT OFFICIALS

- A. The Contractor shall at all times provide proper facilities for safe access to the Work by authorized government officials.

1.04 CONSTRUCTION SAFETY PROGRAM

- A. Refer to General Conditions, Paragraph 8.14.

1.05 NOT USED

1.06 CONFINED SPACES

- A. The Contractor shall perform tests for the presence of combustible or dangerous gases and shall monitor oxygen and combustible gases levels with an approved device immediately prior to a worker entering a confined space and at intervals frequent enough to ensure a safe atmosphere during the time a worker is in such a structure. A record of such tests shall be kept at the jobsite. Post a permit at the entry point and conduct all such entries in conformance with District policy.

1. Sources of ignition, including smoking, are prohibited within 50 feet of any confined space including manholes, lift stations, trenches and tanks.
 - a. Note: Confined spaces for the purpose of this Section shall mean the interior of storm drains, sewers, vaults, drywells, utility pipelines, tunnels, manholes, reservoirs, and any other such structure which is similarly surrounded by confining surfaces so as to limit circulation of oxygen and/or permit the accumulation of dangerous gases or vapors, and has limited access or egress.
- B. No employee shall be permitted to enter or remain within a confined space until such confined space is free of concentrations of harmful gases, and lack of oxygen, unless the employee is wearing suitable and approved respiratory equipment.
 1. Confined spaces that contain or that have last been used as containers of toxic gases, light oils, hydrogen sulfide, corrosives, or poisonous substances, shall, in every case, be tested by means of approved devices or chemical analysis before being entered without wearing approved respiratory equipment.
 2. When entering confined spaces, the Contractor's employees shall follow all applicable safety requirements, including the use of additional employees on watch outside the confined space, the use of a lever with a lifting range to a surface tripod, etc.
- C. Before any Work is performed in a suspected confined space, a detailed procedure shall be submitted to the Engineer 14 days in advance of the Work. The Contractor shall follow as a minimum the provisions of the General Industry Safety Orders, Section 5156, Title 8, California Administrative Code.

1.07 MATERIAL SAFETY DATA SHEET (MSDS)

- A. Refer to General Conditions, Paragraph 8.14. Attention is directed to the provisions of General Industry Safety Orders, Section 5194, Title 8, California Administrative Code. The Contractor shall submit to the Engineer a Material Safety Data Sheet for each hazardous substance proposed to be used, ten days prior to the delivery of such material to the job site or use of such material at a manufacturing plant where the Engineer is to perform an inspection. Hazardous substance is defined as any substance included in the list (Director's List) of hazardous substances prepared by the Director, California Department of Industrial Relations, pursuant to Labor Code Section 6382.

1.08 CONTRACTOR'S RESPONSIBILITY FOR ENVIRONMENTAL PROTECTION

- A. Refer to Section 01014, Protection of the Environment.
- B. Coordination: Construction equipment/vehicle refueling and maintenance operations shall be performed only in designated areas that are either paved or lined and surrounded by protective dikes to provide sufficient volume to contain any spill.
- C. A spill contingency plan shall be developed; upon detection of a spill or leak of construction material, oil, or fuels, clean up procedures shall be implemented. Adequate clean up equipment and supplies shall be kept onsite.
- D. Emission controls shall be installed on applicable construction equipment, and idling of equipment shall be minimized.
- E. Disturbed areas shall be watered whenever soil moisture conditions and weather conditions result in visible dust generation. Dirt stockpiles shall be covered. Dust producing activities shall be

suspended during periods of high winds if dust control measures are unable to avoid visible dust plumes.

- F. Equipment and manpower shall be available at all times during construction for watering of disturbed soil surfaces. Materials subject to wind dispersion shall be covered, as necessary, on a daily basis during site grading and leveling operations.
- G. All construction vehicles and equipment shall be equipped with manufacturer approved muffler/baffles, as applicable.
- H. In the event paleontological specimens (fossils) are uncovered during construction activities, the Contractor shall notify the Owner. All ground disturbing Work in the immediate vicinity of the discovery shall cease until the Owner completes an evaluation of significance and significant specimens are scientifically removed for appropriate study and curation. Refer to Section 01040.

1.09 STATEWIDE GENERAL CONSTRUCTION PERMIT

- A. Contractor shall apply for and meet all requirements for a Statewide General Construction Permit, including preparation of a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP shall address specific pollution prevention techniques to be implemented during construction. The SWPPP shall describe each pollution prevention techniques in detail and shall include drawings and layouts where applicable, to show locations of runoff containment structures, storage areas, etc. The SWPPP shall meet all State and Federal requirements.

PART 2 PRODUCTS

2.01 SAFETY EQUIPMENT

- A. The Contractor, as part of its safety program, shall maintain at its office or other well-known place at the jobsite, safety equipment applicable to the Work as prescribed by the governing safety authorities, all articles necessary for giving first-aid to the injured, and shall establish the procedure for the immediate removal to a hospital or a doctor's care of any person who may be injured on the jobsite.
- B. The Contractor shall do all Work necessary to protect the Owner's personnel and the general public from hazards. Barricades, lanterns, and proper signs shall be furnished in sufficient amount to safeguard the public and the Work.
- C. The performance of all Work and all completed construction, particularly with respect to ladders, platforms, structure openings, scaffolding, shoring, lagging, machinery guards and the like, shall be in accordance with the applicable governing safety authorities.
- D. During construction, the Contractor shall construct and at all times maintain satisfactory and substantial temporary chain link fencing, solid fencing, railing, barricades or steel plates, as applicable at all openings, obstructions, or other hazards in floors, roofs, and walkways. All such barriers shall have adequate warning lights as necessary, or required, for safety.

- E. The Contractor shall provide temporary lighting in all Work areas sufficient to maintain a lighting level during working hours not less than the lighting level required by California OSHA standards.
- F. The Contractor shall provide workers with adequate personal protective equipment including ear protection in accordance with all applicable OSHA standards.

2.02 WARNING DEVICES AND BARRICADES

- A. The Contractor shall adequately identify and guard all hazardous areas and conditions by visual warning devices and, where necessary, physical barriers. Such devices shall, as a minimum, conform to the requirements of Cal-OSHA.

2.03 HAZARDS IN PROTECTED AREAS

- A. Excavations on sites shall be marked or guarded in a manner appropriate for the hazard.

2.04 ACCIDENT REPORTS

- A. If death or serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger to the Owner. In addition, the Contractor must promptly report in writing to the Owner all accidents whatsoever arising out of, or in connection with, the performance of the Work whether on, or adjacent to, the site, giving full details and statements of witnesses.
- B. It shall be the responsibility of the Contractor to notify Federal and State Departments of Labor Occupational Safety and Health Act in accordance with applicable laws and regulations.
- C. See also General Conditions, Paragraph 8.14, Safety Reports.

2.05 FIRE PREVENTION AND PROTECTION

- A. The Contractor shall perform all Work in a fire-safe manner. The Contractor shall supply and maintain on the site adequate fire-fighting equipment capable of extinguishing incipient fires. The Contractor shall comply with applicable federal, local, and state fire-prevention regulations. Where these regulations do not apply, applicable parts of the National Fire Prevention Standard for Safeguarding Building Construction Operations (NFPA No. 241) shall be followed.
- B. Sufficient number of fire extinguishers of the type and capacity required to protect the Work and ancillary facilities shall be provided in readily accessible locations.
- C. See also General Conditions, Paragraph 8.14, Fire Protection.

2.06 USE OF EXPLOSIVES

- A. Use of explosives is not allowed.

2.07 SITE SECURITY

- A. The Contractor, where necessary to safeguard the Work and equipment, shall at its cost, employ licensed, uniformed security guards, physically capable of adequately patrolling the whole of the Work, who shall be at the site of the Work at all times, except during ordinary working hours, from the beginning to the date of acceptance of the Work.

2.08 CONTRACTOR TO SAFEGUARD EXISTING UTILITIES

- A. The Contractor shall perform all Work, including excavation, dewatering, and demolition operations, in such a manner as to avoid damage to existing fire hydrants, power poles, lighting standards, and all other existing utilities, public or private.

2.09 PROTECTION OF PROPERTY

- A. All public and private property, pavement or improvement, shall be safely guarded from injury or loss in connection with this contract by the Contractor at all times. Should any facility, structure, or property be damaged during operations of the Contractor, he shall immediately notify the proper owners or authorities.
- B. The Contractor, at its own expense, shall rebuild, repair, restore, and make good, to the existing conditions, all injuries and damage resulting from its operations.

END OF SECTION 01060

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SECTION 01300 SUBMITTALS

PART 1 GENERAL

1.01 DESCRIPTION. This Section covers requirements for submittals and forms a part of all other Specification Sections in which submittals are specified or required. Refer to the specific Sections and Divisions of the Specifications for additional submittal requirements.

A. Submittal Requirements Included in This Section.

1. Shop drawings.
2. Samples.
3. Material lists and equipment data.
4. Sub-Contractor Qualifications.
5. Certificates including, but not limited to warranties, bonds, service agreements.

PART 2 PRODUCTS (Not applicable to this Section)

PART 3 EXECUTION

3.01 SUBMITTALS-GENERAL REQUIREMENTS. The Contractor shall submit to the Owner for its review all shop drawings, samples, materials lists, equipment data, record documents, manufacturer's equipment manuals, and other submittals required by the Contract Documents and herein, or subsequently required by modifications. All such items required to be submitted for review shall be furnished by and at the expense of the Contractor, and any work affected by them shall not proceed without such review. Submittals and their contents shall be properly prepared, identified, and transmitted as provided herein or as the Owner may otherwise direct. Except for record documents, and instructional manuals for operation and maintenance, each submittal shall be approved before the material or equipment covered by the submittal is delivered to the site.

- A. Number of Copies. Unless otherwise specified, each submittal shall include three (3) sets of black line or blue line printed copies.
- B. Submittal Review Time. Contractor shall allow a total period of not less than four (4) weeks for review and approval of submittals, not including the time necessary for delivery or mailing, and shall cause no delay in the Work. Extension of the Contract Time will not be granted because of the Contractor's failure to make timely and correctly prepared and presented submittals with allowance for the checking and review periods.
- C. Deviations. At the time of the submission, the Contractor shall give notice, in writing, in the submittal, of any deviation from the requirements of the Contract Documents. The deviations shall be clearly indicated or described. The Contractor shall state in writing, all variation in costs occasioned by the deviations, and any assumptions of the cost of all related changes if the deviation is approved.
- D. Method of Submittal. The Contractor shall deliver submittals by means of dated, signed, and sequence numbered transmittals on the Owner provided forms (provided at the end of this section) identifying as to initial or resubmittal status, and fully describing the

Sausalito-Marín City Sanitary District
Submittals

submittal contents. In each transmittal, the Contractor shall state the Project Number and Name, Name and Address of Contractor, Name and Address of Subcontractor, Manufacturer, Distributor, and specification Section (as applicable), Articles, and paragraphs to which the submittal pertains; accompanying data sheets, catalogs, and brochures shall be identified in the same manner. Where several types or models are contained in the literature, the Contractor shall delete non-applicable portions, or specifically indicate, which portions are intended and applicable. Submittal transmittals shall fully index all items submitted.

1. Incomplete Submittals, including those not correctly transmitted, not correctly titled and identified, or not bearing the Contractor's review and approval stamp, will be returned to the Contractor without review.
 2. Interrelated Submittals. Except where the preparation of a submittal is dependent upon the approval of a prior submittal, all submittals pertaining to the Work, shall be submitted simultaneously.
- E. Contractor's Review and Approval. Every submittal of shop drawings, samples, materials lists, equipment data, instruction manuals, and other submittals upon which the proper execution of the Work is dependent, shall bear the Contractor's review and approval stamp certifying that the Contractor: 1) has reviewed, checked and approved the submittal and has coordinated the contents with the requirements of the Contract Documents, 2) has determined and verified all quantities, field measurements, field construction criteria, materials, equipment, catalog numbers, and similar data, or will do so, and 3) states the Work covered by the submittal is recommended by the Contractor and the Contractor's guarantee will fully apply thereto. Contractor's stamp shall be dated and signed by the Contractor in every case.
- F. Owner's Review. Submittals will be reviewed only for conformance with the design concept of the Project and with the information given in the Contract Documents. The review of a separate item, as such, will not indicate approval of the assembly in which the item functions, nor shall review be construed as revising, in any way, the requirements for a fully integrated and operable system, as specified. The review of submittals shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents, or for any revision in resubmittals, unless the Contractor has given notice, in writing, of the deviation or revision at the time of submission or resubmission, and written acceptance has been given to the specific deviation or revision, nor shall any review relieve the Contractor of responsibility for errors or omissions in the submittals, or for the accuracy of dimensions and quantities, the adequacy of connections, and the proper and acceptable fitting, execution, and completion of the Work.
- G. Corrections and Resubmittals. The Contractor shall make all required corrections and shall resubmit the required number of corrected submittals until approved by the Owner. The Contractor shall direct specific attention, in writing, to revisions other than the corrections called for on previous submittals, and shall state, in writing, all variations in costs, and his assumption of the cost of related changes the same as is required for deviations in 3.01B. Identify each resubmittal with number of the original submittal, followed by consecutive letters starting with "A" for first resubmittal, "B" for second resubmittal, etc. Note that in addition to any applicable liquidated damages, the Owner

reserves the right to deduct monies from the amounts due to Contractor to cover the cost of Owner's review time beyond the second submission.

- H. Check of Returned Submittals. The Contractor shall check submittals returned to him for correction and ascertain if the corrections result in extra cost to him above that included under the Contract Documents, and shall give written notice to the Owner within five (5) days, if in his opinion, such extra cost results from corrections. By failing to notify the Owner or by starting any Work covered by a submittal, the Contractor waives all claims for extra costs resulting from required corrections.
- I. Conformance. No Work represented by required submittals shall be purchased, or paid for, or commenced until the applicable submittal has been approved. Work shall conform to the approved submittals and all other requirements of the Contract Documents, unless subsequently revised by an appropriate modification, in which case, the Contractor shall prepare and submit revised submittals as may be required. The Contractor shall not proceed with any related Work which may be affected by the Work covered under submittals until the applicable submittals have been approved.
- J. Piecemeal Submittals. Piecemeal submittals will be returned unreviewed. However, for mechanical equipment and the like, separate submittals for embedded items, embedded metal work and anchors, will be reviewed, as applicable.

3.02 SHOP DRAWINGS. Each submittal shall be complete with respect to dimensions, design criteria, materials, connections, bases, foundations, anchors, and the like, and shall be accompanied by technical and performance data, as necessary, to fully illustrate conformance with the Contract Documents. Unless otherwise specified, each submittal shall include three (3) sets of black line or blue line printed copies. The printed copies shall be submitted folded to 8-1/2 inches x 11 inches in size. For catalog cuts and the like, which are 8-1/2 inch x 11 inch format, provide no less than three (3) copies which will be retained by the Owner.

- A. Title Block and Identification. On each shop drawing, provide a space for the Owner's approval or correction stamp, and a title block showing the following:
 - 1. Names and addresses of Contractor, sub-Contractor, manufacturer, distributor, as applicable
 - 2. Name and address of Owner
 - 3. Date, scale of drawings, and identification number
 - 4. Contractor's review and approval stamp
 - 5. Owner's number
 - 6. Plan Reference and Specification Section reference
 - 7. Project Name
- B. Preparation and Size. Details and information shall be clearly drawn, dimensioned, noted, and cross referenced. Unless otherwise approved, prepare shop drawings on 22 X 34, or 11 X 17, or 8-1/2 inch x 11 inch sheets, as applicable.

- C. Information Required. Shop drawings shall contain details and information fully developing the pertaining Contract Document requirements and such other information as may be specified or required for approval, including, but not limited to:
1. Related work with cross references to applicable portions of the Contract Documents.
 2. Dimensions, including variations between indicated dimensions and actual conditions.
 3. Physical configurations with critical dimensions for clearance, access and servicing.
4. List of materials, including fasteners and connectors, as applicable.
5. Grouting work, including grouting space and material.
6. Anchoring details showing anchor bolt type and class, sizes, embedments, projections, and locations measured with respect to permanent structural features. An anchor bolt template shall be shown on the Shop Drawings and shall be furnished unless waived in writing by the Owner.
 7. Protective coatings and factory finishes fully described as to materials, number of coats, plated and metallic coating finishes, treatments, and similar information, all based on specified requirements. The term "as specified" is not acceptable for this purpose.
 8. Machinery and equipment details. Standard catalog items need not be illustrated in detail, but indicate and detail sizes, supports, and connections.
- E. Details and Connections. Satisfactorily detail all connections required to complete the Work, including details necessary to make indicated or specified additions to existing work or to provide connections for future work. Design connections and parts of strength to withstand, without adverse deflection or stress, all loads or pressures to which they may be subjected and to develop the strength of the members or parts connected. In no case shall the connections, parts, or details be inferior to those required by the Contract Documents.
- F. Related Work. Except as provided in 3.02G., the term "by others" is not acceptable for the description of related work shown in the shop drawings. Clearly note by name or description the Contractor, Subcontractor, or trade to provide such related Work; where such name or description is missing, it shall be understood and agreed that the Contractor is to furnish and install such related Work.
- G. Work by Construction Phase Contractor. Work understood to be performed by the Owner's construction phase Contractor shall be clearly called out as such by the Contractor, in the Contractor's submittal(s).

- H. Composite Shop Drawings with Installation Layouts. Prepare and submit such drawings, wherever specified or required. Owner reserves the right to determine when composite drawings are required showing dimensional plans and elevations of the materials or equipment in the involved, and include complete information as to arrangements, locations, clearances, avoidance of interferences, access, sizes, supports, connections, services, assembly, disassembly, and installation. Composite shop drawings and layouts shall be coordinated in the field by the Contractor and his Subcontractors for proper relationship based on field conditions, and shall be checked and approved by them before submittal. Contractor shall have competent technical personnel readily available for such coordinating and checking.
- 3.03 INSTALLATION INSTRUCTIONS. The Contractor shall submit two copies of manufacturers' installation instructions for material and equipment incorporated in the Work to the extent specified in other Sections and Divisions of the Specifications or requested by the Owner for its review. Installation instructions will be reviewed for general adequacy only. After review, the SUPPLIER shall distribute copies to all those involved with the instructions.
- 3.04 OTHER SUBMITTALS. Provide no less than four (4) copies of other submittals such as calculations, manufacturer's certified reports, operational demonstration and system validation reports specified elsewhere in the Contract Documents, three (3) of which will be retained by the Owner and the rest of which will be returned to the Contractor marked to show the required corrections.
- 3.05 FORM OF REVIEW.
- A. Copies of submittals which are returned to the Contractor and which are subject to review will be marked with notations (1), (2), (3) or (4).
1. No Exceptions Taken.
 2. Make Corrections Noted
 3. Amend and Resubmit.
 4. Rejected - Resubmit.
- B. Returned copies of drawings marked with either notation (1) or (2) authorize Contractor to proceed with the fabrication, or construction, or any combination thereof, covered by such returned drawings, provided, that such fabrication, or construction shall be subject to the comments, if any, shown on such returned copies
- C. Returned copies of drawings marked with notation (3) or (4) shall be corrected as necessary and revised drawings shall be submitted in the same manner as before.
- D. Returned copies of drawings marked with either notation (3) or (4) shall be resubmitted not later than seven (7) days after date of transmittal by Owner.

3.06 MANUALS FOR EQUIPMENT AND SYSTEMS

- A. Provide an operation and maintenance manual for each item of equipment or system as specified in the individual Specification sections. Provide four (4) copies of/for each item for initial submittals; four (4) copies each item for final submittals. For the final submittal, also include an electronic file using PDF format, bookmarked for each equipment item included. Owner shall retain two (2) copies of initial submittal.
- B. Assemble operation and maintenance manuals into one set for entire Project prior to final Application for Payment.
- C. Content for each unit (or common units) and system, as appropriate, complete including Controls, Accessories, and Appurtenances:

1. Description of Unit and Component Parts:

- a. Function, normal operating characteristics, and limiting conditions.
- b. Performance curves, engineering data, nameplate data, and tests.
- c. Complete nomenclature and commercial number of replaceable parts.
- d. Cost of equipment and components.

2. Operating Procedures:

- a. Startup, break-in, routine, and normal operating instructions.
- b. Test procedures and results of factory tests, where required.
- c. Regulation, control, stopping, and emergency instructions.
- d. Shutdown instructions for both short and extended durations.
- e. Summer and winter operating instructions, as applicable.
- f. Safety precautions.
- g. Special operating instructions.
- h. Installation instructions.

3. Maintenance and Overhaul Procedures:

- a. Routine operations.
- b. Guide to troubleshooting.
- c. Disassembly, removal, repair, reinstallation, and reassembly.

4. Installation Instructions: Including alignment, adjusting, calibrating, and checking.

5. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.

- a. Preventive maintenance and overhaul instructions.

- b. Predicted life of parts subject to wear.
 - c. Items recommended to be stocked as spare parts and ordering instructions.
 - d. Identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).
- 6. Grease/Oil Points: Instructions and diagrams.
- 7. Manufacturer's printed operating and maintenance instructions.
- 8. Description of operation sequence by control manufacturer.
- 9. List of electrical relay settings, and control and alarm contact settings.
- 10. Electrical interconnection wiring diagram, including control and lighting systems.
- 11. As-installed control diagrams by control manufacturer.
- 12. Results of field functional and performance tests, as required.
- 13. Contractor's coordination drawings and as-installed, color-coded, piping diagrams.
- 14. Original manufacturer's recommended spare parts list, manufacturer's current prices, and recommended quantities to be maintained in storage.
- 15. Other data as required under individual Specification sections.

D. Content for each Electric or Electronic Item or System, as appropriate:

1. Description of Unit and Component Parts:

- a. Function, normal operating characteristics, and limiting conditions.
- b. Performance curves, engineering data, nameplate data, and tests.
- c. Complete nomenclature and commercial number of replaceable parts.
- d. Interconnection wiring diagrams, including all control and lighting systems.

2. Circuit Directories of Panelboards:

- a. Electrical service.
- b. Controls.
- c. Communications.

3. As-installed, color-coded, wiring diagrams.

4. Operating Procedures:

- a. Routine and normal operating instructions.
- b. Sequences required.
- c. Safety precautions.
- d. Special operating instructions.

5. Maintenance Procedures:

- a. Routine operations.
- b. Guide to troubleshooting.
- c. Adjustment and checking.
- d. List of relay settings, control and alarm contact settings.

6. Manufacturer's printed operating and maintenance instructions.

7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

8. Cost of equipment and components.

9. Estimated life expectancy of equipment and components.

10. Other data as required under pertinent sections of the Specifications.

E. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.

F. Additional Requirements for O&M Data: See individual Specification sections.

3.07 REVISION OF SUBMITTALS. Whenever a Modification causes a change to the information contained in previously approved submittals, the SUPPLIER shall submit information and data corresponding to the changed requirements for approval. Revision submittals shall be submitted following the procedures required for previously approved submittals.

END OF SECTION 01300

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TRANSMITTAL

Submittal Description: _____

Submittal No: _____

Spec Section: _____

	Routing	Sent	Received
OWNER: SAUSALITO MARIN CITY SANITARY DISTRICT	Contractor/CM		
PROJECT:	CM/Engineer		
	Engineer/CM		
CONTRACTOR:	CM/Contractor		

We are sending you ☐ Attached ☐ Under separate cover via _____.

☐ Submittals for review and comment

☐ Product data for information only

Remarks: _____

Item	Copies	Date	Section No.	Description	Review action ^a	Reviewer initials	Review comments attached

^a Note: NE = No exceptions noted; MCN = Make corrections noted; A&R = Amend and resubmit; R = Rejected

Attach additional sheets if necessary.

Contractor

Certify either A or B:

- ☐ A. We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work, specified (no exceptions).
- ☐ B. We have verified that the material or equipment contained in this submittal meets all the requirements specified except for the attached deviations.

No.

1.1 Deviation

Certified by: _____

Contractor's Signature

Corrections or comments made relative to submittals during this review do not relieve the Contractor from compliance with the requirements of the drawings and specifications. This submittal is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating his work with that of other trades, and performing the work in a safe and satisfactory manner.

For SMCS: _____

Construction Manager

Sausalito Marin City Sanitary District
 Submittals

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SECTION 01301

SCHEDULE OF VALUES

PART 1 GENERAL

1.01 GENERAL

- A. This Section defines the process whereby the Schedule of Values (lump sum price breakdown) shall be developed and utilized by the Contractor for preparation of Contractor's Progress Payment Requests.
- B. All price breakdown items shall include all manpower, equipment and material costs such that the total of all items equals the Contract Bid Price.
- C. The Contractor shall install all equipment and appurtenances required to construct the complete system as specified and shown in order to receive payment of the full lump sum contract price upon project completion.

1.02 SCHEDULE OF VALUES

- A. Contractor shall submit a Schedule of Values for the major components of the WORK at the Preconstruction Conference in accordance with Section 01010. Overhead and profit shall not be shown as a separate item; and, each line item shall include pro-rated amounts for the Contractor's costs, overhead, profit, temporary facilities and other expenses in connection with the item of work. The total of all items listed in the schedule shall be equal to the Contract Sum. For each line item which has an installed value of \$10,000.00 or more, break down the item and list the values of major products or operations. The listing shall include, at a minimum, the proposed value for the following major WORK components; schedule separate line item cost for:
 - 1. Mobilization and Demobilization. Provide a lump sum price for each. Maximum value not to exceed two and one-half percent (2.5%) of total contract price for each, to be paid on completion of each.
 - 2. Each trade or class of work. As a minimum, use the Table of Contents of these Specifications, all Sections in Division 2 through 16, as format.
- B. The Contractor and Owner's Representative shall meet and jointly review the preliminary Schedule of Values and make any adjustments in value allocations if, in the opinion of the Owner, these are necessary to establish fair and reasonable allocation of values for the major WORK components. Front end loading will not be permitted. The Owner may require reallocation of major WORK components from items in the above listing if in the opinion of the Owner such reallocation is necessary. This review and any necessary revisions shall be completed within ten (10) days from the date of the Notice of Proceed.

1.03 CHANGES TO SCHEDULE OF VALUES

- A. In the event that the Contractor and Owner agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION 01301

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SECTION 01310

PROGRESS SCHEDULES

PART 1 GENERAL

1.01 SUBMITTALS

- A. Submit with Each Progress Schedule Submission:
 - 1. Contractor's certification that progress schedule submission is the actual schedule being utilized for execution of the Work and certification by all Subcontractors with 5 percent or more of Work that they concur with Contractor's progress schedule submission.
 - 2. Four legible copies of the progress schedule.
 - 3. One electronic copy of the progress schedule. See Paragraph 1.03 for format.
- B. Preliminary Progress Schedule: Submit within 15 days of the Notice to Proceed and as specified in the General Conditions.
- C. Initially Acceptable Progress Schedule: As provided in the General Conditions.
- D. Acceptable Progress Schedule: Submit adjusted schedule or confirm validity of current acceptable schedule with each monthly Application for Payment in accordance with Paragraph 9.2 of the General Conditions, and at such other times as necessary to reflect: i) progress of Work to within 5 working days prior to submission; ii) changes in Work scope and activities modified since submission; iii) delays in Submittals or resubmittals, deliveries, or Work; iv) adjusted or modified sequences of Work; v) other identifiable changes; and vi) revised projections of progress and completion.
- E. Narrative Progress Report: Submit with each monthly submission of progress schedule.
- F. Precedent to final payment, provide four copies of any Critical Path Method (CPM) type schedule utilized with certification that said schedule represents correctly the way the Work was performed.
- G. Progress quantity chart.

1.02 PROGRESS OF THE WORK

- A. If Contractor fails to complete activity by its latest scheduled completion date and this failure may extend Contract Times (or Milestones), Contractor shall, within 7 days of such failure, submit a written statement as to how Contractor intends to correct nonperformance and return to the acceptable current progress schedule. Actions by Contractor to complete Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.
- B. Owner may order Contractor to increase plant, equipment, labor force, or working hours if Contractor fails to: i) complete a critical scheduled activity by its latest Milestone completion

date; or ii) satisfactorily execute Work as necessary to prevent delay to the overall completion of the Project.

1.03 PROGRESS SCHEDULE REQUIREMENTS

A. General:

1. Schedule(s) shall reflect Work logic sequences, restraints, delivery windows, review times, Contract Times, and Milestones set forth in the Agreement and Section 01040, Coordination, and shall begin with the date of Notice to Proceed and conclude with the date of Final Completion.
2. The schedule requirement herein is the minimum required. Contractor may prepare a more sophisticated schedule if such will aid Contractor in execution and timely completion of Work.
3. Base schedule on standard 5-day Work week.
4. When bar chart or network analysis schedules are specified, use Microsoft Project latest version or a compatible and approved software.
5. Adjust or confirm on a monthly basis.
6. Use of float suppression techniques such as preferential sequencing or logic, special lead/lag logic restraints, and extended activity times are prohibited, and use of float time disclosed or implied by use of alternate float-suppression techniques shall be shared to proportionate benefit of Owner and Contractor.
7. Pursuant to above float-sharing requirement, no time extensions will be granted nor delay damages paid until a delay occurs which: i) impacts Project's critical path; ii) consumes available float or contingency time; and iii) extends Work beyond contract completion date.
8. If Contractor provides an accepted schedule with an early completion date, Owner reserves the right to reduce the duration of the Work to match the early completion date by issuing a deductive Change Order at no change in Contract Price.

B. Network Analysis Diagram: Provide a comprehensive computer-generated schedule using CPM, generally as outlined in Associated General Contractors of America (AGC) publication "The Use of CPM in Construction – A Manual for General Contractors and the Construction Industry," latest edition, prepared on reproducible paper, not larger than 30 inches by 42 inches.

1. Show complete interdependence and sequence of construction and Project related activities reasonably required to complete the Work, identifying Work of separate stages and other logically grouped activities, and clearly identify critical path of activities.
2. Include at a Minimum: Subcontract Work; major and other equipment and critical product design, fabrication, testing, delivery and installation times including required lead time for Owner-furnished products; move-in and other preliminary activities; Project closeout and cleanup; Substantial Completion dates; Submittals that may impact critical path; and system/subsystem/component testing, facility startup, and training activities that may impact critical path.
3. Provide sub schedules to further define critical portions of the Work, i.e., Process Instrumentation and Control System/Subsystems.

4. Indicate dates for early-and late-start, early-and late-finish, float, and duration.
5. No activity duration, exclusive of those for Submittals review and product fabrication/delivery, shall be less than 1 day nor more than 15 working days, unless otherwise approved by Engineer.
6. Activity duration for Submittals review shall not be less than review time specified unless clearly identified and prior written acceptance has been obtained from Engineer.
7. Monthly Schedule Submissions: Include overall percent complete, projected and actual, and percent completion progress for each listed activity.
8. Prepare a schedule report listing information for each activity in network diagram in tabular format, and sorted according to:
 - a. Early-start, within responsibility.
 - b. Early-start.
 - c. Activity number sequence.
 - d. Activity number sequence with predecessor and successor activity.

C. Disposition of Progress Schedules: In accordance with Section 01300, Submittals.

1.04 NARRATIVE PROGRESS REPORT REQUIREMENTS

A. Include, as a minimum:

1. Summary of Work, completed during the past period between Narrative Progress Reports.
2. Work planned during the next period.
3. Explanation of differences between summary of Work completed and Work planned in previously submitted Narrative Progress Report.
4. Current and anticipated delaying factors and their estimated impact on other activities and completion Milestones.
5. Corrective action taken or proposed.

1.05 CLAIMS FOR ADJUSTMENT OF CONTRACT TIMES

A. Reference the General Conditions.

B. Where Engineer has not yet rendered formal decision on Contractor's claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in progress schedule, Contractor shall reflect that amount of time adjustment in progress schedule as Engineer may accept as appropriate for the interim. It is understood and agreed that such interim acceptance by Engineer will not be binding and will be made only for purpose of continuing to schedule Work, until such time as formal decision as to an adjustment, if any, of the Contract Times acceptable to Engineer has been rendered. Contractor shall revise progress schedule prepared thereafter in accordance with Engineer's formal decision.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION 13010

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SECTION 01400

QUALITY CONTROL

PART 1 GENERAL

1.01 INSPECTION AND TESTING

- A. Additional requirements for tests are described in Section 01650, Facility Startup, and other Technical Paragraphs of these Specifications.

1.02 GENERAL

- A. Where the Contract Documents require work to be field tested or approved, it shall be tested in the presence of the Construction Manager or its authorized representative. The Construction Manager shall have the right to witness all on-site tests performed by the Contractor and any shop tests. The results of any tests performed by the Contractor shall be made available for the information of the Construction Manager. Inspections, tests or favorable reviews by the Construction Manager or others shall not relieve the Contractor from its obligation to perform the work in accordance with the requirements of the Contract Documents or for its sole responsibility for the quality of workmanship and materials.
- B. Except as specifically required under the technical specifications for testing and inspection, all tests for materials furnished by the Contractor will be done in accordance with commonly recognized standards of national organizations. Where tests are to be performed by the Construction Manager or by an independent laboratory or agency, the Contractor shall furnish such samples of all materials as required by the Construction Manager without charge. The sample or samples of materials to be tested shall be selected by such laboratory or agency, or the Construction Manager, and not by the Contractor. No material for which the Contract Documents require the submittal and approval of tests, certificates of compliance or other documentation shall be incorporated in the Work until such submittal has been made and approved.
- C. The Contractor shall provide safe access for the Construction Manager and inspectors to adequately inspect the quality of work and the conformance with the Contract Documents. The Contractor shall furnish the Construction Manager the necessary labor and facilities for such things as excavation in the compacted fill to the depths required to take samples. The Contractor shall provide adequate lighting, ventilation, ladders and other protective facilities as may be necessary for the safe performance of inspections.
- D. Upon completion of the Work the Construction Manager will conduct a final inspection as provided for in Section 10.2 of the General Conditions, Final Inspection and Payment.

Records shall be available at all reasonable hours for inspection by other local or State agencies to ascertain compliance with laws and regulations.

1.03 NOTICE

- A. The Contractor shall notify the Construction Manager at least 24 hours before any field testing or special inspections are required to be performed by the Construction Manager or independent laboratory furnished by the District. The Contractor shall notify the Construction Manager at least two hours before any inspection is required to be performed or to witness the Contractor's on-site field testing.
- B. Whenever the Contractor varies the period during which work is carried on each day, the Contractor shall give due notice to the Construction Manager so that proper inspection may be provided. Any work done in the absence of the Construction Manager shall be subject to rejection.
- C. The Contractor shall give the Construction Manager written notification at least 30 days prior to the shipment of materials and equipment to be tested and/or inspected at the point of origin. Satisfactory tests and inspections at the point of origin shall not be construed as a final acceptance of the materials and equipment nor shall such tests and inspections preclude retesting or re-inspection at the site of the Work.

1.04 COSTS OF TESTING

- A. The Contractor shall be responsible for, and shall pay for, all quality control and off-site tests of materials required including all source and mix design tests for the approval of soil and concrete materials.
- B. The Contractor shall be responsible for, and shall pay for, all source quality control and all on-site tests of materials required, except those tests specifically noted to be performed and paid for by the District. The District will perform the soils compaction and concrete confirmation tests detailed in the Technical Specifications during the performance of the Work.
- C. The Construction Manager shall have the authority to require additional tests or inspections due to the manner in which the Contractor executes its work. Examples of such additional tests and inspections include; tests of materials substituted for previously accepted materials, or substituted for specified materials, or retests made necessary by failure of material to comply with the requirements of the Specifications. Where such tests and inspections are required by Contract to be performed by the District, the District will pay for the additional tests and inspections but will issue an unilateral Change Order to deduct these costs from the Contract price.

1.05 WORK COVERED PRIOR TO INSPECTION AND/OR TESTING

- A. Work requiring inspection and/or testing shall not be concealed or buried prior to the acceptance of such inspection or testing. Work covered without the favorable review or consent of the Construction Manager shall, if required by the Construction Manager, be uncovered for inspection and/or testing at the Contractor's expense.

1.06 WORK COVERED WITH PRIOR INSPECTION AND/OR TESTING

- A. If the Construction Manager considers it necessary or advisable that covered work which was favorably inspected and tested be uncovered for re-inspection and/or retesting, the Contractor, at the Construction Manager's request, will uncover, expose or otherwise make available for observation, inspection or testing as the Construction Manager may require, that portion of the work in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that such work is defective, the Contractor will bear all expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction. If, however, such work is not found to be defective the Contractor will be allowed an increase in the Contract price or an extension of the Contract time, or both, directly attributable to such uncovering, exposure, observation, testing and reconstruction, and a Change Order shall be issued for such additional work.

END OF SECTION 01400

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SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.01 SUBMITTALS

- A. Meet requirements of Section 01300, SUBMITTALS, as applicable. Make Submittals required below before starting Work at the site or in accordance with accepted schedule of Submittals submissions.
- B. Administrative Submittals: Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies.

1.02 MOBILIZATION

- A. Reference the General Conditions.
 - B. Mobilization shall include, but not be limited to, these principal items:
 - 1. Obtaining required permits.
 - 2. Moving CONTRACTOR's plant and equipment required for first month operations onto site.
 - 3. Installing temporary construction power, wiring, and lighting facilities.
 - 4. Providing onsite communication facilities, including telephones.
 - 5. Providing onsite sanitary facilities and potable water facilities as specified and as required by Laws and Regulations, and governing agencies.
 - 6. Arranging for and erection of CONTRACTOR's work and storage yard.
 - 7. Posting OSHA required notices and establishing safety programs and procedures.
 - 8. Having CONTRACTOR's superintendent at the site full time.
 - 9. Submitting of initially acceptable schedules as required in the General Conditions.
 - C. Payment for Mobilization. The CONTRACTOR's attention is directed to the condition that no payment for mobilization, or any part thereof will be approved for payment under the contract until all applicable mobilization items listed above have been completed.
- ##### **1.03 CONTRACTOR ACCESS, STAGING/LAYDOWN AREA, USE OF PREMISES**
- A. Not Used.

- B. Lands furnished by OWNER upon which CONTRACTOR shall perform the Work are as shown on the Drawings.
 - C. Unless otherwise provided, specific location(s) and available area(s) for CONTRACTOR's staging/laydown, and site access, shall be as directed or finalized at the preconstruction meeting.
 - D. CONTRACTOR's employees shall park their vehicles in the designated staging area. Vehicles outside of the staging area shall be limited to those necessary for transportation of equipment and shall be clearly marked with the company name.
 - E. CONTRACTOR's employees shall not use OWNER's facilities including, but not limited to, buildings, restrooms/showers, or landscaped areas for break or lunch times. CONTRACTOR's employees shall be responsible for cleaning up any litter from break or lunch times.
 - F. Should CONTRACTOR use a dual-gate system required for use of nonunion personnel, CONTRACTOR shall bear all costs of providing and maintaining the dual-gate system. Such costs shall include costs for gates, signs at all gates as required by OWNER, fencing or other barriers acceptable to OWNER for segregating union and nonunion staging areas, and other items.
- 1.04 PERMITS. Permits, Licenses, or Approvals: Obtain in accordance with Paragraph 6.06 of the General Conditions.
- 1.05 PROTECTION OF WORK AND PROPERTY
- A. Not used.
 - B. Comply with OWNER's safety rules.
 - C. Keep OWNER informed of serious accidents on the site and related claims.
 - D. Use of Explosives: No blasting or use of explosives will be allowed on the site.
 - E. During the performance of the Work, CONTRACTOR is responsible for adapting its means, methods, techniques, sequences, and procedures of construction to allow OWNER to maintain operation as described in Section 01030, SPECIAL PROJECT CONSTRAINTS, at the existing level of facility production and consistent with applicable permit requirements, and Laws and Regulations. In performing such Work and in cooperating with OWNER to maintain operations, it may be necessary for CONTRACTOR to plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items that will be included within the Contract Price.

PART 2 PRODUCTS

2.01 OWNER'S TRAILER. A trailer for use as the OWNER's field office will NOT be required.

2.02 CONTRACTOR FIELD OFFICE

- A. It is optional that the CONTRACTOR shall install a project field office at the WORK site. The CONTRACTOR shall provide and pay for all temporary utilities including water, sanitary connection, telephone and electric power services for its field office. The CONTRACTOR is responsible for all costs associated with obtaining and maintaining temporary utilities.

PART 3 EXECUTION

3.01 OWNER'S FIELD OFFICE. Not required.

3.02 TEMPORARY UTILITIES

A. Power:

1. Electric power is available at the site from the OWNER.
2. Electrical appurtenances required for providing temporary electric power services for the CONTRACTOR shall be provided by the CONTRACTOR and approved by the OWNER.
3. If the CONTRACTOR damages any of the Owner's electrical components, the Contractor shall be responsible for repairing the damage to the satisfaction of the Owner.
4. The CONTRACTOR shall provide its own diesel or gasoline engine driven air compressor system when required for its pneumatic tools or equipment if any.

B. Lighting: Provide temporary lighting at least to meet all applicable safety requirements to allow erection, application or installation of materials and equipment, and observation or inspection of the Work. Cost of temporary lighting required for performing the Work will be borne by the CONTRACTOR.

C. Heating, Cooling, and Ventilating:

1. Provide as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for the installation of materials, and to protect materials, equipment, and finishes from damage due to temperature or humidity.
2. Provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
3. Pay all costs of installation, maintenance, operation, removal, and fuel consumed.
4. Provide portable unit heaters, complete with controls, oil- or gas-fired, and suitably vented to outside as required for protection of health and property.
5. If permanent natural gas piping is used for temporary heating units, do not modify or reroute gas piping without approval of OWNER. Provide separate gas metering as required by OWNER.

D. Water:

1. CONTRACTOR may use water from the OWNER'S water system only related to the WORK to be performed by the CONTRACTOR. The CONTRACTOR shall provide temporary connections, piping and valving to the OWNER'S water system at

CONTRACTOR's expense. The CONTRACTOR shall not make connection to any water system without first obtaining permission from the OWNER.

2. CONTRACTOR will provide temporary facilities and piping required to bring water to the point of use, and remove them when no longer needed.
3. CONTRACTOR will provide water required for testing equipment, manholes or vaults, and piping prior to Substantial Completion, unless otherwise specifically stated in the Specifications for the equipment, systems, or facilities to be tested.
4. Recycled water is available at site for use. CONTRACTOR facilities, receiving and using recycled water shall be marked appropriately, i.e. "Recycled Water Do Not Drink."

E. Sanitary and Personnel Facilities:

1. Provide and maintain facilities for CONTRACTOR's employees, Subcontractors, and all other onsite employer's employees. Service, clean, and maintain facilities and enclosures.
2. Use of OWNER's existing sanitary facilities by CONTRACTOR's personnel will not be allowed.

F. Communication:

1. The CONTRACTOR shall make arrangements to obtain and pay for its own communication equipment such as telephone, cellular phone, and facsimile equipment.
2. Arrange and provide onsite telephone service for CONTRACTOR's use during construction. CONTRACTOR to pay all costs of installation and monthly bills.
3. No incoming telephone calls shall be allowed to OWNER's plant telephone system.

G. Fire Protection: Furnish and maintain on the site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of the National Fire Prevention Standard for Safeguarding Building Construction Operations (NFPA No. 241).

3.03 PROTECTION OF WORK AND PROPERTY

A. General:

1. Not Used.
2. Perform Work within rights-of-way and easements in a systematic manner that minimizes inconvenience to property owners and the public.
3. No primary access road shall be cut off from vehicular traffic for a period exceeding four (4) hours unless special arrangements have been made. Constraints to complete work in the Plant Access Road are specified in Section 01030.

4. Maintain in continuous service all existing pipelines, cables, storm drains, process drains, sewers, poles and overhead power, and all other utilities encountered along the line of Work, unless other satisfactory arrangements have been made.
5. Where completion of Work requires temporary or permanent removal and/or relocation of an existing utility, coordinate all activities with owner of said utility and perform all work to their satisfaction.
6. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.
7. Keep fire hydrants and water control valves free from obstruction and available for use at all times.
8. In areas where CONTRACTOR's operations are adjacent to or near pipelines, cables, storm drains, sewers, process drains, and such operations may cause damage or inconvenience, suspend operations until arrangements necessary for protection thereof have been made by CONTRACTOR.
9. Notify all affected parties other than OWNER, which may be affected by any construction operations, five (5) days in advance. Thereafter, provide written notice at least two (2) days in advance.
10. Do not impair operation of existing sewer systems. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures. Maintain original site drainage wherever possible.

B. Site Security:

1. Security Fence: Provide and maintain additional temporary security fences as necessary to protect the Work and CONTRACTOR's equipment, stored material, etc.

C. Barricades and Lights:

1. Provide as necessary to prevent unauthorized entry to construction areas and affected roads, streets, and alleyways, inside and outside of fenced area, and as required to ensure public safety and the safety of OWNER's, CONTRACTOR's employees, other employer's employees, and others who may be affected by the Work.
2. Provide to protect existing facilities and adjacent properties from potential damage.
3. Locate to enable access by facility operators and property owners.

D. Signs and Equipment:

1. Conform to requirements of Caltrans Standard Specifications.
2. Barricades: Provide in sufficient quantity to safeguard public and Work.

3. Traffic Cones: Provide to delineate traffic lanes to guide and separate traffic movements.
 4. Provide at obstructions, such as material piles and equipment.
 5. Illuminate barricades and obstructions with warning lights from sunset to sunrise.
 6. Use to alert general public of construction hazards, which would include surface irregularities, unramped walkways, grade changes, and trenches or excavations in roadways and in other public access areas.
 7. No Parking signs shall be posted at least forty-eight (48) hours prior to start of Work in affected area. No Parking signs shall be posted on barricades and not on existing trees or poles.
- E. Existing Structures: Where CONTRACTOR contemplates removal of small structures such as signposts and culverts that interfere with CONTRACTOR's operations, obtain OWNER's prior approval. Replace those removed in a condition equal to or better than original.
- F. Finished Construction: Protect finished floors and concrete floors exposed as well as those covered with composition tile or other applied surfacing.
- G. Waterways: Keep ditches, culverts, existing swales, and natural drainages continuously free of construction materials and debris.
- H. Dewatering: Construct, maintain, and operate channels, flume drains, sumps, pumps, or other temporary diversion and protection works. Furnish materials required, install, maintain, and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from the various parts of the Work. Maintain the foundations and parts of the Work free from water.

3.04 TEMPORARY CONTROLS

- A. Water Pollution Control:
1. Prior to commencing excavation and construction, obtain OWNER's agreement with detailed plans showing procedures intended to handle and dispose of sewage, groundwater, and stormwater flow, including dewatering pump discharges.
 2. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm drains or sanitary sewers. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris, and rubbish.
- B. Erosion, Sediment, Runoff, and Flood Control:
1. Provide, maintain, and operate temporary facilities to control erosion and sediment releases, prevent runoff of recycled water, and to protect Work and existing facilities from flooding during construction period.

2. Obtain and comply with the General NPDES Permit for Storm Water Discharges associated with Construction Activity.

3.05 STAGING AREA

- A. The CONTRACTOR's staging area shall be coordinated with the Owner.
- B. Temporary Storage Area: Construct temporary storage area for storage of products that are not subject to damage by weather conditions.
- C. Temporary Storage Buildings:
 1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored.
 2. Arrange or partition to provide security of contents and ready access for inspection and inventory.
 3. Store combustible materials (paints, solvents, fuels, etc.) in a well-ventilated and remote building meeting safety standards.

3.06 ACCESS ROADS AND DETOURS

- A. No road detours are anticipated for the Work.
- B. Maintain drainage ways.
- C. Where required, or as directed by OWNER's Representative, provide gravel, crushed rock, or other stabilization material to permit access by all motor vehicles at all times.
- D. Maintain road grade and crown to eliminate potholes, rutting, and other irregularities that restrict access.
- E. Where construction affects existing fences, install and maintain gates. Temporary fencing will be adequate to perform the function of the permanent fencing it will replace on a short term basis. Refer also to any permit requirements in Section 01040, COORDINATION.
- F. Upon completion of construction, leave roads and fences in same or better condition as prior to start of construction activities, and suitable for future use by OWNER.

3.07 PARKING AREAS

- A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, OWNER's operations, or construction operations.
- B. Provide parking facilities for personnel working on the Project in CONTRACTOR's staging area. No employee or equipment parking will be permitted on OWNER's existing paved areas.

3.08 CLEANING DURING CONSTRUCTION

A. General:

1. In accordance with the General Conditions, as may be specified in specific Specification sections, and as required herein.
2. Wet down exterior surfaces prior to sweeping to prevent blowing of dust and debris.
3. Provide approved containers for collection and disposal of waste materials, debris, and rubbish. At least at weekly intervals, dispose of such waste materials, debris, and rubbish offsite.
4. At least weekly, brush sweep the entry drive and roadways, and all other streets and walkways affected by Work and where adjacent to Work.

3.09 REMOVAL OF TEMPORARY FACILITIES AND UTILITIES

- A. At such time or times any temporary construction facilities and utilities are no longer required for the Work, CONTRACTOR shall notify OWNER of his intent and schedule for removal of the temporary facilities and utilities, and obtain OWNER's approval before removing the same. As approved, CONTRACTOR shall remove the temporary facilities and utilities from the site as his property and leave the site in such condition as specified, as directed by OWNER, and/or as shown on the Drawings.
- B. After completion of the project, all temporary utility services shall be disconnected or removed and all affected improvements shall be restored to their original condition by the CONTRACTOR at no cost to the OWNER.
- C. The condition of the site shall be left in a condition that will restore original drainage, evenly graded, seeded or planted as necessary, and left with an appearance equal to, or better than original.

END OF SECTION 01500

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SECTION 01600
DELIVERY, STORAGE AND HANDLING

PART 1 GENERAL
1.01 SCOPE OF WORK

- A. This Section specifies the general requirements for the delivery handling, storage and protection for all items required in the construction of the work. Specific requirements, if any, are specified with the related item.

1.02 TRANSPORTATION AND DELIVERY

- A. Transport and handle items in accordance with manufacturer's instructions.
- B. Schedule delivery to reduce long term on-site storage prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the Owner's Representative.
- C. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.
- D. Deliver products to the site in manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting and installing.
- E. All items delivered to the site shall be unloaded and placed in a manner which will not hamper the Contractor's normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic.
- F. Provide necessary equipment and personnel to unload all items delivered to the site.
- G. Promptly inspect shipment to assure that products comply with requirements, quantities are correct and items are undamaged. For items furnished by others (i.e. Owner, other Contractors), perform inspection in the presence of the Owner's Representative. Notify Owner's Representative verbally, and in writing, of any problems.

1.03 STORAGE AND PROTECTION

- A. Store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instruction shall be studied by the Contractor and reviewed with the Owner's Representative by him/her. Instruction shall be carefully followed and a written record of this kept by the Contractor. Arrange storage to permit access for inspection.
- B. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- C. Cement and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural, miscellaneous and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products

Sausalito-Marín City Sanitary District
Delivery, Storage and Handling

shall be handled and stored in a manner to reduce breakage, cracking and spalling to a minimum.

- D. All mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) shall be stored in a weathertight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the Owner's Representative. Building shall be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer.
1. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer.
 2. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.
 3. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.
 4. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

END OF SECTION

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SECTION 01650

FACILITY STARTUP

PART 1 GENERAL

1.01 DEFINITIONS

- A. Facility Startup: Includes putting Project in operating order, cleaning, adjusting and balancing equipment, initial operation (startup) of equipment item, operating equipment, starting systems, operation of systems, testing of equipment and systems, and demonstration and verification of the completed facility as a unit.
- B. Functional Test: A test or tests in the presence of the Owner's Representative to demonstrate that the installed equipment or system meets manufacturer's installation and performance requirements and other requirements specified including, but not limited to, pressure testing, leak testing, vibration testing, and proper mechanical connections and operability for all valves and appurtenances.
- C. Operation Period: The operation period begins when the facility has been successfully started up as defined under Paragraph Startup Test Period and has met all Substantial Completion requirements.
- D. Performance Test: A test performed in the presence of the Owner and after any required functional test specified, to demonstrate and confirm that the equipment and/or system meets the specified performance requirements.
- E. Significant Interruption: May include any of the following events:
 - 1. Failure of Contractor to maintain qualified onsite startup personnel as scheduled
 - 2. Failure to meet specified performance for more than 2 consecutive hours.
 - 3. Failure of any critical equipment unit, system, or subsystem that is not satisfactorily corrected within 5 hours after failure.
 - 4. Failure of noncritical unit, system, or subsystem that is not satisfactorily corrected within 8 hours after failure.
 - 5. As may be determined by Owner.
- F. Startup Test Period:
 - 1. Startup of the entire facility or any portion thereof includes coordinated operation of the facilities by the Contractor, Subcontractors, Owner operating personnel, and Supplier or manufacturer's representatives for equipment items and systems after all required functional tests have been completed and those performance tests deemed necessary for the safe operation of the entire facility have been completed.
 - 2. Startup of the entire facility or any portion thereof shall be considered complete when, in the opinion of the Owner, the facility or designated portion has operated in the manner intended for five (5) continuous days without significant interruption. This period is in addition to any training, functional, or performance test periods specified elsewhere. A significant interruption will require the startup then in progress to be stopped and restarted after corrections are made.

- G. System: The overall process, or a portion thereof, that performs a specific function. A system may consist of two or more subsystems as well as two or more types of equipment.

1.02 SUBMITTALS

A. Administrative Submittals:

1. Functional and performance test schedules and plan for equipment, units, and systems at least fourteen (14) days prior to start of related testing. Include test plan and procedures.
2. Schedule and plan of facility startup activities at least fourteen (14) days prior to commencement.

B. Quality Control Submittals:

1. Manufacturer's Certificate of Proper Installation as required.
2. Test Reports: Functional and performance testing, in format acceptable to Owner and certification of functional and performance test for each piece of equipment or system specified.
3. Operation and maintenance data as required.
4. Certifications of Calibration: Testing equipment including vibration test equipment.

1.03 FACILITY STARTUP; CONTRACTOR RESPONSIBILITIES

A. General:

1. Perform Work for tests specified, including items furnished by Owner.
2. Demonstrate proper installation, adjustment, function, performance, and operation of equipment, systems, control devices, and required interfaces individually and in conjunction with existing system.
3. Provide water, power, chemicals, and other items as required for testing, unless otherwise indicated.

1.04 FACILITY STARTUP; OWNER'S RESPONSIBILITIES

A. General:

1. Review Contractor's test plan and schedule.
2. Witness each functional or performance test.
3. Coordinate other plant operations, if necessary, to facilitate Contractor's tests.
4. Provide reclaimed water, as available.

B. Startup Test Period: Operate process units and devices, with support of Contractor.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 TESTING PREPARATION

A. General:

1. Complete Work associated with the unit and related processes before testing, including related manufacturer's representative services.
2. Provide related operating and maintenance manuals, and spare parts and special tools as specified before testing any unit or system. **These manuals shall be provided two weeks in advance of any on site testing.**
3. Furnish qualified manufacturer's representatives when required to assist in testing.
4. Schedule and attend pretest (functional and performance) meetings related to test schedule; plan of test; materials, chemicals, and liquids required; facilities' operations interface; and Owner involvement.
5. Designate and provide one or more persons to be responsible for coordinating and expediting Contractor's facility startup duties. The person or persons shall be present during facility startup meetings and shall be available at all times during the facility startup period.
6. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required to conduct testing.

B. Cleaning and Checking: Prior to starting functional testing:

1. Calibrate testing equipment for accurate results.
2. Inspect and clean equipment, devices, connected piping, and structures so they are free of foreign material.
3. Lubricate equipment in accordance with manufacturer's instructions.
4. Turn rotating equipment by hand and check motor-driven equipment for correct rotation.
5. Open and close switches by hand and operate other devices to check for binding, interference, or improper functioning.
6. Check power supply to electric-powered equipment for correct voltage.
7. Adjust clearances and torques.
8. Test piping for leaks.

C. Ready-to-test determination will be by Owner, based at least on the following:

1. Notification by Contractor of equipment and system readiness for testing.
2. Acceptable testing plan.
3. Acceptable operation and maintenance manuals incorporating review comments.
4. Adequate completion of Work adjacent to, or interfacing with, equipment to be tested, including items to be furnished by Owner.
5. Availability and acceptability of supplier or manufacturer's representative, when specified, to assist in testing of respective equipment, and satisfactory fulfillment of other specified manufacturers' responsibilities.
6. All spare parts and special tools delivered to Owner.

3.02 FUNCTIONAL TESTING

A. General:

1. Begin testing at a time mutually agreed upon by the Owner, Supplier, manufacturer's representative(s), and Contractor.
2. Notify in writing Owner, and Supplier or manufacturer's representative at least five (5) working days prior to scheduled date of functional tests.

3. Separate items of equipment demonstrated to function properly during subsystem testing may require no further functional test if documentation of subsystem testing is acceptable to Owner.
4. Conduct functional test until each individual component item or system has achieved three (3) continuous hours of satisfactory operation. Demonstrate all operational features and controls function during this period while in automatic modes.
5. If, in Owner's opinion, each system meets the functional requirements specified, such system will be accepted as conforming for purposes of advancing to performance testing phase, if required. If, in Owner's opinion, functional test results do not meet requirements specified, the systems will be considered as nonconforming.
6. Performance testing shall not commence until the equipment or system meets functional tests specified.

3.03 PERFORMANCE TESTING

A. General:

1. Begin testing at time mutually agreed upon by the Owner, Supplier, manufacturers' representative(s), and Contractor, as appropriate.
 - a. Owner will be present during test.
 - b. Notify Owner at least five (5) working days prior to scheduled date of test.
2. Follow approved testing plan and detailed procedures specified.
3. Source and type of fluid, gas, or solid for testing shall be as specified.
4. Unless otherwise indicated, provide all labor, materials, and supplies for conducting the test and taking all samples and performance measurements.
5. Prepare performance test report summarizing test method. Include test logs, pertinent calculations, and certification of performance.

3.04 STARTUP TEST PERIOD

A. Test Reports: As applicable to the equipment furnished, certify in writing that:

1. Tanks, pumps, piping systems, and valves have been successfully tested and are fully operational.
2. Equipment systems and subsystems have been checked for proper installation, started, and successfully tested to indicate that they are operational and can perform their intended function.
3. Systems and subsystems are capable of performing their intended functions.
4. Facilities are ready for final testing and their intended operation.

B. Attend planning meetings and arrange for attendants by key major equipment supplier or manufacturer representatives and required, or as required by the Contract Documents.

C. Designate and provide one or more persons to be responsible for coordinating and expediting Contractor's facility startup duties.

- D. When facility startup has commenced, schedule remaining Work so as not to interfere with or delay the completion of facility startup. Support the facility startup activities with adequate staff to prevent delays and process upsets. This staff shall include, but not be limited to, major equipment and system manufacturers' representatives, Subcontractors, electricians, instrumentation personnel, millwrights, pipefitters and plumbers.
- E. Supply and coordinate specified manufacturer's facility startup services, as applicable.
- F. Make adjustments, repairs, and corrections necessary to complete facility startup.
- G. After the facility is operating, complete the testing of those items of equipment, systems, and subsystems which could not be or were not adequately or successfully tested prior to startup test period.

3.05 PARTIAL UTILIZATION

- A. After successful performance testing of a particular equipment type or system, Owner may elect to start up a portion of the equipment or system for continuous operation in accordance with Paragraph 10 of the General Conditions. Such operation will not interfere with testing of other equipment and systems that may still be underway, and shall not preclude the need to startup that portion operated in combination with the rest of the facility when testing is completed.

3.06 CONTINUOUS OPERATIONS

- A. Owner will accept equipment and systems as substantially complete and ready for continuous operation only after successful facility startup is completed and documented, and reports submitted, and manufacturers' services completed for training of Owner's personnel.

END OF SECTION 01650

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SECTION 01700

CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 CONTRACT CLOSEOUT SUBMITTALS

- A. Reference: Paragraph 10, General Conditions and as otherwise required in the Contract Documents.
- B. Record Documents: As required in Section 01720, Record Documents.
- C. Approved Shop Drawings and Samples: As required in Section 01300, Submittals, of the specifications.
- C. Operations and Maintenance Manuals: Provide as required; or in accordance with the individual Specification sections.
- E. Certificates of Testing and Inspection: As required in Paragraph 3.3 of the General Conditions and the individual Specification sections.
- F. Certificate of Substantial Completion as required in Paragraph 10 of the General Conditions.
- G. Special Bonds, Special Warranties, and Service Agreements:
 - 1. Form of Submittals:
 - a. Bind in commercial quality, 8-1/2 by 11-inch three-ring side binders with hardback, clear, plastic covers. Label cover of each binder with typed or printed title 'WARRANTIES AND BONDS,' with title of Project; name, address, and telephone number of Contractor and equipment Supplier; and name of responsible principal.
 - b. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the Specification section in which specified, and the name of the product or Work item.
 - c. Separate each warranty of Bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, Supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - 2. Preparation for Submission: Obtain notarized warranties and bonds, executed in duplicate by responsible Subcontractors, Suppliers, and manufacturers, within ten (10) days after completion of the applicable item or Work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the date of Substantial Completion is determined. Retain warranties, Bonds, service agreements until time specified for submission.
 - 3. Time of Submission:
 - a. For equipment or component parts of equipment put into service during construction to be utilized by Owner in accordance with Paragraph 9.2 of

the General Conditions, submit documents within ten (10) days after the date of Substantial Completion for that part of the work.

- b. Submit other Submittals within twenty (20) days after the date of Substantial Completion and prior to submission of final Application for Payment.
- c. For item of Work, when acceptance is delayed beyond date of Substantial Completion, submit within 10 days after Owner's written acceptance, listing the date of acceptance as the beginning of the warranty period.

G. Certificates of Evidence of Insurance: As required in Paragraph 8.8, General Conditions.

H. Consent of Surety to Final Payment: As required in Paragraph 9.2.5, General Conditions.

I. Releases or Waivers of Liens and Claims: As required in Paragraph 9.2, General Conditions.

J. Spare parts and special tools.

K. Other Required Submittals: In accordance with the Contract Documents.

1.02 FINAL APPLICATION FOR PAYMENT. Submit final Application for Payment in accordance with procedures and requirements of Article 9, General Conditions; Section 01025, Measurement and Payment; and as may otherwise be specified herein.

1.03 FINAL INSPECTION. Reference Paragraph 10.2, General Conditions. Also, all applicable permitting agencies.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 FINAL CLEANING

A. At completion of Work or of a part thereof and immediately prior to Contractor's request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to Contractor's notice of completion, clean entire site or parts thereof, as applicable.

1. Leave the Work and adjacent areas affected in a clean condition satisfactory to Owner.
2. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces. Broom clean exterior paved driveways and parking areas. Hose clean sidewalks, loading areas, and others contiguous with principal structures.
3. Repair, patch, touch up marred surfaces to specified finish and match adjacent surfaces.
4. Rake clean all other surfaces.
5. Leave water courses, gutters, and ditches open and in condition satisfactory to Owner.

- B. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

END OF SECTION 01700

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SECTION 01720

RECORD DOCUMENTS

PART 1 GENERAL

1.01 SUBMITTALS

- A. Quality Control Submittals: Written procedures for maintaining and markup of record documents.
- B. Contract Closeout Submittal: Submit Record Documents in accordance with the requirements of this section. Submit prior to application for final payment.

1.02 QUALITY ASSURANCE

- A. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain record documents.
- B. Accuracy of Records:
 - 1. Coordinate changes within record documents, making legible and accurate entries on each page of Specifications and each sheet of Drawings and other documents where such entry is required to show change.
 - 2. Purpose of Project record documents is to provide factual information regarding aspects of Work, both concealed and visible, to enable future modification of Work to proceed without lengthy and expensive site measurement, investigation, and examination.
- C. Make entries within 24 hours after receipt of information that a change in Work has occurred.
- D. Prior to submitting each request for progress payment, request Owner's review and approval of current status of record documents. Failure to properly maintain, update, and submit record documents may result in return of Contractor's Application for Progress Payment by Owner as provided in Paragraph 9.2 of the General Conditions.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Maintain record documents completely protected from deterioration, loss, and damage until completion of Work.
- B. In event of loss of recorded data, use means necessary to again secure data to Owner's acceptance.
 - 1. Such means shall include, if necessary in Owner's opinion, removal and reconstruction of covering materials, at no cost to Owner.

PART 2 PRODUCTS

2.01 RECORD DOCUMENTS

- A. Promptly following commencement of Contract Times, secure from Owner at no cost to Contractor, one complete set of Contract Documents. Drawings will be half size, 11 by 17 inches.

PART 3 EXECUTION
3.01 MAINTENANCE OF RECORD DOCUMENTS

A. General:

1. Label or stamp each record document with title, "RECORD DOCUMENTS," in neat large printed letters.
2. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.

B. Preservation

1. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
2. Make documents and Samples available at all times for observation by Owner.

C. Making Entries on Drawings

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
 - a. Color Coding:
 - i. Green when showing information deleted from Drawings.
 - ii. Red when showing information added to Drawings.
 - iii. Blue and circled in blue to show notes.
2. Date entries
3. Call attention to entry by "cloud" drawn around area or areas affected.
4. Legibly mark to record actual changes made during construction, including, but not limited to:
 - a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
 - b. Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment or Work. Reference to at least two measurements of permanent surface improvements.
 - c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
 - d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.

- e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, Written Amendment, and Owner's written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.
- 5. Dimensions on Schematic Layouts: Show on record drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
 - a. Clearly identify the item by accurate note such as "cast iron drain," galv. Water," and the like.
 - b. Show, by symbol or note, vertical location of item ("under slab," "in ceiling plenum, " "exposed," and the like).
 - c. Make identification so descriptive that it may be related reliably to Specifications.
- D. Make entries in other pertinent documents as accepted by Owner.
- E. If documents are not accepted by Owner, secure a new copy of that document from Owner at Owner's usual charge for reproduction and handling, and carefully transfer change data to new copy to acceptance of Owner.

END OF SECTION 01720

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SECTION 01730
OPERATING AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Compile, organize, submit, and revise, as directed by the Engineer an Operation and Maintenance Manual for each piece of equipment furnished, as required by the Specifications.
- B. Compile, organize, submit, and revise, as required, the attached Equipment Manufacturer's Certificate of Installation Testing and Instruction for acknowledgement by the Owner.
- C. Compile, submit, and revise as directed by the Engineer, the following attached Computerized Maintenance Management System (CMMS) datasheets for each piece of equipment furnished on this project:
 - 1. CMMS Information Worksheet
 - 2. Spare Parts List
 - 3. PM Program Worksheet
 - 4. Equipment Nameplate data Record

1.02 CONTENT OF MANUAL

- A. Each manual shall be specific to this Contract. All non-applicable information shall be crossed out, and the applicable information shall be highlighted or otherwise indicated in a manner to prevent confusion of those utilizing the manuals.
- B. Each manual shall contain the following information:
 - 1. Neatly typewritten Title Page/Cover Sheet to include:
 - a. Identification of equipment covered by the manual by providing the process name and equipment tag numbers.
 - b. Name of responsible principal, address, telephone number and area of responsibility of:
 - (1) Contractor.
 - (2) Subcontractor or installer.
 - (3) Product manufacturer.
 - (4) Nearest service center or maintenance contract or, as appropriate.
 - (5) Nearest source of supply for parts, materials, supplies or replacement products.
 - 2. Neatly typewritten Table of Contents sheet to include the following manual section headings:

- a. CMMS Data Sheets
 - b. System and Component Description
 - c. Maintenance Schedule
 - d. Installation Instructions
 - e. Operation Procedures
 - f. Maintenance Instructions
 - g. Troubleshooting Guide
 - h. Drawings and Spare Parts Lists
 - i. Technical Data
 - j. Other Components
 - k. Warranties, Bonds and Service Contracts
3. Manual sections shall be manufacturer's original printed information or neatly typewritten pages. Each section shall be tabbed in consecutive order such that the first tab will be Table of Contents.

1.03 MANUALS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT

- A. In addition to the required content as listed in Paragraph 1.02, manuals for electric and electronic equipment shall include:
 1. Circuit directories of panelboards.
 - a. Electrical service.
 - b. Controls and control loops.
 - c. Communications.
 2. As-installed color coded wiring diagrams.
 3. Refer to Division 16 for further requirements.

1.04 MANUALS FOR MATERIALS AND FINISHES

- A. Submit two copies of complete manuals for applied materials, finishes, moisture protection and weather-exposed products in final form only.
- B. Content
 1. Manufacturer's data, giving full information on product.

2. Instructions for care and maintenance.
3. Additional pertinent information as required by the respective Specification sections for the products.

1.05 SUBMITTAL SCHEDULE

- A. Manuals shall be submitted according to the following schedule:
1. Submit three preliminary copies of manuals to the Owner prior to equipment delivery and no later than 30 days following approval of the shop drawings for each piece of equipment. Engineer will review and return one copy with comments.
 2. Submit three revised copies of manuals to the Owner, incorporating comments and revisions required by the Owner and/or Engineer 30 days after initial receipt of the reviewed preliminary manuals and comments from the Engineer. When manufacturer training is required for the subject equipment/system, the training shall not occur until after the revised copies have been approved by the Engineer. These revised copies shall be the source document for such training.
 3. Submit seven final copies of the manuals to the Owner, identical to the revised copies as approved by the Engineer, within 60 days of initial receipt of the approved revised copies from the Engineer, or prior to issuance of a certificate of substantial completion, whichever is earlier. The seven final copies shall be submitted in binders, as detailed in Paragraph 1.06.

1.06 FORM OF MANUAL SUBMITTALS

- A. Format
1. Printed and typewritten sheets shall be standard 8-1/2 inch X 11 inch size.
 2. Paper shall be 20 pound minimum, white, with standard three hole punch pattern, with punched edges of each sheet of final submittals reinforced with plastic, cloth or metal.
 3. All text shall be manufacturer's original printed sheets or neatly typewritten pages.
 4. Sections shall be separated with tabbed index sheets to correlate with the Table of Contents of the manual.
 5. Drawings that are standard 8-1/2 inch x 11 inch size shall also have standard three hole punch pattern with punched edges of each sheet of final submittals reinforced with plastic, cloth or metal. Drawings larger than standard 8-1/2 inch X 11 inch size shall be folded and inserted into standard three hole punch pattern, 8-1/2 inch X 11 inch size, 0.0035 gauge standard pocket plastic sheet protectors.
 6. All diagrams, drawings and illustrations shall be of original quality, reproducible by the dry copy method.

B. Binding:

1. Preliminary and revised manual submittals.
 - a. Commercial quality three ring binders.
 - (1) Cleanable, oil, moisture and wear resistant, vinyl sealed stiff board covers with full size clear plastic/vinyl pockets on front and spine.
 - (2) Ring size to suit thickness of manual content.
2. Final manual submittals.
 - a. Four copies shall be bound in uniform three ring binders as detailed in Paragraph 1.06.B. 1.
 - b. Submit an electronic version of the entire O&M manual on CDs using PDF format, with bookmarks for each piece of equipment included.

1.07 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment and maintenance of products, equipment and systems, at agreed upon times.
- B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- C. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

1.08 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. Equipment furnished under Divisions 11, 13, 15 and 16 shall include the cost of a competent representative of the manufacturers of all equipment to supervise the installation, adjustment and testing of the equipment and to instruct the Owner's operating personnel on operation and maintenance. This supervision may be divided into two or more time periods as required by the installation program or as directed by the Engineer.
- B. See the detailed specifications for additional requirements for furnishing the services of manufacturer's representatives.
- C. A certificate in the form attached to this Section, from the manufacturer and signed by Owner's representative stating that the installation of the equipment is satisfactory, that the unit has been satisfactorily tested, is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of the unit shall be submitted for each piece of equipment furnished on the project.

EQUIPMENT MANUFACTURER'S CERTIFICATE OF INSTALLATION TESTING
AND INSTRUCTION

Owner: _____

Project: _____

Contract No. _____

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

_____ (Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial No.)

installed for the subject project [has] [have] been installed in a satisfactory manner, [has] [have] been satisfactorily tested, [is] [are] ready for operation, and that Owner assigned operating personnel have been suitably instructed in the operation, lubrication, and care of the unit[s] on Date: _____ Time: _____.

CERTIFIED BY: _____ DATE: _____
(Signature of Manufacturer's Representative)

OWNER'S ACKNOWLEDGMENT OF MANUFACTURER'S INSTRUCTION

[I] [We] the undersigned, authorized representatives of the _____ and/or Plant Operating Personnel have received classroom and hands on instruction on the operation, lubrication, and maintenance of the subject equipment and [am] [are] prepared to assume normal operational responsibility for the equipment:

_____ DATE: _____

_____ DATE: _____

_____ DATE: _____

1.2 CMMS Information Worksheet

Asset #	Crit Factor	Asset Location	Safety Require	Asset Name	Asset Description	Cost	Replace Cost	Depreciation No. of Mo.	Warr Exp Date	Manufacturer	Model #	Part #	Serial #	Supplier	Install Date	Purchase Date	Manufactured Date

1.3 Spare Parts List

Asset #	Asset Name	Recommended Spare Part	Cost	Manufacturer/Address /Ph #/Contact Name	Supplier/Address/Ph #/Contact Name	Model #	Part #	Serial #	Purchase Date	Manufactured Date

PM Program Worksheet

Asset #	Asset Name	Task Description	Est Hours	Work Group	Priority 1-4	Freq	LPM Date	Recom Due Date

Form Completed By: _____

Date: _____

EQUIPMENT NAMEPLATE DATA RECORD	
Asset No.:	Location:
Asset Name:	Description:
Supplier Name:	Address/Phone/Contact:
PUMP	
Manufacturer Name:	Address/Phone/Contact:
Description:	
Output:	TDH: Model No.: Serial No.:
Size:	RPM: Type:
Installed Date:	Impeller Data:
Project No.:	Purchase Cost: Vendor:
Remarks:	
MOTOR	
Manufacturer Name:	Address/Phone/Contact
Model No.:	Serial No.:
RPM: Volts:	H.P.: Ph:
Amps: Hz:	EFF/SF: Code:
Frame: Type:	Insul Class:
Design:	Duty:
Remarks:	
COMPONENT	
Manufacturer Name:	Address/Phone/Contact
Model No.:	Serial No.:
Remarks/Specifications:	
GENERIC	
Manufacturer Name:	Address/Phone/Contact:
Remarks/Specifications:	

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SECTION 01740 WARRANTIES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Preparation and submittal of warranties.
- B. Time and schedule of submittals.

1.02 RELATED SECTIONS

- A. Section 00700 - General Conditions: Warranties and correction of work.
- B. Section 01700 - Contract Closeout: Contract closeout procedures.
- C. Section 01730 - Operation and Maintenance Data.
- D. Individual Specifications Sections: Warranties required for specific Products or Work.

1.03 FORM OF SUBMITTALS

- A. Bind in commercial quality 8-1/2 x 11 binders with durable plastic covers.
- B. Cover: Identify each binder with typed or printed title WARRANTIES with title of Project; name, address and telephone number of Contractor [and equipment supplier]; and name of responsible company principal.
- C. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of Product or work item.
- D. Separate each warranty with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

1.04 PREPARATION OF SUBMITTALS

- A. Obtain warranties executed by responsible Subcontractors, suppliers, and manufacturers, within 15 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties until time specified for submittal.

1.05 TIME OF SUBMITTALS

- A. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
- B. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
- C. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing the date of acceptance as the beginning of the warranty period.

END OF SECTION

* * * * *

SECTION 01140

WORK RESTRICTIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for sequencing and scheduling the Work affected by existing site and facility operations, work restrictions, and coordination between construction operations and OWNER operations.

1.02 GENERAL CONSTRAINTS ON SEQUENCE AND SCHEDULING OF WORK

- A. The Highway Booster Pump Station is the Sausalito-Marín City Sanitation District's (OWNER's) only means of transferring wastewater from the collection system to its plant for treatment prior to discharging water to the San Francisco Bay. Impairing the operational capabilities of the pump station or the treatment plant will result in serious environmental damage and monetary fines.
- B. Conduct work in a manner that will not impair the operational capabilities of essential elements of the pump station or treatment process or reduce the capacity of the system below levels sufficient to transfer and treat the raw wastewater to the water quality limitations specified in the OWNER's National Pollutant Discharge Elimination System (NPDES) permit.
- C. Include costs in the bid price for compliance with the specific limitations and constraints and the related general factors pertaining to maintaining the operational capacity of the pump station and downstream treatment facility.

1.03 INTERRUPTION OF OPERATIONS

- A. Execute the Work while the existing facility is in operation to the extent possible.
- B. Indicate required shutdowns of existing facilities or interruptions of existing operations on Progress Schedule. Prior approval from OWNER will be required for each shutdown. Shutdowns will be permitted to the extent that existing operation of the pump station and treatment plant will not be jeopardized and the identified constraints are satisfied.
- C. The OWNER will evaluate each request based on the system's ability to reliably meet capacity demands.
- D. Do not begin alterations until OWNER's written permission has been received.
- E. Unless indicated otherwise, provide 14 days written notice and a 24-hour final written notice to the OWNER and ENGINEER for review and acceptance prior to:
 - 1. Beginning demolition of any facility, utility or equipment.
 - 2. Beginning a piping tie-in to an existing facility or pipe.
 - 3. Draining a tank or structure prior to beginning work adjacent to or inside that tank or structure.

4. Interrupting the power source to an operating facility.
 5. Conducting any other work that will interrupt normal system operations.
- F. The 14 days written notice shall be accompanied with a completed System Outage Request (SOR) to be filled out by the CONTRACTOR. System Outage Requests shall include sketches and written description of the affected areas or processes, bypass and plugging plans, flow and volume calculations, schedule of downtime and service restoration, and other pertinent information for systems or process affected by the shutdown.
- G. The 24-hour final written notice shall identify any major deviations, if any, to the System Outage Request. Major deviations that cannot be reasonably accommodated by OWNER may result in denial of the System Outage Request, and any costs associated with delays that occur as a result of this denial shall be borne solely by the CONTRACTOR.
- H. The CONTRACTOR shall control the release of any sewage volumes temporarily stored in piping or tanks during a shutdown to prevent a rush of flow to the wet well and treatment plant. The CONTRACTOR shall be responsible for any damage caused by the uncontrolled discharge of high flows. The CONTRACTOR shall be held responsible for overburdening the sewer collection system or treatment plant that causes the discharge of sewage into the environment. The CONTRACTOR shall reimburse the OWNER for any fines levied by regulatory agencies due to spills, backups, or overflows resulting from the CONTRACTOR's failure to comply with the requirements herein.
- I. Minimize shutdown times by thorough advanced planning. Have required equipment, materials, and labor on hand, ready for work, at time of shutdown.
- J. All OSHA required lock-out/tag-out safety procedures shall be observed and followed.

1.04 COMPLIANCE WITH NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT AND OTHER REGULATORY PERMITS

- A. The existing system is operating under the terms of a NPDES permit issued by the California Regional Water Quality Control Board San Francisco Bay Region. This permit specifies the water quality limits that the treatment plant must meet prior to discharge of effluent. A copy of the existing permit is on file for review at the treatment plant.
- B. Perform work in a manner that will not prevent the existing system from achieving the discharge water quality requirements established by regulations.
- C. Bear the cost of penalties imposed or scheduled on the OWNER by any regulatory agency for discharge violations caused by actions of the CONTRACTOR.
- D. Bypassing of untreated or partially treated sewage to surface waters or drainage courses is prohibited during construction. When such accidental bypassing occurs as a result of actions of the CONTRACTOR, the OWNER is entitled to take appropriate action and costs incurred will be deducted from progress payments.

1.05 REQUIREMENTS FOR MAINTAINING CONTINUOUS OPERATION OF EXISTING FACILITIES

- A. Facilities or conditions required to keep the existing pump station operational include, but are not limited to, the following:
 - 1. Electrical power including transformers, distribution wiring and motor control centers.
 - 2. Piping for conveyance of wastewater and other utilities to and from the facility.
 - 3. Lighting.
 - 4. Instrumentation, meters, controls and telemetry equipment.
 - 5. Safety equipment and features.
 - 6. Storm drainage.
- B. Conduct the Work and provide temporary facilities required to keep the existing pump station continuously operational.
- C. Do not remove or demolish existing facilities required to keep the existing pump station operational at the capacities specified until the existing facilities are replaced by temporary, new, or upgraded facilities or equipment. The replacement facilities shall have been tested and demonstrated to be operational prior to removing or demolishing existing facilities.

1.06 OPERATIONS AND MAINTENANCE ACCESS

- A. Provide and maintain safe, continuous access to control equipment and deliveries for operations staff and other personnel contracted to perform work at the site.

1.07 SHUTDOWN CONSTRAINTS

- A. Comply with shutdown constraints described herein.
- B. A shutdown is defined herein as that period of time during which a normal collection system, pump station, or treatment plant function and activity cannot take place or are interrupted.

1.08 UTILITIES

- A. Maintain electrical, telephone, gas, sanitary facilities, and other utilities within existing facilities in service. Provide temporary utilities when necessary.
- B. Provide advance notice to and utilize services of Underground Services Alert (U.S.A.) for location and marking of underground utilities operated by utility agencies other than the OWNER.
- C. All work involving electrical service shall be coordinated with PG&E in advance.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 COORDINATION OF WORK

- A. Maintain overall coordination of execution of work.
- B. Obtain construction schedules from subcontractors and suppliers and assume responsibility for correctness.
- C. Incorporate schedules from subcontractors and suppliers into Progress Schedule to plan for and comply with sequencing constraints.
- D. Where proper execution of the Work depends upon work by others, inspect and promptly report discrepancies and defects.

3.02 GENERAL REQUIREMENTS FOR EXECUTION OF WORK

- A. Locate temporary facilities in a manner that minimizes interference to OWNER's operation and maintenance personnel.
- B. Unless otherwise specified, install temporary pipelines of the same size as its connection to the existing facility at the downstream end of the pipeline.
- C. Provide piping of suitable material for the material being conveyed.
- D. Provide submittals on proposed temporary pumping facilities, temporary plugs, and temporary electrical and instrumentation components necessary to maintain existing facilities.
- E. Dimensions for all existing structures, piping, paving, and other nonstructural items are approximate. The CONTRACTOR shall field verify all dimensions and conditions and report any discrepancies to the ENGINEER a minimum of 14 days in advance of any construction in the area and prior to fabrication of materials.
- F. Discrepancies between coordinates, bearings and lengths, and stationing shall be resolved in the following order of precedence:
 - 1. Coordinates.
 - 2. Bearings and lengths.
 - 3. Stationing.

3.03 WORK SEQUENCE AND CONSTRAINTS

- A. General:
 - 1. The Suggested Work Sequence and Constraints presented herein do not necessarily include all items affecting the completion of the Work, but are intended to describe in general the critical events necessary to minimize disruptions of the existing facilities. Utilize the description of critical events in the Suggested Work Sequence and Constraints in this Section as a guideline for scheduling and completing the Work.
 - 2. Additional Constraints may be imposed during the Work depending on CONTRACTOR's sequence of work.

3. No more than one process, piping system, or electrical system may be removed from service at any one time, unless indicated otherwise by the OWNER.
4. Any element not listed herein but requiring a shutdown shall have a maximum shutdown duration of 1 hour for planning purposes. Once these unforeseen shutdowns have been identified, confirm allowed shutdown durations with OWNER prior to starting the work.
5. Unless noted otherwise or as determined by the ENGINEER, the term "Substantially Complete" referenced in this Section for any item shall be defined as when all structural, mechanical, HVAC, electrical, instrumentation, and other incidental Work necessary to render that item of Work complete and ready for operation by the OWNER at the OWNER's discretion.

B. Removing Facilities from Service:

1. The OWNER will be responsible for taking existing equipment out of service. CONTRACTOR shall coordinate shutdown and restart activities with the OWNER's operations staff.
2. The CONTRACTOR shall be responsible for draining structures, removing accumulated materials and debris, and cleaning drained facilities prior to commencing work:
 - a. OWNER will be responsible for the operation of all existing equipment including valves, gates, pumps, and other equipment that impacts system operation. While reasonable efforts will be made by OWNER to positively shut-off valves, gates, and other isolation devices, CONTRACTOR shall plan for and provide means in his work to drain and dispose of the pipe contents, and remove any liquid leakage, dripping, and spills from the shut-off device or the isolated pipe in a manner without impacting his work.
 - b. Contents removed from structures and pipes shall be disposed by the CONTRACTOR.
3. The following structures may require isolation depending on the CONTRACTOR's sequence of work. Some of these structures have existing valves. Where temporary isolation of any of these structures is required per the Contract Documents or as determined by the CONTRACTOR to complete the WORK, CONTRACTOR shall provide the required temporary equipment such as plugs, stop plates, or other isolation devices necessary for isolation of these structures. Coordinate installation of all isolation devices with their respective work sequence activities and with OWNER's operations staff to minimize negative impacts on system operation:
 - a. Highway Booster Lined 8" CIP Force Main
 - b. Highway Booster Pump Station Wet Well.
 - c. Highway Booster Pump Station Dry Well.
 - d. Sewer Manholes.
 - e. Associated sewer lines.
 - f. Power and control system.

C. Work in Highway Booster Lined 8" CIP Force Main:

1. Suggested Work Sequence:
 - a. Install and test bypass pump system from the existing bypass vault to a baker tank or other means of storage supplied by the Contractor.

- b. District will shut 8" gate valve at 16" force main, and arrange for a 1-hour temporary shut-down of the 8" force main to allow contractor to make connections for temporary bypass in order to clean and CCTV force main.
 - c. If 8" gate valve cannot be closed, then Contractor shall excavate; install a line stop immediately upstream of the existing gate valve; and install a new 8" gate valve.
 - d. Place temporary bypass system in service and drain force main back to baker tank using temporary bypass system.
 - e. Clean and CCTV force main.
 - f. Drain and clean temporary piping into baker tank.
 - g. Decommission temporary bypass pumping system.
2. Connection and Shutdown Constraints:
- a. All work in the force main shall occur in the dry season between May 1 and September 30.
 - b. New valve on force main (if required) shall be operational and capable of discharge to the treatment plant by September 30.
 - c. Duration of the 8" force main shutdown shall not exceed 1 day.

D. New Manhole Construction

1. Suggested Work Sequence:
- a. Field verify conditions in upstream manhole, dimensions, elevations and other information to properly fabricate temporary bypass pumping system required to bypass existing 10" SS line and SSMH 570000.
 - b. Install temporary bypass pump(s) and piping to divert flow from 10" SS pipeline from SSMH upstream of new 48" SSMH directly to the wet well.
 - c. Substantially complete all work related to installation of new SSMH and 10" SS line; flow meter vault, valve vault, and associated force main.
 - d. Decommission bypass pumping system as soon as possible following completion of work.
2. Connection and Shutdown Constraints:
- a. All work in the sewer collection system shall occur between May 1 and November 15.
 - b. Minimize noise and visual impacts caused by bypass pumping during the course of work.
 - 1) Conduct all work during normal working hours unless otherwise approved by the ENGINEER.
 - 2) Any temporary engine driven equipment such as diesel engine driven generators or pumps shall be sound attenuated and provided with a secondary sound attenuation enclosure rated for 60 dBA at 20 feet.

E. Work in Highway Booster Pump Station Dry Well (New Wet Well) and Existing Wet Well:

1. Suggested Work Sequence:
- a. Install temporary bypass pump(s) and piping to divert flow from new or existing SSMH to force main at the existing bypass vault.
 - b. Conduct work while temporary bypass system is in service.
 - c. Drain discharge piping into wet well.
 - d. Perform roof and mechanical demolition work.
 - e. Plug holes and sump in Dry Well as shown on the Drawings.
 - f. Epoxy injection grout dry well joints.

- g. Substantially complete mechanical work in the dry well including pump replacement, pipe and valve installation, pipe penetrations and system testing as shown on the Drawings and make connection to force main.
 - h. Replace roof.
 - i. Coat interior of wet well.
 - j. Demolish equipment in control room, repair concrete, and plug holes in wall.
 - k. Clean and fill existing wet well with cellular concrete, level floor, paint interior and exterior of control room, replace door.
 - l. Install control panels and complete electrical work.
 - m. Restore flow to the wet well and place pumps P-1 and P-2 in service.
 - n. Decommission temporary bypass pumping system.
 - o. Complete all other miscellaneous work that can be done without impacting pump station operation.
2. Connection and Shutdown Constraints:
- a. All work in the dry well shall occur between May 1 and November 15.
 - b. Do not discontinue bypass pumping until at least one out of two pumps in the pump station is fully operational and capable of pumping flows to the treatment plant.

F. Electrical:

- 1. General:
 - a. All electrical outages must be scheduled with the Owner a minimum of fourteen (14) calendar days in advance.
 - b. The start and end of all electrical outages must occur between the hours of 8AM and 4PM Monday through Friday, except as otherwise noted herein.
 - c. The hours for maximum outage times are consecutive hours, not working hours.
- 2. Standby Power Requirements:
 - a. The pump station shall always have two sources of power.
 - b. Normally the two sources of power shall be PG&E power source and one of the following:
 - 1) Existing portable generator source.
 - 2) New stationary generator source supplied by Contractor.
 - c. During PG&E switchover, the two sources shall be the existing portable and new stationary power sources.
- 3. Suggested Work Sequence and Constraints:
 - a. For PG&E service switch-over sequence and detailed requirements and constraints, refer to electrical drawings and Section 16000.

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SECTION 01329

SAFETY PLAN

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Development and maintenance of a Construction Safety Plan.

1.02 REFERENCES

- A. California Labor Code, Section 6401.7.
- B. National Fire Protection Association (NFPA):
 - 1. 70E - Standard for Electrical Safety in the Workplace.
- C. Occupational Safety and Health Standards (OSHA).

1.03 CONSTRUCTION SAFETY PLAN

- A. Detail the Methods and Procedures to comply with California Labor Code Section 6401.7, NFPA 70E, Federal, and Local Health and Safety Laws, Rules and Requirements for the duration of the Contract Times. Methods and procedures must also comply with the Owner's Safety Plan. Include the following:
 - 1. Identification of the Certified or Licensed Safety Consultant who will prepare, initiate, maintain and supervise safety programs, and procedures.
 - 2. Procedures for providing workers with an awareness of safety and health hazards expected to be encountered in the course of construction.
 - 3. Safety equipment appropriate to the safety and health hazards expected to be encountered during construction. Include warning devices, barricades, safety equipment in public right-of-way and protected areas, safety equipment used in multi-level structures, personal protective equipment (PPE) as required by NFPA 70E.
 - 4. Methods for minimizing employees' exposure to safety and health hazards expected during construction.
 - 5. Procedures for reporting safety or health hazards.
 - 6. Procedures to follow to correct a recognized safety and health hazard.
 - 7. Procedures for investigation of accidents, injuries, illnesses, and unusual events that have occurred at the construction site.
 - 8. Periodic and scheduled inspections of general work areas and specific workstations.
 - 9. Training for employees and workers at the jobsite.
 - 10. Methods of communication of safe working conditions, work practices and required personal protection equipment.
 - 11. Provision of a site specific emergency action and evaluation plan.
 - 12. Verify safety plan includes reference to and compliance with latest Owner safety policies.

- B. Assume sole responsibility for every aspect of Health and Safety on the jobsite, including the health and safety of subcontractors, suppliers, and other persons on the jobsite:
 - 1. Forward available information and reports to the Safety Consultant who shall make the necessary recommendations concerning worker health and safety at the jobsite.
 - 2. Employ additional health and safety measures specified by the Safety Consultant, as necessary, for workers in accordance with OSHA guidelines.
- C. Transmit to Owner and Engineer copies of reports and other documents related to accidents or injuries encountered during construction.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01354

HAZARDOUS MATERIAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Procedures required when encountering hazardous materials at the Work site.

1.02 REFERENCES

- A. California Code of Regulations (CCR):
 - 1. Title 8: Industrial Relations.
 - 2. Title 22: Social Security.
- B. California Occupational Safety and Health Administration (Cal-OSHA).
- C. United States Code of Federal Regulation (CFR):
 - 1. Title 29 - Labor:
 - a. 1926.62 - Lead.
 - 2. Title 40 - Protection of Environment.
 - a. 261 - Identification and Listing of Hazardous Waste.

1.03 SUBMITTALS

- A. Submit laboratory reports, hazardous material removal plans, and certifications.

1.04 DEFINITIONS

- A. Asbestos Cement Pipe: Also commonly referred to as AC Transite Pipe, AC pipe or ACP. Pipe that is generally composed of cement and asbestos fibers.
- B. Competent Person: A trained worker who is capable of identifying existing and predictable asbestos hazards, perform exposure assessment and monitoring, is qualified to train other workers, and has the authority to take immediate corrective action to eliminate a hazardous exposure.

1.05 HAZARDOUS MATERIALS PROCEDURES

- A. Hazardous materials are those defined by 40 CFR and State specific codes.
- B. When hazardous materials have been found:
 - 1. Prepare and initiate implementation of plan of action.
 - 2. Notify immediately Owner, Engineer, and other affected persons.
 - 3. Notify such agencies as are required to be notified by Laws and Regulations with the times stipulated by such Laws and Regulations.
 - 4. Designate a Certified Industrial Hygienist to issue pertinent instructions and recommendations for protection of workers and other affected persons' health and safety.

5. Identify and contact subcontractors and licensed personnel qualified to undertake storage, removal, transportation, disposal, and other remedial work required by, and in accordance with, laws and regulations.
- C. Forward to Engineer, copies of reports, permits, receipts, and other documentation related to remedial work.
- D. Assume responsibility for worker health and safety, including health and safety of subcontractors and their workers.
 1. Instruct workers on recognition and reporting of materials that may be hazardous.
- E. File requests for adjustments to Contract Times and Contract Price due to the finding of Hazardous Materials in the Work site in accordance with Contract Documents.
 1. Minimize delays by continuing performance of the Work in areas not affected by hazardous materials operations.

1.06 ASBESTOS MATERIALS

- A. It is the specific intent of these Contract Documents to exclude from the Work any and all products or materials containing asbestos. No products containing asbestos shall be incorporated in the Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01410

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Regulatory authorities and codes.

1.02 AUTHORITIES HAVING JURISDICTION

- A. Sausalito Marin City Sanitary District Discharge Permit.
- B. Building Department: Marin County.
- C. Fire Department: Southern Marin Fire Protection District.
- D. Caltrans Encroachment Permit.

1.03 APPLICABLE CODES

- A. California Code of Regulations (CCR), California Building Standards Code, CCR Title 24:
 - 1. Building code:
 - a. California Building Code (CBC), Title 24, Part 2 – 2013.
 - 2. Electrical code:
 - a. California Electrical Code (CEC), Title 24, Part 3 – 2013.
 - 3. Existing building code
 - a. California Existing Building Code (CEBC), Title 24, Part 10 – 2013.
 - 4. Fire code:
 - a. California Fire Code (CFC), Title 24, Part 9 – 2013.
 - 5. Green building standards code:
 - a. California Green Building Standards Code (Cal Green), Title 24, Part 11 – 2013.
 - 6. Historical building code:
 - a. California Historical Building Code (CHBC), Title 24, Part 8 – 2013.
 - 7. Mechanical code:
 - a. California Mechanical Code (CMC), Title 24, Part 4 – 2013.
 - 8. Plumbing code:
 - a. California Plumbing Code (CPC), Title 24, Part 5 – 2013.
 - 9. Energy code:
 - a. California Energy Code (CEC), Title 24, Part 6 – 2013.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01455

SPECIAL TESTS AND INSPECTIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: This Section describes the requirements for providing special tests and inspections.
- B. Related sections:
 - 1. Section 01400 - Quality Control.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C140 -Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 - 2. C270 - Standard Specification for Mortar for Unit Masonry.
 - 3. C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 - 4. C1019 - Standard Test Method for Sampling and Testing Grout.
 - 5. C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
- B. California Building Code (CBC).

1.03 DESCRIPTION

- A. This Section describes special tests and inspections of structural assemblies and components to be performed in compliance with CBC.
- B. These special tests and inspections are in addition to the requirements specified in Section 01400, and by the individual Sections.
- C. The Owner will employ 1 or more inspectors who will provide special inspections during construction.

1.04 INSPECTION

- A. Duties of Special Inspector:
 - 1. General: Required duties of the Special Inspector are described in CBC.

1.05 TESTS

- A. Selection of the material required to be tested shall be by the Owner's Testing Laboratory and not the Contractor.

1.06 SPECIAL TESTING AND INSPECTIONS

- A. Testing laboratory: Special tests will be performed by the Owner's testing laboratory as specified in Section 01450.
- B. Owner reserves the right to positive material identification tests.
 - 1. Contractor must make materials available for testing.
- C. The following types of work require special inspection as described in CBC, Refer to the following verification, testing and inspection schedules.
 - 1. Appendix A, Cast-In-Place Concrete Special Inspection Schedule.
 - 2. Appendix B, Essential Mechanical and Electrical Inspection Schedule.
 - 3. Appendix C, Structural Steel Special Inspection Schedule.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 SCHEDULE

- A. The Contractor shall allow time necessary for Special Inspections as listed above.
- B. Sufficient notice shall be given so that the Special Inspections can be performed. This includes time for off-site Special Inspectors to plan the inspection and travel to site.

3.02 PROCEDURE

- A. The Special Inspector will immediately notify the Engineer of any corrections required and follow notification with appropriate documentation.
- B. The Contractor shall not proceed until the work is satisfactory to the Engineer.

END OF SECTION

APPENDIX A
CAST-IN-PLACE CONCRETE SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Reference Standard	Frequency of Inspection	
		Continuous During Task Listed	Periodic During Task Listed
1. Inspection of reinforcing steel, including prestressing tendons, and placement.		–	X
2. Inspection of reinforcing steel welding.	IBC Table 1704.3, Item 5B	–	–
3. Inspect bolts to be installed in concrete prior to and during placement of concrete.		X	–
4. Verifying use of required design mix.		–	X
5. At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.		X	–
6. Inspection of concrete and shotcrete placement for proper application techniques.		X	–
7. Inspection for maintenance of specified curing temperature and techniques.		–	X

**APPENDIX B
ESSENTIAL MECHANICAL AND ELECTRICAL
INSPECTION SCHEDULE**

Verification and Inspection	Reference Standard	Frequency of Inspection	
		Continuous During Task Listed	Periodic During Task Listed
1. Anchorage of electrical equipment for emergency standby power.		—	X
2. Anchorage of other electrical or mechanical equipment over 1,000 lb. on floors or roofs.		—	X
3. Anchorage of pipelines greater than 8 inches in diameter.		—	X

APPENDIX C
STRUCTURAL STEEL SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Reference Standard	Frequency of Inspection	
		Continuous During Task Listed	Periodic During Task Listed
1. Material verification of high-strength bolts, nuts and washers:			
a. Identification markings to conform to ASTM standards specified in the approved construction documents.		—	X
b. Manufacturer's certificate of compliance required.		—	X
2. Inspection of high-strength bolting:			
a. Bearing-type connections.		—	X
b. Slip-critical connections.		X	X
3. Material verification of structural steel:			
a. Identification markings to conform to ASTM standards specified in the approved construction documents.		—	X
b. Manufacturers' certified mill test reports.		X	—
4. Material verification of weld filler materials:			
a. Identification markings to conform to AWS specification in the approved construction documents.		—	X
b. Manufacturer's certificate of compliance required.		—	X
5. Inspection of welding:			
a. Structural steel:		—	—
1) Complete and partial penetration groove welds.		X	—
2) Multi-pass fillet welds.		X	—
3) Single-pass fillet welds > 5/16".		X	—
4) Single-pass fillet welds ≤ 5/16".		—	X
5) Floor and deck welds.		—	X
b. Reinforcing steel:		—	—
1) Verification of weldability of reinforcing steel other than ASTM A706.		—	X
2) Reinforcing steel-resisting flexural and axial forces in boundary elements of special reinforced concrete shear walls and shear reinforcement.		X	—
3) Shear reinforcement.		X	—
4) "Form Saver" (reinforcing couplers).		X	—

Verification and Inspection	Reference Standard	Frequency of Inspection	
		Continuous During Task Listed	Periodic During Task Listed
6. Inspection of steel frame joint details for compliance with approved construction documents:			X
a. Details such as bracing and stiffening.		X	—
b. Member locations.		X	—
c. Application of joint details at each connection.		X	
7. Seismic force resisting systems identified on structural plans.		X	—

SECTION 01605
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Product requirements; product selection; product options and substitutions; quality assurance; delivery, handling, and storage; and manufacturer's instructions.
- B. Related section:
 - 1. Section 01730 - Operation and Maintenance Data.
 - 2. Section 09960 - High-Performance Coatings.

1.02 DEFINITIONS

- A. Execution: Inclusive of performance, workmanship, installation, erection, application, field fabrication, field quality control, and protection of installed products.
- B. Products: Inclusive of material, equipment, systems, shop fabrications, mixing, source quality control.

1.03 REFERENCES

- A. American National Standards Institute (ANSI).

1.04 PRODUCT REQUIREMENTS

- A. Comply with Specifications and referenced standards as minimum requirements.
- B. Provide products by same manufacturer when products are of similar nature, unless otherwise specified.
- C. Provide identical products when products are required in quantity.
- D. Provide products with interchangeable parts whenever possible.
- E. Require each equipment manufacturer to have maintenance facilities meeting the following requirements:
 - 1. Minimum 3 years operational experience.
 - 2. Location in continental United States.
 - 3. Equipment and tools capable of making repairs.
 - 4. Staff qualified to make repairs.
 - 5. Inventory of maintenance spare parts.

1.05 PRODUCT SELECTION

- A. When products are specified by standard or specification designations of technical societies, organizations, or associations only, provide products that meet or exceed reference standard and Specifications.
- B. When products are specified with names of manufacturers but no model numbers or catalog designations, provide:
 - 1. Products by one of named manufacturers that meet or exceed Specifications.
 - 2. Approved or equal.
- C. When products are specified with names of manufacturers and model numbers or catalog designations, provide:
 - 1. Products with model numbers or catalog designations by one of named manufacturers.
 - 2. Approved or equal.
- D. When products are specified with names of manufacturers, but with brand or trade names, model numbers, or catalog designations by one manufacturer only, provide:
 - 1. Products specified by brand or trade name, model number, or catalog designation.
 - 2. Products by one of named manufacturers proven in accordance with requirements for or equals to meet or exceed quality, appearance and performance of specified brand or trade name, model number, or catalog designation.
 - 3. Approved or equal.
- E. When Products are specified with only one manufacturer followed by "or Equal," provide:
 - 1. Products meeting or exceeding Specifications by specified manufacturer.
 - 2. Approved or equal.

1.06 QUALITY ASSURANCE

- A. Employ entities that meet or exceed specified qualifications to execute the Work.
- B. Inspect conditions before executing subsequent portions of the Work. Accept responsibility for correcting unsatisfactory conditions upon executing subsequent portions of the Work.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

1.07 DELIVERY, HANDLING, STORAGE, AND PROTECTION

- A. Prepare products for shipment by:
 - 1. Applying grease and lubricating oil to bearings and similar items.
 - 2. Separately packing or otherwise suitably protecting bearings.
 - 3. Tagging or marking products to agree with delivery schedule or shop drawings.
 - 4. Including complete packing lists and bills of material with each shipment.
 - 5. Packaging products to facilitate handling and protection against damage during transit, handling, and storage.
 - 6. Securely attach special instructions for proper field handling, storage, and installation to each piece of equipment before packaging and shipment.
- B. Mandatory requirements prior to shipment of equipment:
 - 1. Engineer approved shop drawings.

2. Engineer approved Manufacturer's Certificate of Source Testing.
 3. Submit draft operations and maintenance manuals, as specified in Section 01730.
- C. Transport products by methods that avoid product damage. Deliver products in undamaged condition in manufacturer's unopened containers or packaging.
- D. Provide equipment and personnel to handle products by methods to prevent soiling or damage.
- E. Upon delivery, promptly inspect shipments.
1. Verify compliance with Contract Documents, correct quantities, and undamaged condition of products.
 2. Immediately store and protect products and materials until installed in Work.
 3. Acceptance of shipment does not constitute final acceptance of equipment.
- F. Furnish covered, weather-protected storage structures providing a clean, dry, noncorrosive environment for all mechanical equipment, valves, architectural items, electrical and instrumentation equipment and special equipment to be incorporated into this project.
1. Storage of equipment shall be in strict accordance with the "instructions for storage" of each equipment supplier and manufacturer including connection of heaters, placing of storage lubricants in equipment, etc.
 2. The Contractor shall furnish a copy of the manufacturer's instructions for storage to the Engineer prior to storage of all equipment and materials.
 3. Corroded, damaged, or deteriorated equipment and parts shall be replaced before acceptance of the project.
 4. Equipment and materials not properly stored will not be included in an application for payment.
- G. Store products with seals and legible labels intact.
- H. Store moisture sensitive products in weathertight enclosures.
- I. Maintain products within temperature and humidity ranges required or recommended by manufacturer.
- J. Maintain storage areas at ambient temperatures recommended by manufacturer.
- K. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Repaint damaged painted surfaces.
- L. Exterior storage of fabricated products:
1. Place on aboveground supports that allow for drainage.
 2. Cover products subject to deterioration with impervious sheet covering.
 3. Provide ventilation to prevent condensation under covering.
- M. Store loose granular materials on solid surfaces in well-drained area. Prevent materials mixing with foreign matter.
- N. Provide access for inspection.

- O. Maintain equipment per the manufacturer's recommendation and industry standards, including oil changes, rotation, etc. Provide a log of equipment maintenance to the Engineer on a monthly basis.
 - 1. Rotation log shall include, as a minimum, the equipment identification, date stored, date removed from storage, copy of manufacturer's recommended storage guidelines, date of rotation of equipment, and signature of party performing rotation.
- P. Protection after installation:
 - 1. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove covering when no longer needed.

1.08 MANUFACTURER'S INSTRUCTIONS

- A. Deliver, handle, store, install, erect, or apply products in accordance with manufacturer's instructions, Contract Documents, and industry standards.
- B. Periodically inspect to assure products are undamaged and maintained under required conditions.
- C. Provide operations and maintenance manuals as specified in Section 01782:
 - 1. Draft versions submitted prior to equipment shipment to project.
 - 2. Final version submitted and approved no later than 60 days prior to Owner Training.

1.09 SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS

- A. Provide spare parts, maintenance products, and special tools as required by Specifications.
- B. Box, tag, and clearly mark items.
- C. Store spare parts, maintenance products, and special tools in enclosed, weather-proof, and lighted facility during the construction period.
 - 1. Contractor is responsible for spare parts and special tools until acceptance by Owner.
 - 2. Protect parts subject to deterioration, such as ferrous metal items and electrical components with appropriate lubricants, desiccants, or hermetic sealing.

PART 2 PRODUCTS

2.01 SPARE PARTS AND SPECIAL TOOLS

- A. Spare parts and special tools inventory list, see Appendix A:
 - 1. Equipment tag number.
 - 2. Equipment manufacturer.
 - 3. Subassembly component, if appropriate.
 - 4. Quantity.
 - 5. Storage location.
- B. Large items:
 - 1. Weight: Greater than 50 pounds.
 - 2. Size: Greater than 24 inches wide by 18 inches high by 36 inches long.
 - 3. Stored individually.

4. Clearly labeled:
 - a. Equipment tag number.
 - b. Equipment manufacturer.
 - c. Subassembly component, if appropriate.
- C. Smaller items:
 1. Weight: Less than 50 pounds.
 2. Size: Less than 24 inches wide by 18 inches high by 36 inches long.
 3. Stored in spare parts box.
 4. Clearly labeled:
 - a. Equipment tag number.
 - b. Equipment manufacturer.
 - c. Subassembly component, if appropriate.
- D. Spare parts and special tools box:
 1. Wooden box:
 - a. Size: 24 inches wide by 18 inches high by 36 inches long.
 2. Hinged wooden cover.
 - a. Strap type hinges.
 - b. Locking hasp.
 - c. Spare parts inventory list taped to underside of cover.
 3. Coating: As specified in Section 09960.
 4. Clearly labeled:
 - a. The words "Spare Parts and/or Special Tools".
 - b. Equipment tag number.
 - c. Equipment manufacturer.

PART 3 EXECUTION

3.01 CLOSEOUT ACTIVITIES

- A. Owner may request advanced delivery of spare parts and special tools.
 1. Deduct the delivered items from inventory and provide transmittal documentation.
- B. Immediately prior to the date of Substantial Completion, arrange to deliver spare parts and special tools to Owner at a location on site chosen by the Owner.
 1. Provide itemized list of spare parts and special tools that matches the identification tag attached to each item.
 2. Owner and Engineer will review the inventory and the itemized list to confirm it is complete and in good condition prior to signing for acceptance.

3.02 ATTACHMENTS

- A. Appendix A - Spare Parts and Special Tools Inventory List.

END OF SECTION

APPENDIX A
SPARE PARTS AND SPECIAL TOOLS INVENTORY LIST

Owner: _____ **Date:** _____
Contractor: _____ **Project No.:** _____
Project Name: _____

Inventory List				
Spec Number: _____ Spec Title _____				
Equipment Tag No.: _____ Equipment Manufacturer: _____				
Quantity	Subassembly Component	Description	Manufacturer's Part Number	Storage Location

SECTION 01610

PROJECT DESIGN CRITERIA

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Project design criteria such as temperature and site elevation.

1.02 PROJECT DESIGN CRITERIA

- A. All equipment and materials for the project are to be suitable for performance in wastewater pump station environment and under following conditions:
 - 1. Design temperatures are:
 - a. Outdoor temperatures: 30 to 110 degrees Fahrenheit.
 - b. Indoor temperatures for the following buildings:
 - 1) Process areas: 40 to 90 degrees Fahrenheit.
 - 2) Electrical rooms: 40 to 90 degrees Fahrenheit.
 - 3) Wastewater Temperatures: 60 to 75 degrees Fahrenheit.
 - 2. Design groundwater elevation: 10.0.
 - 3. Moisture conditions: Defined in individual equipment sections and as indicated on the drawings.
 - 4. Site elevation: Approximately 13 feet above mean sea level.
 - 5. Marine environment with coastal fog and sea salt spray.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01612

SEISMIC DESIGN CRITERIA

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Seismic design criteria for the following:
 - 1. Anchorage of mechanical and electrical equipment.
 - 2. Seismic design and design of anchorage for small tanks fabricated off site and shipped to the Project site.
 - 3. Other structures or items as specified or indicated on the Drawings.
- B. Related sections:
 - 1. Section 01410 - Regulatory Requirements.
 - 2. Section 03055 - Adhesive-Bonded Reinforcing Bars and All-Thread Rods.
 - 3. Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

1.02 REFERENCES

- A. American Society of Civil Engineers (ASCE):
 - 1. 7-10 - Minimum Design Loads for Buildings and Other Structures.

1.03 SYSTEM DESCRIPTION

- A. Design in accordance with the requirements of the building code as specified in Section 01410:
- B. Design spectral acceleration at short period, S_{DS} : 1.001.
- C. Design of non-structural components and their connections to structures:
 - 1. Component amplification factor, a_p : In accordance with ASCE 7, Tables 13.5-1 and 13.6-1
 - 2. Component response modification factor, R_p : In accordance with ASCE 7, Tables 13.5-1 and 13.6-1.
 - 3. Component importance factor, I_p : 1.5.
- D. Seismic Design Category (SDC): D.
- E. Design requirements: Anchorage of equipment to structures.
 - 1. Do not use friction to resist sliding due to seismic forces. Do not design or provide connections that use friction to resist seismic loads. Resist seismic forces through direct tension and/or shear on anchors and fasteners.
 - 2. Do not use more than 60 percent of the weight of the mechanical and electrical equipment for designing anchors for resisting overturning due to seismic forces.
 - 3. Do not use more than 60 percent of the weight of the tank for resisting overturning due to seismic forces.

4. Anchoring and fastening to concrete and masonry:
 - a. Provide anchors specified in Sections 03055 and 05190.

1.04 SUBMITTALS

- A. Shop drawings and calculations: Complete shop drawings and seismic calculations.
- B. Calculations shall be signed and stamped by a civil or structural engineer licensed in the state where the Project is located.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01756

COMMISSIONING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for equipment and system testing and facility start-up, including the following:
 - 1. Start-up plan.
 - 2. Performance testing.
 - 3. General start-up and testing procedures.
 - 4. Functional testing.
 - 5. Operational testing.
 - 6. Certificate of proper installation.
 - 7. Services of manufacturer's representatives.
 - 8. Training of OWNER's personnel.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 15050 - Common Work Results for Mechanical Equipment.
 - b. Section 15958 - Mechanical Equipment Testing.

1.02 GENERAL TESTING, TRAINING, AND START-UP REQUIREMENTS

- A. Contract requirements: Testing, training, and start-up are requisite to the satisfactory completion of the Contract.
- B. Complete testing, training, and start-up within the Contract Times.
- C. Allow realistic durations in the Progress Schedule for testing, training, and start-up activities.
- D. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing functional testing, performance testing, and operational testing.
- E. Provide competent, experienced technical representatives of equipment manufacturers for assembly, installation and testing guidance, and operator training.

1.03 START-UP PLAN

- A. Submit start-up plan for each piece of equipment and each system not less than 3 weeks prior to planned initial start-up of equipment or system.
- B. Provide detailed sub-network of Progress Schedule with the following activities identified:
 - 1. Manufacturer's services.
 - 2. Installation certifications.
 - 3. Operator training.
 - 4. Submission of Operation and Maintenance Manual.
 - 5. Functional testing.
 - 6. Performance testing.
 - 7. Operational testing.
- C. Provide testing plan with test logs for each item of equipment and each system when specified. Include testing of alarms, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.
- D. Provide summary of shutdown requirements for existing systems that are necessary to complete start-up of new equipment and systems.
- E. Revise and update start-up plan based upon review comments, actual progress, or to accommodate changes in the sequence of activities.

1.04 PERFORMANCE TESTING

- A. Test equipment for proper performance at point of manufacture or assembly when specified.
- B. When source quality control testing is specified:
 - 1. Demonstrate equipment meets specified performance requirements.
 - 2. Provide certified copies of test results.
 - 3. Do not ship equipment until certified copies have received written acceptance from ENGINEER. Written acceptance does not constitute final acceptance.
 - 4. Perform testing as specified in the equipment sections.
- C. Include costs associated with witnessing performance tests in the bid price. Include costs for 2 OWNER's representatives for travel, lodging, transportation to and from lodging, and 50 dollars meal allowance per person per day.

1.05 GENERAL START-UP AND TESTING PROCEDURES

- A. Mechanical systems: As specified in the individual equipment Sections and Sections 15050 and 15958:
 - 1. Remove rust preventatives and oils applied to protect equipment during construction.
 - 2. Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.
 - 3. Flush fuel system and provide fuel for testing and start-up.
 - 4. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.
 - 5. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.

6. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
 7. Perform cold alignment and hot alignment to manufacturer's tolerances.
 8. Adjust V-belt tension and variable pitch sheaves.
 9. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to insure no leakage, but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.
 10. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.
 11. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to operational testing.
- B. Electrical systems: As specified in Division 16 and the individual equipment Sections:
1. Perform insulation resistance tests on all conductors except conductors for 120 V lighting and conductors for control signals that are completely internal to electrical panels.
 2. Perform continuity tests on grounding systems.
 3. Test and set switchgear and circuit breaker relays for proper operation.
 4. Perform direct current high potential tests on all cables that will operate at more than 2,000 volts. Obtain services of independent testing lab to perform tests.
 5. Check motors for actual full load amperage draw. Compare to nameplate value.
- C. Instrumentation systems: As specified in Division 13 and the individual equipment Sections:
1. Bench or field calibrate instruments and make required adjustments and control point settings.
 2. Leak test pneumatic controls and instrument air piping.
 3. Energize transmitting and control signal systems, verify proper operation, ranges, and settings.

1.06 FUNCTIONAL TESTING

- A. Perform checkout and performance testing as specified in the individual equipment Sections.
- B. Functionally test mechanical and electrical equipment, and instrumentation and controls systems for proper operation after general start-up and testing tasks have been completed.
- C. Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration. Perform initial checks in the presence of and with the assistance of the manufacturer's representative.
- D. Demonstrate proper operation of each instrument loop function including alarms, local and remote controls, instrumentation, and other equipment functions. Generate signals with test equipment to simulate operating conditions in each control mode.
- E. Conduct continuous 8-hour test under full load conditions. Replace parts that operate improperly.

1.07 OPERATIONAL TESTING

- A. After completion of operator training, conduct operational test of the entire facility. Demonstrate satisfactory operation of equipment and systems in actual operation.
- B. Conduct operational test for continuous 7-day period.

- C. OWNER will provide operations personnel, power, fuel, and other consumables for duration of test.
- D. Immediately correct defects in material, workmanship, or equipment that became evident during operational test.
- E. Repeat operational test when malfunctions or deficiencies cause shutdown or partial operation of the facility or results in performance that is less than specified.

1.08 CERTIFICATE OF PROPER INSTALLATION

- A. At completion of Functional Testing, furnish written report prepared and signed by manufacturer's authorized representative, certifying equipment:
 - 1. Has been properly installed, adjusted, aligned, and lubricated.
 - 2. Is free of any stresses imposed by connecting piping or anchor bolts.
 - 3. Is suitable for satisfactory full-time operation under full load conditions.
 - 4. Operates within the allowable limits for vibration.
 - 5. Controls, protective devices, instrumentation, and control panels furnished as part of the equipment package are properly installed, calibrated, and functioning.
 - 6. Control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown have been tested and are properly functioning.
- B. Furnish written report prepared and signed by the electrical and/or instrumentation subcontractor certifying:
 - 1. Motor control logic that resides in motor control centers, control panels, and circuit boards furnished by the electrical and/or instrumentation subcontractor has been calibrated and tested and is properly operating.
 - 2. Control logic for equipment start-up, shutdown, sequencing, interlocks, and emergency shutdown has been tested and is properly operating.
 - 3. Co-sign the reports along with the manufacturer's representative and subcontractors.

1.09 TRAINING OF OWNER'S PERSONNEL

- A. Provide operations and maintenance training for items of mechanical, electrical, and instrumentation equipment. Utilize manufacturer's representatives to conduct training sessions.
- B. Coordinate training sessions to prevent overlapping sessions. Arrange sessions so that individual operators and maintenance technicians do not attend more than 2 sessions per week.
- C. Provide Operation and Maintenance Manual for specific pieces of equipment or systems 1 month prior to training session for that piece of equipment or system.
- D. Satisfactorily complete functional testing before beginning operator training.
- E. Training sessions: Provide training sessions for equipment as specified in the individual equipment Sections.
- F. The CONTRACTOR shall videotape all training sessions and provide a copy for the OWNER.

- G. The CONTRACTOR shall designate and provide 1 or more persons to be responsible for coordinating and expediting his/her training duties. The person or persons so designated shall be present at all training coordination meetings with the OWNER.
- H. The CONTRACTOR's coordinator shall coordinate the training periods with OWNER personnel and manufacturer's representatives, and shall submit a training schedule for each piece of equipment or system for which training is to be provided. Such training schedule shall be submitted not less than 21 calendar days prior to the time that the associated training is to be provided and shall be based on the current plan of operation.

1.10 RECORD KEEPING

- A. Maintain and submit following records generated during start-up and testing phase of Project:
 - 1. Daily logs of equipment testing identifying all tests conducted and outcome.
 - 2. Logs of time spent by manufacturer's representatives performing services on the job site.
 - 3. Equipment lubrication records.
 - 4. Electrical phase, voltage, and amperage measurements.
 - 5. Insulation resistance measurements.
 - 6. Data sheets of control loop testing including testing and calibration of instrumentation devices and setpoints.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01783

WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Warranty and bonds requirements.

1.02 SUBMITTALS

- A. For each item of material or equipment furnished under the Contract:
 - 1. Submit form of manufacturer's warranty prior to fabrication and shipment of the item from the manufacturer's facility.
 - 2. Submit form of manufacturer's special warranty when specified.
- B. Provide consolidated warranties and bonds within 15 calendar days of Substantial Completion:
 - 1. Contents:
 - a. Organize warranty and bond documents:
 - 1) Include Table of Contents organized by specification section number and the name of the product or work item.
 - b. Include each required warranty and bond in proper form, with full information, are certified manufacturer as required, and are properly executed by Contractor, or subcontractor, supplier, or manufacturer.
 - c. Provide name, address, phone number, and point of contact of manufacturer, supplier, and installer, as applicable.
 - 2. Hardcopy format:
 - a. Submit 2 copies.
 - b. Assemble in 3 D-side ring binders with durable cover.
 - c. Identify each binder on the front and spine with typed or printed title "Warranties and Bonds"; Project Name or Title, and the Name Address and Telephone Number of the Contractor.
 - 3. Electronic copy in PDF format:
 - a. Submit 1 copy.

1.03 OWNER'S RIGHTS

- A. Owner reserves the right to reject warranties.
- B. Owner reserves the right to refuse to accept Work for the project if the required warranties have not been provided.

1.04 RELATIONSHIP TO GENERAL WARRANTY AND CORRECTION PERIOD

- A. Warranties specified for materials and equipment shall be in addition to, and run concurrent with, both Contractor's general warranty and the correction period requirements.

- B. Disclaimers and limitations in specific materials and equipment warranties do not limit Contractor's general warranty, nor does such affect or limit Contractor's performance obligations under the correction period.

1.05 MANUFACTURER'S WARRANTY MINIMUM REQUIREMENTS

- A. Written warranty issued by item's manufacturer.
- B. Project-specific information, properly executed by product manufacturer, and expressly states that its provisions are for the benefit of the Owner.
- C. Covers all costs associated with the correction of the defect, including but not limited to removal of defective parts, new parts, labor, and shipping.
 - 1. When correcting warranted Work that has failed, remove and replace other Work that had been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- D. Provides a timely response to correct the defect.
 - 1. Manufacturer shall provide, in a timely fashion, temporary equipment as necessary to replace warranted items requiring repair or replacement, when warranted items are in use and are critical to the treatment process, as defined by Owner.
 - 2. In the case that Owner has to provide temporary equipment to replace function of warranted item requiring repair or replacement, manufacturer shall reimburse Owner for such costs associated with the temporary equipment.
- E. Warranty commence running on the date of substantial completion.
 - 1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of warranty period.
- F. Duration of Warranty: 1 year.

1.06 MANUFACTURER'S SPECIAL WARRANTY

- A. Manufacturer's special warranty is a written warranty published by the manufacturer which includes the requirements specified in the Section where the item is specified.
 - 1. Includes Project-specific information and requirements, properly executed by product manufacturer, and expressly states that its provisions are for the benefit of the Owner. Technical sections indicate Project-specific requirements that differ from the minimum warranty requirements for that item.
 - a. Examples include extending the duration of manufacturer's warranty or to provide increased rights to Owner.
 - 2. Manufacturer's warranties commence on the date that the associated item is certified by Engineer as substantially complete.

1.07 WARRANTY WORK

- A. Contractor's responsibilities:
 - 1. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the product, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.

- B. Replacement cost:
 - 1. Upon determination that work covered by warranty has failed, replace or rebuild the work to an acceptable condition complying with requirement of the Contract Documents.
 - a. Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether Owner has benefited from the use of the work through a portion of its anticipated useful service life.
- C. Related damages and losses:
 - 1. When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.
- D. Owner's recourse:
 - 1. Written warranties are in addition to implied warranties, and shall not limit the duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitation on time in which Owner can enforce such other duties, obligations, rights, or remedies.
- E. Reinstatement of warranty:
 - 1. When work covered by a warranty has failed and has been corrected by replacement or rebuilding, reinstate the warranty by written endorsement.
 - a. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

1.08 IMPLIED WARRANTIES

- A. Warranty of title and intellectual rights:
 - 1. Except as may be otherwise indicated in the Contract Documents, implied warranty of title required by Laws and Regulations is applicable to the Work and to materials and equipment incorporated therein.
 - 2. Provisions on intellectual rights, including patent fees and royalties, are in the General Conditions, as may be modified by the Supplementary Conditions.
- B. Implied warranties: Duration in accordance with Laws and Regulations.

1.09 BONDS

- A. Bond requirements as specified in the technical sections.
- B. Bonds commence running on the date of substantial completion.
 - 1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of bond period.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 02050

SOILS AND AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Aggregate base course.
 - 2. Drain Rock.
 - 3. Native material.
 - 4. Sand.
 - 5. Stabilization material.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C 117 - Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing.
 - 2. C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - 3. C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 4. D 422 - Standard Test Method for Particle-Size Analysis of Soils.
 - 5. D 2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
 - 6. D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - 7. D 4829 - Standard Test Method for Expansion Index of Soils.
- B. California Department of Transportation:
 - 1. Standard Specifications.
 - 2. California Test 205.
 - 3. California Test 211.
 - 4. California Test 217.
 - 5. California Test 229.
 - 6. California Test 301.

1.03 SUBMITTALS

- A. Product data:
 - 1. Material source.
 - 2. Gradation.
 - 3. Testing data.
- B. Quality control for aggregate base course:
 - 1. Test reports: Reports for tests required by Sections of Standard Specifications.
 - 2. Certificates of Compliance: Certificates as required by Sections of Standard Specifications.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Storage and protection: Protect from segregation and excessive moisture during delivery, storage, and handling.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General:
1. Provide material having maximum particle size not exceeding 4 inches and that is free of trash, lumber, debris, leaves, grass, roots, stumps, and other organic matter.
 2. Materials derived from processing demolished or removed asphalt concrete are not acceptable.
- B. Aggregate base course:
1. Class 2, 3/4-inch maximum aggregate size, free from organic matter and other deleterious substances, and of such nature that aggregate can be compacted readily under watering and rolling to form a firm, stable base.
 2. Aggregate base course for structures:
 - a. Consist of crushed or fragmented particles.
 - b. Coarse aggregate material retained in Number 4 sieve shall consist of material of which at least 25 percent by weight shall be crushed particles when tested in accordance with California Test 205.
 3. Aggregate shall not be treated with lime, cement, or other chemical material.
 4. Durability index: Not less than 35 when tested in accordance with California Test 229.
 5. Aggregate grading and sand equivalent tests shall be performed to represent not more than 500 cubic yards or 1 day's production of material, whichever is smaller.
 6. Sand equivalent: Not less than 25 when tested in accordance with California Test 217.
 7. Resistance (R-value): Not less than 78 when tested in accordance with California Test 301.
 8. Conforms to size and grade within the following limits when tested in accordance with ASTM C 117 and ASTM C 136:

Sieve Sizes (Square Openings)	Percent by Weight Passing Sieve
1 inch	100
3/4 inch	90 - 100
Number 4	35 - 60
Number 30	10 - 30
Number 200	2 - 9]

- C. Drain rock:
1. Durability index: Not less than 40 when tested in accordance with California Test 229.

2. Consists of hard, durable particles of stone or gravel; screened or crushed to specified size and gradation; and free from organic matter, lumps or balls of clay, or other deleterious matter.
3. Crush or waste coarse material and waste fine material as required to meet gradation requirements.
4. Conforms to size and grade within the following limits when tested in accordance with ASTM C117 and C136:

Sieve Size (Square Openings)	Percent By Weight Passing Sieve
2 inch	100
1-1/2 inch	95 - 100
3/4 inch	50 - 100
3/8 inch	15 - 55
Number 200	0 - 2

D. Native material:

1. Sound, earthen material passing 1-inch sieve.
2. Percent of material by weight passing Number 200 sieve shall not exceed 30 when tested in accordance with ASTM D 422.
3. Expansion index less than 35 when tested in accordance with ASTM D 4829.

E. Sand:

1. Clean, coarse, natural sand.
2. Non-plastic when tested in accordance with ASTM D 4318.
3. 100 percent shall pass a 1/2-inch screen.
4. No more than 20 percent shall pass a Number 200 sieve.

F. Stabilization material:

1. Durability percentage of wear not greater than 40 percent when tested in accordance with California Test 211.
2. Consists of clean, hard, durable particles of crushed rock or gravel; screened or crushed to the specified sizes and gradations; and free of any detrimental quantity of soft, friable, thin, elongated, or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance.
3. Shall be free of slaking or decomposition under the action of alternate wetting and drying.
4. The portion of material retained on the 3/8-inch sieve shall contain at least 50 percent of particles having 3 or more fractured faces. Not over 5 percent shall be pieces that show no such faces resulting from crushing. Of that portion which passes the 3/8-inch sieve but is retained on the Number 4 sieve, not more than 10 percent shall be pieces that show no faces resulting from crushing.
5. Conforms to size and grade when tested in accordance with ASTM C 117 and ASTM C 136.

Sieve Size (Square Openings)	Percent by Weight Passing Sieve
1 inch	100
3/4 inch	90 - 100
Number 4	0 - 10
Number 200	0 - 2

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 02084

PRECAST MANHOLES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Precast concrete manholes.
- B. Related sections:
 - 1. Section 02318 - Trenching.
 - 2. Section 03154 - Hydrophilic Rubber Waterstop.
 - 3. Section 03300 - Cast-in-Place Concrete.
 - 4. Section 05500 - Metal Fabrications.
 - 5. Section 07900 - Joint Sealants.
 - 6. Section 09960 - High Performance Coatings.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C 361 - Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
 - 2. C 478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - 3. C 857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 - 4. C 858 - Standard Specification for Underground Precast Concrete Utility Structures.

1.03 SYSTEM DESCRIPTION

- A. Performance requirements:
 - 1. Manholes and appurtenances: Manholes and appurtenances shall be watertight and free from infiltration or exfiltration.

1.04 SUBMITTALS

- A. Shop drawings: Submit shop drawings for precast manholes.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Precast concrete manholes:
 - 1. Construct precast concrete manholes in accordance with design, size, shape, form, details, and at locations indicated on the Drawings and specified.
 - 2. Construct manholes of precast eccentric or concentric manhole units in accordance with the requirements indicated on the Drawings and specified.

3. Provide precast, cylinder units, taper sections, and eccentric flat top sections meeting strength requirements in accordance with ASTM C 478.
4. Construct precast manhole sections of Class D concrete as specified in Section 03300 to form and dimensions indicated on the Drawings.
5. Coat exterior of manhole with coal tar epoxy substitute as specified in Section 09960.

2.02 ACCESSORIES

- A. Precast concrete manholes:
 1. Joint sealant: Use precast concrete joint sealant as specified in Section 07900.
 2. Manhole frames and cover sets: Type, size, and quality as specified in Section 05500 or as indicated on the Drawings. Coat underside of manhole cover and frame as required in Section 09960.
 3. Piping penetrations through cylinder units:
 - a. Install Kor-N-Seal, or equivalent, rubber gasket boots with steel clamps when pipe penetrates existing structure.
 - b. Piping connections to the new manhole bases shall be as indicated on the Drawings. Hydrophilic rubber waterstop per Section 03154.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Concrete manholes:
 1. Excavation and backfill: As specified in Section 02318.
 2. Precast concrete manholes:
 - a. Manhole bases:
 - 1) Form and place concrete on undisturbed soil and/or on aggregate base course compacted to 95 percent of maximum density.
 - 2) Form that portion of base above invert elevation of sewer pipe to provide smooth channel section as indicated on the Drawings.
 - 3) Check forms for accuracy of dimensions and relative smoothness prior to placing concrete for base. Channels shall vary uniformly in size and shape from inlet to outlet if required.
 - 4) Construct of Class A concrete as specified in Section 03300 to form and dimensions indicated on the Drawings.
 - 5) Place base concrete as monolith.
 - b. Manhole sections:
 - 1) Set each manhole section plumb.
 - 2) Use sections of various heights and adjustment rings to bring top of manhole ring and cover to required elevation.
 - c. Joints:
 - 1) Seal joints with precast concrete joint sealant as specified in Section 07900 unless otherwise indicated on the Drawings.
 - 2) Clean joints with brush and prime.
 - 3) Apply precast concrete joint sealant as follows, except where instructions differ from manufacturer's printed instructions. Where these instructions differ from manufacturer's instructions, install

precast concrete joint sealant in accordance with manufacturer's written instructions:

- a) Remove silicon treated protective paper from one side of preformed rope and lay preformed rope, paper side up, on cleaned joint surface. Press surface firmly end-to-end around entire joint, making minimum 1-inch laps where necessary.
- b) Remove protective paper from preformed rope and lower next section into place.
- 4) Seal joints watertight.
- d. Manhole frame and cover sets:
 - 1) Install manhole frames and cover sets at locations indicated on the Drawings.
 - 2) Setting:
 - a) Set manhole frames and covers at elevations and requirements indicated on the Drawings.
 - (1) Set manhole covers flush with paving.
 - (2) Where no paving exists, set manhole cover 3 inches above surrounding grade.
 - b) Where structure is outside limits of traveled shoulder but not in roadside ditch, place structure 1/10 foot or more above existing ground surface.
 - c) Where cover is in existing pavement or in traveled way of existing road shoulder, place cover flush with existing surface.
 - d) Where manhole cover falls in existing roadside ditch or right of way, place manhole cover approximately 1-1/2 feet above existing ground surface.
 - e) Set manhole frames at required grade and securely attach to top of precast manhole shaft unit or on adjustment rings, using cement mortar.
 - f) Setting covers:
 - (1) After frames are securely set in place in accordance with requirements specified, install covers and perform necessary cleaning and scraping of foreign materials from frames and covers as required to accomplish and to assure proper fit.
 - (2) Any frame and cover which creates noise when passed over by traffic shall be replaced.
3. Pipe stubs:
 - a. Provide pipe stubs at manhole locations and in conformance with details indicated on the Drawings and as specified.
 - b. Plugging stubs:
 - 1) Plug stubs with vitrified clay stopper as indicated on the Drawings.
 - 2) Unless otherwise indicated on the Drawings, comply with following:
 - a) Stubs up to and including 21 inches: Vitrified clay stoppers.

3.02 FIELD QUALITY CONTROL

A. Tests:

1. Sanitary sewer manholes: Vacuum test all sanitary sewer manholes. Use following vacuum test procedures and requirements:
 - a. After completion of the manhole barrels but prior to backfilling and grade ring installation, seal all openings in the manhole with plugs and a rubber ring "donut" type plug inserted inside the opening of the cone.
 - b. Attach a small vacuum pump to a hose connected to the plug and apply 4 pounds per square inch of vacuum.
 - 1) Allow vacuum to stabilize at 3.5 pounds per square inch for 1 minute, then begin the test.
 - 2) The manhole must maintain vacuum such that no greater than 0.5 pounds per square inch of vacuum is lost during the specified test period.
 - c. The specified test period is as follows:

Manhole Depth (Feet)	Minimum Test Period (Minutes)
0-5	4.5
5-10	5.5
10-15	6.0
Greater than 15	6.5

- d. Patch as required and retest manholes that fail the test.
- e. Provide a vacuum regulator on the vacuum pump such that no greater than 4 pounds per square inch can be applied to the manhole during the test.
- f. Repair all manholes that do not meet the leakage test, or are unsatisfactory from visual inspection.
 - 1) Retest after repair is completed.

END OF SECTION

SECTION 02085

PRECAST CONCRETE VAULTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Precast concrete vaults.
- B. Related section:
 - 1. Section 01300 - Submittals.
 - 2. Section 01612 - Seismic Design Criteria.
 - 3. Section 07900 - Joint Sealants.
 - 4. Section 08320 - Floor Access Doors.
 - 5. Section 09960 - High-Performance Coatings.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO).
 - 1. LRFD Bridge Design Specifications.
- B. American Concrete Institute (ACI):
 - 1. 318 - Building Code Requirements for Structural Concrete and Commentary.
- C. ASTM International (ASTM):
 - 1. C 150 - Standard Specification for Portland Cement.
 - 2. C 857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete utility Structures.
 - 3. C 858 - Standard Specification for Underground Precast Concrete utility Structures.
- D. Occupational Safety and Health Administration (OSHA).

1.03 SUBMITTALS

- A. General:
 - 1. Furnish submittals as specified in Section 01300.
- B. Shop drawings:
 - 1. Show dimensions, locations, lifting inserts, reinforcement, and joints.
 - 2. Structural design calculations for vaults, signed by a licensed registered Civil or Structural Engineer licensed in the State of California.
- C. Manufacturer's Certification for Vaults: Written certification that the vault complies with the requirements of this Section.

1.04 QUALITY ASSURANCE

- A. Inspection:
 - 1. After installation, the Contractor shall demonstrate that vaults have been properly installed, level, with tight joints, at the correct elevations and orientations, and that the backfilling has been carried out in accordance with the Contract Documents.

PART 2 PRODUCTS

2.01 VAULTS

- A. Manufacturers: One of the following or equal:
 - 1. Utility Vault Company.
 - 2. Oldcastle Precast.
- B. Provide precast vaults for the size indicated on the Drawings.
- C. The minimum structural member thickness for vaults shall be 5 inches.
 - 1. Cement shall be Type V portland cement in accordance with ASTM C 150.
 - 2. The minimum 28-day concrete compressive strength shall be 4,000 pounds per square inch.
 - 3. All reinforcing steel shall be embedded in the concrete with a minimum clear cover as recommended by ACI 318.
- D. Design requirements: Loads on structures:
 - 1. In accordance with ASTM C 857, except as modified in this Section.
 - 2. Loads at the ground surface:
 - a. "Roadway": Load from heavy, frequently repeated vehicle traffic:
 - 1) ASTM C 857, Table 1, Designation A-16 (AASHTO HS20-44).
 - 3. Loads against walls. Include effects of groundwater and seismic accelerations on earth pressures.
 - a. Equivalent lateral pressure:
 - 1) Triangular distribution: 70 pounds per square foot per foot of depth (triangular distribution).
 - 2) Rectangular distribution backfill-induced live load surcharge: 240 pounds per square foot.
 - b. Surface surcharge load: In accordance with ASTM C 857 A-16 wheel load if such surcharge exceeds backfill loads described in the preceding paragraph.
 - c. Groundwater effects: Include groundwater effects on lateral earth pressure loads using design elevation of 10.
 - 1) Use equivalent lateral pressure of 90 pounds per square foot per foot of depth (triangular distribution) for soil below the design groundwater elevation.
 - d. Seismic acceleration effects:
 - 1) As specified in Section 01612 for seismic design criteria.
 - 2) On opposite sides of the structure, uniform equivalent lateral pressure type distribution, with a pressure of 37.5 in pounds per square foot where it is the depth of structure.

- 3) Adding lateral force for soil accelerating toward structure:
 - a) Direct uniform pressure distribution toward the wall, effectively increasing the static lateral soil pressure.
 - 4) Reducing lateral force for soil accelerating away from structure:
 - a) Direct inverted pressure distribution away from the wall, effectively reducing the static lateral soil pressure.
 4. Groundwater and flood loads, and buoyancy effects:
 - a. As specified in Geotechnical Report for design groundwater and design flood elevations.
 - b. Lateral pressure effects: Determine based on groundwater and flood elevations specified.
 - c. Buoyancy: For groundwater and flood conditions, provide factor of safety against flotation of at least 1.20.
 - 1) If the weight of soil overlying footing projections on the structure is considered to resist flotation, use a buoyant unit weight of soil equal to not more than 70 pounds per cubic foot.
 - 2) Concrete fill may be provided in the bottom section of precast portland cement concrete structures to add weight. Submit proposed details.
 5. Soil bearing pressure at base:
 - a. Maximum 750 pounds per square foot total pressure on prepared subgrade soils.
 6. Lifting and handling loads:
 - a. Make provision in the design for the effects of loads or stresses that may be imposed on structures during fabrication, transportation, or erection.
 7. Load combinations:
 - a. Design structures to sustain the specified loads individually or in combination.
- E. Design requirements: Structural analysis, design and detailing:
1. Analyze and design structures including the effects of 2-way action ("plate action") and of load transfer around current and future openings.
 2. Where structures include panels designed for future removal ("knockout panels"), design structures for loads and stresses with any combination of any or all such panels in place or removed.
 3. Design structures in accordance with the requirements of ACI 318 and this Section.
 4. Provide reinforcement at all areas subject to tensile stress when loaded with the specified loads and combinations thereof.
 5. Provide temperature and shrinkage reinforcement to equal or exceed ACI 318 requirements in all concrete sections.
 6. Provide minimum clear concrete cover over reinforcement at both interior and exterior faces of all members in accordance with the following:
 - a. Vaults: 2 inches.
 7. Reinforcement details:
 - a. Walls: For structures with wall thickness of 8 inches or less, locate a single mat of reinforcement at the center of the wall.
 - b. Slabs: For structures with slab thickness of 7 inches or less, locate a single mat of reinforcement at the center of the slab.
 - c. Structures with wall or slab thicknesses exceeding these limits shall have a reinforcement at each face of the member.

- 8. Joints:
 - a. Provide structures with watertight joints between sections, and detailed to minimize water infiltration at duct bank and conduit penetrations.
 - b. Provide structures with non-skid, shiplap, or tongue and groove joints between sections.
- F. Design requirements: Materials:
 - 1. Portland cement concrete vaults:
 - a. In accordance with ASTM C 858, except as modified in this Section.
 - b. Proportion concrete mixes to resist damage from freezing and thawing in a moist environment, and for exposure to deicing chemicals. In accordance with ACI 318 requirements for minimum specified compressive strength and air entrainment.
 - 2. Seal joints watertight with precast concrete joint sealant as specified in Section 07900.
- G. Where joints are designed in pre-cast concrete vaults, such joints shall be interlocking to secure proper alignment between members and prevent migration of soil through the joint. Structural sections at joints shall be sized sufficiently to reinforce the section against localized distress during transportation and handling and against excess contact bearing pressures through the joint.
- H. Vault shall be solid walled construction.
 - 1. Where penetration of the pre-cast concrete vault are required for piping, conduit, or ducts, such penetrations shall be accommodated through pre-cast openings or core-drilled sections.
 - 2. Openings for penetrations shall be smooth and free of surface irregularities and without exposed steel reinforcing.
 - 3. Vaults need not be designed to resist thrust from piping passing through the vault.
 - 4. Coordinate pipe penetration locations with piping arrangement as indicated on the Drawings.
- I. Slope bottom of vault to Drainage Sump as indicated on the Drawings.
- J. Drainage Sump: Dimensions as indicated on the Drawings.
 - 1. Drainage Sump shall consist of an open knockout in the bottom of the vault. Provide additional reinforcing as required to accommodate knockout.

2.02 ACCESS HATCH

- A. Where openings for access to the vault are required, the full clear space opening indicated shall be provided, without obstructions from brackets or supports. For large openings where brackets or supports are designed to protrude into the opening for support of required covers, such brackets or supports shall be designed to be easily removed and replaced with a minimum of effort and without cutting or welding.
- B. Access hatch as specified in Section 08320.

2.03 COATINGS

- A. Coat interior and exterior of vault in accordance with Section 09960 or as indicated on the Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Pre-cast concrete sections shall be transported and handled with care in accordance with the manufacturer's written recommendations.
 - 1. Where lifting devices are provided in pre-cast sections, such lifting devices shall be used as intended.
 - 2. Where no lifting devices are provided, the Contractor shall follow the manufacturer's recommendations for lifting procedures to provide proper support during lifting.
- B. Buried pre-cast concrete vaults shall be assembled and placed in excavations on properly compacted soil foundations as indicated. Pre-cast concrete vaults shall be set to grade and oriented to provide the required dimensions and clearances from pipes and other structures.
- C. Apply coatings in accordance with manufacturer's instructions.

END OF SECTION

SECTION 02200

SITE CLEARING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Clearing and grubbing project site.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 01354 - Hazardous Material Procedures.

1.02 REFERENCES

- A. United States Code of Federal Regulations (CFR):
 - 1. 40 - Protection of Environment.
 - a. 503 - Standards for the Use or Disposal of Sewage Sludge.

1.03 DEFINITIONS

- A. Clearing: Consists of removal of natural obstructions and existing foundations, buildings, fences, lumber, walls, stumps, brush, weeds, rubbish, trees, boulders, utility lines, and any other items which interfere with construction operations or are designated for removal.
- B. Grubbing: Consists of the removal and disposal of wood or root matter below the ground surface remaining after clearing and includes stumps, trunks, roots, or root systems greater than 1 inch in diameter or thickness to a depth of 6 inches below the ground surface.

1.04 QUALITY ASSURANCE

- A. Regulatory requirements: Verify and comply with applicable regulations regarding those governing noise, dust, nuisance, drainage and runoff, fire protection, and disposal.
- B. Pre-construction conference: Meet with Engineer to discuss order and method of work.

1.05 PROJECT CONDITIONS

- A. Environmental requirements:
 - 1. For suspected hazardous materials found: As specified in Section 01354.

1.06 SEQUENCING AND SCHEDULING

- A. Clearing and grubbing: Perform clearing and grubbing in advance of grading operations.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions: Examine site and verify existing conditions for beginning work.

3.02 PREPARATION

- A. Protect existing improvements from damage by site preparation work.

3.03 INSTALLATION

- A. Clearing:
 - 1. Clear areas where construction is to be performed or specified in this Section, of fences, lumber, walls, stumps, brush, roots, weeds, trees, shrubs, rubbish, and other objectionable material of any kind which, if left in place, would interfere with proper performance or completion of the work, would impair its subsequent use, or form obstructions.
 - 2. Do not incorporate organic material from clearing and grubbing operations in fills and backfills.
 - 3. Contractor's temporary construction facilities: Fill or remove pits, fill, and other earthwork required for erection of facilities, upon completion of the work, and level to meet existing contours of adjacent ground.
- B. Grubbing:
 - 1. From excavated areas: Grub stumps, roots, and other obstructions 3 inches or over in diameter to depth of not less than 18 inches below finish grade.
 - 2. In embankment areas or other areas to be cleared outside construction area: Do not leave stumps, roots, and other obstructions higher than the following requirements:

Height of Embankment over Stump	Depth of Clearing and Grubbing
0 feet to 2 feet	Grub stumps or roots 3 inches or over in diameter to 18 inches below original grade. Cut others flush with ground.

Height of Embankment over Stump	Depth of Clearing and Grubbing
2 feet to 3 feet	Grub stumps 1 foot and over in diameter to 18 inches below original grade. Cut others flush with ground.
Over 3 feet	Leave no stumps higher than stump top diameter, and in no case more than 18 inches.

3. Backfill and compact cavities left below subgrade elevation by removal of stumps or roots to density of adjacent undisturbed soil.

END OF SECTION

SECTION 02222
BUILDING DEMOLITION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Demolition of structures.

1.02 SUBMITTALS

- A. Demolition plan and schedule.
- B. Disposal means and locations.

1.03 PROJECT CONDITIONS

- A. Environmental requirements:
 - 1. Conform to existing environmental requirements and regulations regarding noise, dust, and vibration.
- B. Existing conditions:
 - 1. Verify that utility services are disconnected.

1.04 SEQUENCING AND SCHEDULING

- A. Demolish existing fence.
- B. Abandon 10" sanitary sewer and existing manhole
- C. Abandon existing wet well and piping
- D. Demolish dry well pumps and piping.
- E. Demolish existing dry well roof.
- F. Demolish electrical equipment in control room. Do NOT demolish existing station building. Existing building shall be protected during construction.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions pertaining to demolition work.

3.02 PREPARATION

- A. Utilities:
 - 1. Disconnect any remaining utility services.
 - 2. Plug or cap cut pipes and conduits with removable plugs or caps acceptable to Engineer.
- B. Protection:
 - 1. Use saw cutting and other methods acceptable to Engineer to protect adjacent facilities.
 - 2. Provide berms and other means acceptable to Engineer to keep drainage from demolition areas.

3.03 DEMOLITION

- A. Completely remove from project site structures specified or indicated on the Drawings to be demolished.
 - 1. Unless otherwise specified or indicated on the Drawings, demolition includes removal of slabs, piping, conduits, and appurtenances and backfilling of resulting voids with suitable excavated or imported material, compacted to 95 percent relative density.

END OF SECTION

SECTION 02240

DEWATERING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Installation and maintenance of dewatering systems.
 - 2. Disposal of water entering excavation or other parts of the work.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 03300 - Cast-in-Place Concrete.
 - b. Section 03600 - Grouting.

1.02 REFERENCES

- A. National Electrical Manufacturers Association (NEMA):
 - 1. 250 – Enclosures for Electrical Equipment (1000 V Maximum).

1.03 DEFINITIONS

- A. NEMA Type 4X enclosure in accordance with NEMA 250.

1.04 SYSTEM DESCRIPTION

- A. Design requirements:
 - 1. Keep excavations reasonably free from water. Draw down static groundwater level to minimum of 3 feet below anticipated bottom of excavations before the excavation reaches bottom elevation.
 - 2. Dewatering design analysis. Include following:
 - a. Evaluation of anticipated subsurface conditions.
 - b. Required well spacing.
 - c. Diameter of wells.
 - d. Depth to screen, screen height, and mesh size.
 - e. Backfill and filter pack.
 - f. Pump size.
 - g. Drawdown duration.
 - h. Drawdown and steady state flow rates.
 - i. Expected settlements.
 - 3. Include water drawdown curves in dewatering calculations.

4. Coordinate dewatering design with excavation and shoring design. Excavation and shoring design shall consider changes in groundwater conditions and associated earth pressures.
 5. Do not place concrete or masonry foundations or concrete slabs in water. Do not allow water to rise over these elements until concrete or mortar has set for at least 24 hours.
 6. Maintain operation of dewatering system until complete structure -- including walls, slabs, beams, struts, and other structural elements -- has been constructed; concrete has attained its specified compressive strength; and backfill has been completed to finished grade.
 7. Provide standby power to ensure continuous dewatering in case of power failure.
- B. Dewatering shored excavations:
1. Dewater from within shoring.
 2. Use impermeable shoring system to minimize lowering of groundwater outside shoring.
 3. Extend impermeable shoring below bottom of excavation sufficient amount to:
 - a. Minimize lowering of groundwater outside shoring.
 - b. Prevent unstable excavation due to piping and heave.
 4. To minimize settlement outside shoring due to dewatering, do not lower groundwater outside shoring more than 1 foot. Provide groundwater recharge if required to maintain this groundwater elevation outside of shoring.
 5. Provide monitoring wells located outside shoring for monitoring groundwater elevation.
- C. Obtain written permission from Engineer before locating wells, well points, or drain lines for dewatering within the limits of a structure's foundation.
- D. Locate dewatering facilities where they will not interfere with utilities and construction work to be performed by others.
- E. Discharge.
1. Discharge water to wet well or new SSMH using heavy duty filter sock suitable for sand, rock, and grit removal.
 2. Discharge water shall meet SMCSD water quality requirements as shown in Appendix B.

1.05 SUBMITTALS

- A. Dewatering plan:
1. Required permits.
 2. Arrangement, location, and depths of dewatering system components.
 3. Type and sizes of desilting tanks and filters.
 4. Identify proposed alignment, support, and protection for discharge pipe. Identify location of discharge and provide details for that location. For pipes discharging to manholes, provide details of pipe entry at manhole.
- B. Well construction logs. Include:
1. Descriptions of actual materials encountered, categorized in accordance with Unified Soil Classification System.
 2. Construction details.
 3. Well development procedures and results.

4. Deviations from original design.
- C. Qualifications:
1. Dewatering contractor.
 2. Dewatering design engineer.
 3. Testing laboratory.

1.06 QUALITY ASSURANCE

- A. Dewatering plan:
1. Prepared by a qualified Civil Engineer, licensed in the state where the Project is located.
 - a. The dewatering design engineer shall have at least 8 years of experience in designing similar systems.
- B. Regulatory requirements:
1. Obtain required water discharge permits.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 INSTALLATION

- A. During construction, provide and maintain ample means and devices to promptly remove and properly dispose of water entering excavation or other parts of the work, whether water is surface water or underground water.
- B. Keep excavations reasonably free of water.
- C. Make provisions to maintain continuous dewatering.
1. Provide standby power to maintain dewatering during power outages and interruptions.
 2. Provide 24-hour monitoring by personnel skilled in operation and maintenance of the system, and capable of providing or obtaining work required to maintain system operation.
- D. Intercept and divert precipitation and surface water away from excavations. Use dikes, curb walls, ditches, pipes, sumps, or other means acceptable to Engineer.
- E. Disposal of water:
1. Dispose of water from the work in suitable manner without damage to adjacent property.
 2. Do not drain water into work built or under construction.
 3. Dispose of water in such manner that it will not be a menace to public health or safety.
- F. Wells, well points, and drain lines for dewatering:
1. Provide after receiving Engineer's written acceptance.

2. Fill dewatering wells, pipes, and french drains to be left in place within structure foundation limits with Class "C" concrete as specified in Section 03300.

3.02 CONSTRUCTION

- A. Prior to release of groundwater to its static level: Confirm that:
 1. All groundwater pressure relief devices for structure are fully operational.
 2. Construction of structure is complete and concrete has reached its specified compressive strength.
 3. Backfill of structure is complete.
- B. Control release of groundwater to its static level to prevent disturbance of natural foundation soils or compacted backfills and fills and to prevent flotation or movement of structures, pipelines, or other facilities.

END OF SECTION

SECTION 02260

EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for designing, providing, maintaining, and removing excavation support and protection.
- B. Related sections:
 - 1. Section 01410 - Regulatory Requirements.
 - 2. Section 02240 - Dewatering.
 - 3. Section 02312 - Controlled Low Strength Material (CLSM).

1.02 REFERENCES

- A. American Society of Civil Engineers (ASCE):
 - 1. Guidelines of Engineering Practice for Braced and Tied-Back Excavations.
- B. California Code of Regulations (CCR):
 - 1. Title 8 - Industrial Relations:
 - a. Division 1. Department of Industrial Relations.
 - 1) Chapter 4. Division of Industrial Safety.
 - a) Subchapter 4. Construction Safety Orders.
 - (1) Article 6. Excavations.
- C. Department of the Navy Naval Facilities Engineering Command (NAVFAC):
 - 1. Design Manual 7.2 - Foundations and Earth Structures.
 - 2. Design Manual 7.3 - Soil Dynamics and Special Design Aspects.
- D. State of California Department of Transportation (Caltrans):
 - 1. Caltrans California Trenching and Shoring Manual.
- E. United States Steel Corporation (USS):
 - 1. Steel Sheet Piling Design Manual.

1.03 DEFINITIONS

- A. General Engineering Design Practice: General engineering design practice in area of the Project, performed in accordance with recent engineering literature on subject of shoring and stability of excavations.
- B. Shoring: A temporary structural system designed to support vertical faces, or nearly vertical faces, of soil or rock for purposes of excavation. Shoring includes cantilevered sheet piling, internally braced sheet piling, slurry walls, soldier piles and lagging, and other similar shoring systems. Sloping of the soil is not shoring.
- C. Support levels: Level of tiebacks, wales, rackers, bottom of excavation, and other types of support.

1.04 SYSTEM DESCRIPTION

- A. Where General Engineering Design Practice is specified, provide drawings and calculations that are performed and signed performed by civil or structural engineer registered in State where Project is located:
 - 1. Clearly disclose assumptions made, criteria followed, and stress values used for materials being used in design calculations.
 - 2. Submit list of references acceptable to Engineer that substantiating appropriateness of design assumptions, criteria, and stress values.
- B. Design requirements:
 - 1. General:
 - a. For trench excavations 5 feet or more in depth and for trenches less than 5 feet in depth when there is potential for cave-in.
 - 1) Perform design pursuant to general engineering design practice.
 - b. In accordance with requirements in CCR, Title 8, Chapter 4, Subchapter 4, Article 6 for trench excavations 5 feet or more in depth and for trenches less than 5 feet in depth when there is potential for cave-in.
 - 1) Where such designs vary from excavation support standards set forth in CCR, Title 8, Chapter 4, Subchapter 4, Article 6, submit design calculations pursuant to general engineering design practice.
 - 2) Provide means for safe and stable excavations that are not less effective than required in CCR, Title 8, Chapter 4, Subchapter 4, Article 6.
 - 3) The preceding requirements do not apply to trench excavation support conforming to standards set forth CCR, Title 8, Chapter 4, Subchapter 4, Article 6.
 - c. Dewatering:
 - 1) Dewater soil inside shoring as specified in Section 02240.
 - 2) Do not lower groundwater outside of shoring more than 1 foot.
 - 3) Recharge groundwater outside shoring to limit groundwater draw down outside of shoring to amount specified above.
 - d. When electing to design with material stresses for temporary construction higher than allowable stresses prescribed in building code as specified in Section 01410, increase in such stresses shall not exceed 10 percent of value of prescribed stresses.
 - e. Minimum safety factor used for design shall not be less than 1.5.
 - f. The calculated minimum depth of penetration of shoring below bottom of excavation shall be increased not less than 30 percent if full value of allowable passive pressure is used in design.
 - g. Maximum height of cantilever shoring above bottom of excavation shall not exceed 15 feet. Use braced shoring when height of shoring above bottom of excavation exceeds 15 feet.
 - h. The location of point of fixity for shoring shall not be less than half calculated minimum embedment depth below bottom of excavation.
 - i. Generally acceptable references for design of shoring and excavations are as follows:
 - 1) ASCE Guidelines of Engineering Practice for Braced and Tied-Back Excavations.
 - 2) Caltrans California Trenching and Shoring Manual.
 - 3) NAVFAC Design Manual 7.2.
 - 4) NAVFAC Design Manual 7.3.

- 5) USS Steel Sheet Piling Design Manual.
 - j. Shoring engineering firm shall obtain errors and omissions insurance for Project for an amount of not less than 500,000 dollars.
- 2. Soldier piles and lagging:
 - a. Provide lagging over full face of excavation. Joints between pieces of lagging shall be tight to prevent loss of soil.
 - b. Provide full face lagging all around penetrations through lagging.
 - c. If the soldier piles are installed in predrilled holes and are not concrete encased, fill predrilled holes with controlled low strength material as specified in Section 02312 after soldiers piles are installed.
 - d. Assumed effective width for passive soil resistance:
 - 1) Effective width of driven soldier piles shall not exceed 2 times width of pile.
 - 2) Effective width of CLSM encased soldier piles in drilled holes shall not exceed 2 times width of pile.
 - 3) Effective width of concrete encased soldier piles shall not exceed 2 times width of concrete encasement.
 - e. Fill voids behind lagging with gravel or other material acceptable to Engineer.
 - f. Apply loads from tie back soil, rock, or deadman anchors concentrically to soldier piles or wales spanning between soldier piles:
 - 1) Wales shall be back-to-back double channels or other members acceptable to Engineer.
 - 2) Do not eccentrically load structural section of soldier piles or wales.
 - g. Design soldier piles for downward loads including vertical loads from tieback anchors.
- 3. Soil anchors, rock anchors, and deadman anchors:
 - a. Design tieback anchors for a safety factor of not less than 2 times calculated load from shoring.
 - b. Proof load all production anchors to 125 percent of calculated load from shoring.
 - c. Lock off production anchors at calculated load from shoring.
 - d. Length of soil anchors used to calculate resistance to load from shoring shall not include any length within potential active pressure soil failure zone behind face of shoring.
 - e. Design tie rods for tieback anchors for 130 percent of calculated load from shoring.
 - f. Design tie rods for tieback anchors for 150 percent of the calculated load from shoring when tie rod couplers are used and for other conditions where stress concentrations can develop.
- 4. Set inside face of shoring back from structure not less than greater of following:
 - a. 5 feet from face of wall.
 - b. 2 foot 6 inches from edge of foundation.
 - c. Depth of excavation below bottom of foundation.

C. Performance requirements:

- 1. General:
 - a. Support faces of excavations and protect structures and improvements in vicinity of excavations from damage and loss of function due to settlement or movement of soils, alterations in ground water level caused by such excavations, and related operations.

- b. Specified provisions:
 - 1) Complement, but do not substitute or diminish, obligations of Contractor for furnishing of safe place of work pursuant to provisions of the Occupational Safety and Health Act of 1970 and its subsequent amendments and regulations and for protection of Work, structures, and other improvements.
 - 2) Represent minimum requirement for:
 - a) Number and types of means needed to maintain soil stability.
 - b) Strength of such required means.
 - c) Methods and frequency of maintenance and observation of means used for maintaining soil stability.
- 2. Provide safe and stable excavations by means of sheeting, shoring, bracing, sloping, and other means and procedures, such as draining and recharging groundwater and routing and disposing of surface runoff, required to maintain stability of soils and rock.
- 3. Provide support for trench excavations for protection of workers from hazard of caving ground.
- 4. Provide shoring:
 - a. Where, as result of excavation work and analysis performed pursuant to general engineering design practice, as defined in this Section:
 - 1) Excavated face or surrounding soil mass may be subject to slides, caving, or other types of failures.
 - 2) Stability and integrity of structures and other improvements may be compromised by settlement or movement of soils, or changes in soil load on structures and other improvements.
 - b. For trenches 5 feet and deeper.
 - c. For trenches less than 5 feet in depth, when there is potential for cave-in.
- 5. For safe and stable excavations, use appropriate design, construction, and maintenance procedures to minimize settlement of supported ground and to prevent damage to structures and other improvements, including:
 - a. Using stiff shoring systems.
 - b. Following appropriate construction sequence.
 - c. Using shoring system that is tight enough to prevent soil loss through the shoring.
 - d. Using shoring system that extends far enough below bottom of excavation to prevent piping, heave, or flow of soil under shoring.
 - e. Design for safety factor of not less than 1.50.
 - f. Providing surface runoff routing and discharge away from excavations.
 - g. Where dewatering inside shoring is necessary, recharge groundwater outside shoring as necessary to prevent settlement in area surrounding shored excavation.
 - h. Where sheet piling is used, use interlocking type sheets:
 - 1) Sheet piles shall be continuous and driven in interlock.
 - 2) If bottom of the excavation is located below the water table, use "ball and socket" or "thumb and finger" type interlock.
 - i. Not applying shoring loads to existing structures and other improvements.
 - j. Not changing existing soil loading on existing structures and other improvements.
 - k. Provide welded steel packing between soil retaining members such as sheet piles and wales and similar members when gap exceeds 1/2 inch before wales are loaded.

1.05 SUBMITTALS

- A. Shop drawings and calculations:
 - 1. Calculations for different load, support, and other conditions that occur during the sequence of installation of shoring, construction of facilities protected by shoring, and sequence of removal of shoring.
 - 2. Sketches showing the condition at various stages of installation and removal of shoring.
 - 3. Show on plan shoring, structures, pipelines, and other improvements located near shoring.
 - 4. When utilities penetrate shoring, show location of penetrations on elevation of all sides of shoring.
 - 5. Show details for ground support and sealing around utility penetrations.
 - 6. Indicate method used for installing driven shoring.
- B. Written geotechnical report with soil characteristics and design recommendations.
- C. Control points and schedule of measurements:
 - 1. Submit location and details of control points and method and schedule of measurements.
 - 2. Survey data.
- D. Detailed sequence of installation and removal of shoring:
 - 1. Consider effects of ground settlement in sequence of installation and removal of shoring.
 - 2. Provide sketches showing conditions at various stages in sequence of installation and removal of shoring.
- E. Submit submittals for excavation support and protection as complete package and include all items required in this Section:
 - 1. Incomplete submittals will not be reviewed and will be returned for resubmittal as complete package.
- F. Submit dewatering submittals as specified in Section 02240 with submittals for excavation support and protection.

1.06 SEQUENCING

- A. Do not begin construction of any shoring or excavation operations until:
 - 1. Submittals for shoring and dewatering have been accepted.
 - 2. Control points as specified in this Section and on existing structures and other improvements have been established and surveyed to document initial elevations and locations.
 - 3. Materials necessary for installation are on site.
- B. Submit submittals minimum of 40 days prior to scheduled date to begin excavation work.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 CONSTRUCTION

- A. Installation of shoring:
 - 1. Install means for providing safe and stable excavations as indicated in submittals.
- B. Removal of shoring:
 - 1. Except for concrete encased soldier piles, slurry walls, and similar shoring systems, remove shoring by completion of Work.
 - 2. Select shoring system and method of removal, which will minimize soil that sticks to shoring from creating voids and causing settlement.
 - 3. To prevent settlement caused by pulling shoring, fill voids with pressure injected grout:
 - a. Inject grout starting at bottom of void and progressively fill void to grade.
 - b. Minimize length of shoring removed ahead of grouting operation and limit time void is left ungrouted to prevent void from closing up before being grouted.
 - 4. Pressure preservative treated wood lagging may be left in place if acceptable to Engineer.
- C. Control points:
 - 1. Establish control points on shoring and on structures and other improvements in vicinity of excavation for measurement of horizontal and vertical movement:
 - a. Set control points on shoring support system:
 - 1) Set points at distances not exceeding 25 feet at each support level.
 - 2. Promptly upon completion of construction of control points survey control points. Submit copy of field notes with measurement.
 - 3. Perform horizontal and vertical survey and measurement of control points at least once every week.
 - a. Field notes shall show current measurement and change in measurement from first measurement taken.
- D. Maintenance:
 - 1. Where loss of soil occurs, plug gap in shoring and replace lost soil with fill material acceptable to Engineer.

2. Where measurements and observations indicate possibility of failure or excessive movement of excavation support, determined in accordance with general engineering design practice, take appropriate action immediately.

END OF SECTION

SECTION 02312

CONTROLLED LOW STRENGTH MATERIAL (CLSM)

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Controlled low strength material (CLSM), also known as “flowable fill.”
- B. Related sections:
 - 1. Section 01400 - Quality Control.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 229R - Report on Controlled Low-Strength Materials.
 - 2. 301 - Specifications for Structural Concrete.
- B. ASTM International (ASTM):
 - 1. C 94 - Standard Specification for Ready Mix Concrete.
 - 2. C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
 - 3. C 150 - Standard Specification for Portland Cement.
 - 4. C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 - 5. C 494 - Standard Specification for Chemical Admixtures for Concrete.
 - 6. C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - 7. D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³(2,700 kN-m/m³)).
 - 8. D 4832 - Standard Test Method of Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
 - 9. D 5971 - Standard Practice for Sampling Freshly Mixed Controlled Low Strength Material.
 - 10. D 6023 - Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material.

1.03 SYSTEM DESCRIPTION

- A. Mixture of portland cement, water, pozzolan, fine aggregate and admixtures, proportioned in accordance with the recommendations of ACI 229 to produce a homogeneous mixture that is flowable, that will readily work into corners and angles; that will not segregate in the plastic state; and that is self-compacting at the time of placement without the use of mechanical vibration.
- B. Performance requirements:
 - 1. Air content, total calculated in accordance with ASTM D 6023: Not less than 8.0 percent, nor greater than 12.0 percent.
 - 2. Compressive strength, measured in accordance with ASTM D 4832 at 28 days: Not less than 50 pounds per square inch, nor greater than 150 pounds per square inch.

3. Wet density: Not greater than 132 pounds per cubic foot.
4. Slump, measured in accordance with ASTM C 143 at the point of placement: Greater than 9 inches and that allows CLSM to flow freely and to be self-compacting during placement.

1.04 SUBMITTALS

- A. Product data: Submit data completely describing materials in the mix and demonstrating compliance with the requirements of this Section.
 1. Cement: Mill tests. Indicate alkali content representative of each shipment.
 2. Fly ash: Identify source and type of fly ash.
 3. Water: Identify source and quality if not from a municipal treatment source.
 4. Admixtures: Manufacturer's product data indicating suitability for use in CLSM mixes and recommended dosage rates.
 5. Aggregate:
 - a. Submit source, type, and sieve analyses.
 - b. Resubmit at any time there is a significant change in grading of materials.
- B. Mix design:
 1. Submit full details, including mix design calculations for mix proposed for use.
 2. Trial batch test data:
 - a. Submit data for each test cylinder.
 - b. Submit data that identifies mix and slump for each test cylinder.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Store or stockpile cement, fly ash, and aggregate in accordance with ACI 301.
- B. Store admixtures in accordance with the manufacturer's recommendations.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cement:
 1. Portland cement in accordance with ASTM C 150, Type I or Type II.
 2. Having total alkali content not more than 0.60 percent.
- B. Fly ash: Class C or Class F fly ash in accordance with ASTM C 618.
- C. Water:
 1. Potable water. Clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances.
- D. Admixtures: Products of a single manufacturer, specifically manufactured or recommended by that manufacturer for use in CLSM.
 1. Air entraining admixture: In accordance with ASTM C 260.
 2. Water reducing admixture: In accordance with ASTM C 494, Type A.

- E. Aggregate:
 - 1. Non-expansive, non-reactive, inert natural sand conforming to the following requirements:
 - a. Not more than 12 percent passing a No. 200 sieve.
 - b. No plastic fines present.
 - c. Including pea gravel no larger than 3/8 inch.

2.02 MIXES

- A. See System Description for performance requirements of the plastic and hardened mix.

PART 3 EXECUTION

3.01 PREPARATION

- A. Do not place CLSM until preparation and condition of surfaces receiving the fill have been observed and accepted by the Engineer.
- B. Remove debris foreign matter, and standing or running water from excavations and areas receiving CLSM before placement.
- C. Pipes and trenches.
 - 1. Where CLSM is placed around and over pipes, secure pipes in place, or place CLSM in lifts to prevent pipe flotation.
 - 2. Where CLSM is placed in long, open trenches, confine material using bulkheads of sandbags, earth dams, or stiffer concrete at open ends of placement.

3.02 MEASURING, BATCHING, MIXING AND TRANSPORTING

- A. Measure, batch, mix and transport CLSM in accordance with the requirements of ASTM C 94 and this Section.
- B. Mix until there is uniform distribution of materials.
- C. Discharge mixer completely prior to recharging.
- D. After trial batch testing and mix acceptance, maintain slump during construction within plus or minus 1 inch of the design slump.

3.03 PLACING

- A. Place controlled low strength material by method that preserves the quality of the material in terms of compressive strength and density.
- B. Maintain fluid properties of the mix during placement.
 - 1. At point of placement, provide material that flows easily around, beneath, or through walls, pipes, conduits, or other structures.
 - 2. Do not place CLSM that has partially hardened or that has been contaminated by foreign materials.
 - 3. Handle and place CLSM using methods that minimize segregation of the mix.

4. Deposit mix as near its final position as possible to avoid segregation due to rehandling or flowing.
 5. Contain and confine mix while it is fluid. Design containment structures and bracing at walls and forms to withstand lateral pressures of wet mix.
- C. Lifts:
1. Limit lift heights of CLSM placed against structures and other facilities that could be damaged due to the pressure from the CLSM, to the lesser of 3 feet or the lift height indicated on the Drawings.
 2. Do not place another lift of CLSM until the last lift of CLSM has set and gained sufficient strength to prevent additional lateral load against the forms or structure due to the weight of the next lift of CLSM.
- D. Water conditions:
1. Do not place CLSM in standing or flowing water.
 2. Do not permit water to flow over the surface of freshly placed or un-hardened CLSM.
 3. Do not submerge CLSM in water within 24 hours after placement.
- E. Manage CLSM bleed water.
1. Grade top surface of CLSM to drain away from the fill.
 2. Provide side containment that permits bleed water to drain to a contained management area away from the fill.

3.04 CURING AND PROTECTION

- A. Curing;
1. Prior to and during curing, install barriers to prevent equipment or personnel from falling into or becoming entrapped in CLSM.
- B. Protect CLSM from:
1. Damage from the elements.
 2. Damage of any nature during surrounding construction operations.

3.05 FIELD QUALITY CONTROL

- A. Provide quality control over the Work of this Section as specified in Sections 01400 and as specified in this Section.
- B. General:
1. Engineer inspection and acceptance required prior to placement.
 2. Make provisions for and furnish all material for the test specimens, and provide manual assistance to assist the Owner's Testing Laboratory in preparing said specimens.

3.06 FIELD QUALITY ASSURANCE

- A. Provide quality control over the work of this Section as specified in Sections 01400.
- B. Field inspections:
1. Engineer shall provide on-site inspection for the Work of this Section.
 2. Advise Engineer of readiness to proceed at least 24 hours prior to each placement of CLSM.

3. Required inspections:
 - a. Engineer will observe the prepared areas. Do not place CLSM until Engineer has observed and accepted preparations.
 4. Record of inspections.
- C. Field sampling and testing:
1. During construction, Owner shall provide sampling and testing to determine whether the CLSM, as produced and placed, complies with the requirements specified.
 - a. Make provisions for and furnish material for test specimens. Cooperate by allowing free access for Owner's independent testing firm to sample and test materials. Provide assistance in obtaining and preparing said specimens.
 2. Sample CLSM for testing in accordance with ASTM D 5971.
 3. Required tests:
 - a. Air content: Prepare sample and test in accordance with ASTM D 6023
 - b. Compressive strength: Prepare and test cylinder specimens in accordance with ASTM D 4832.
 - 1) Prepare 6-inch diameter by 12-inch high specimens for testing.
 - a) Provide one set of specimens for each 150 cubic yards of CLSM placed, but not less than 1 set for each half day's placement.
 - b) Prepare and test not less than 3 cylinders for each set.
 - c) Place CLSM in the molds in accordance with ASTM D 4832. Do not rod or otherwise consolidate the material in the mold.
 - d) In accordance with ASTM D 4832 recommendations for displacing bleed water at the top of the molds and refilling the molds before covering with a lid. Do not use air-tight lids.
 - 2) Place the cylinders in a safe location away from construction activities.
 - a) Protect cylinders from bumping and impact.
 - b) Maintain temperature surrounding cylinders between 60 and 80 degrees Fahrenheit until delivery to the laboratory for testing.
 - c) After the first day, surround molds with a high humidity environment by covering with wet burlap, or equivalent highly absorptive material. Maintain saturation of the cover. Do not sprinkle water directly on the cylinders.
 - 3) After 4 days, place the cylinders in a protective container for transport to the laboratory for testing.
 - a) Exercise caution in moving and transporting the cylinders since they are fragile and will withstand only minimal bumping, banging, or jolting without damage.
 - b) Transport container may be a box with a Styrofoam or similar lining that will limit jarring and bumping of the cylinders.
 - 4) Upon receipt at the testing laboratory, place test cylinders in a moist curing room until dates for testing.
 - 5) Do not remove test cylinders from molds until the day that cylinders is to be capped and tested.
 - 6) Cap and test for compressive strength in accordance with ASTM D 4832.
 - a) Do not perform initial compression test until the cylinders reach an age of at least 4 days.
 - b) Test 1 cylinder at 7 days and 2 at 28 days.

- 7) Compressive strength of the cylinders tested at 28 days shall be equal to or greater than the minimum required compression strength, but shall not exceed maximum compression strength specified.

3.07 NON-CONFORMING WORK

- A. When testing or observation indicates CLSM with properties outside the specified and accepted range, Engineer will issue instructions regarding disposition of nonconforming materials.
- B. Engineer may:
 1. Reject CLSM represented by those test specimens and require its removal and replacement.
 2. Require modification of the mix design to provide CLSM with the properties specified.
- C. Make such modifications at no additional expense to the Owner and with no adjustment to the schedule.

END OF SECTION

SECTION 02314

LOW DENSITY CELLULAR CONCRETE FILL

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Low density cellular concrete fill (LDCCF).
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 03300 - Cast-in-Place Concrete.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 523.1R - Guide for Cast-in-Place Low-Density Cellular Concrete.
- B. ASTM International (ASTM):
 - 1. C 495 - Standard Test Method for Compressive Strength of Lightweight Insulating Concrete.
 - 2. C 567 - Standard Test Method for Determining Density of Structural Lightweight Concrete.
 - 3. C 796 - Standard Test Method for Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam.
 - 4. C 869 - Standard Specification for Foaming Agents Used in Making Preformed Foam for Cellular Concrete.

1.03 SYSTEM DESCRIPTION

- A. Performance requirements:
 - 1. Cellular concrete properties:
 - a. Cellular concrete for Existing Wetwell, with maximum cast density of 30 pounds per cubic foot, and with minimum compressive strength of 40 pounds per square inch.
 - 2. Provide cellular concrete work conforming with best standard practices, in accordance with ACI 523.1R, and recommended practices.

1.04 SUBMITTALS

- A. Mix design.

- B. Cellular concrete applicator qualifications.
- C. Test reports.

1.05 QUALITY ASSURANCE

- A. Cellular concrete applicator qualifications:
 - 1. Cellular concrete applicator shall be approved by the manufacturer of the cellular concrete.
 - 2. Cellular concrete applicator shall be regularly engaged in the placement of cellular concrete including completion of minimum of 40,000 cubic yards in past 5 years.
 - a. Cellular concrete applicator shall furnish a list of all cellular concrete projects completed in last 5 years.
 - b. List shall contain the names, addresses, and telephone numbers of the references for these projects.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. One of the following or equal:
 - 1. Elastizell Corporation of America, Elastizell EF.
 - 2. Cellular Concrete Solutions, Mearl Geofoam.

2.02 MATERIALS

- A. Cellular concrete components:
 - 1. Type II low alkali portland cement.
 - 2. Water as specified in Section 03300.
 - 3. Foaming agent: In accordance with ASTM C 869 when tested in accordance with ASTM C 796.

2.03 PRE-PRODUCTION TESTING

- A. Take 2 sets comprising 4 cylinders for each proposed mix and perform compressive strength tests on samples at 28 calendar days in accordance with ASTM C 495.

2.04 EQUIPMENT

- A. General:
 - 1. Furnish equipment of sufficient size to batch and pump the required volume of low-density cellular concrete as indicated on the Drawings.
 - 2. Maintain equipment in good operating condition and provide an adequate inventory of spare parts and backup equipment on site to assure that equipment is available at all times.
- B. Batching equipment:
 - 1. Utilize mechanical system of batching equipment to ensure consistency of mix.
 - 2. Provide digital printout record of batch scale readings, accurate to 1 pound of dry mix ingredients.

- C. Foam generator:
 - 1. Generate foam by combining controlled quantities of air, water, and foaming agent under pressure in accordance with the foaming agent manufacturer's recommendation.
 - 2. Maintain the temperature of water used in generating foam below 80 degrees Fahrenheit, or as recommended by foaming agent manufacturer.
 - 3. Provide timer controls to repetitively discharge pre-selected quantity, or to continuously discharge at fixed rate.
 - 4. Discharge foam into mixer and blend with cement slurry.
- D. Mixing:
 - 1. Configure mixer to be compatible with pump to assure continuous and uniform flow at point of placement.
 - 2. Provide mixer capable of providing super-wetted, homogenized mix.
 - 3. Equip mixer with water meter with accuracy of within 1 gallon for measuring amount of mixing water to be added to dry mix ingredients.
- E. Pumping:
 - 1. Provide equipment capable of pumping amounts of cellular concrete to be conveyed without pulsation or segregation.
 - 2. Operate pump to uniformly convey continuous stream of cellular concrete, without air pockets.

2.05 MIXES

- A. Generate preformed foam by combining controlled quantities of air, water, and foaming agent under pressure. Foam shall retain its stability until cement sets form a self-supporting matrix.
- B. Admixtures may be used to reduce water, to control set time, and to reduce washout, segregation, and bleeding. Admixtures shall be approved by foaming agent manufacturer and shall be in accordance with their recommendations
- C. Admixture content, batching method, and time of introduction to mix shall be in accordance with manufacturer's recommendations.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Location where cellular concrete is to be placed shall be clean and free of extraneous material and running water.
 - 2. Install cellular concrete as indicated on the Drawings and specified.
 - a. Place cellular concrete in lifts with the lift thickness not exceeding 3 feet. Wait a minimum of 6 hours between placement of lifts.
 - b. After curing for 12 hours, remove any crumbling area on surface and scarified before next layer of cellular concrete is placed.
 - 3. If ambient temperatures are anticipated to be below 40 degrees Fahrenheit within 24 hours after placement, heat mixing water when approved by manufacturer of foaming agent. If use of heated water is not approved by manufacturer of foaming agent, placement is prohibited during such period.

4. Job site batched cellular concrete mix with the foaming agent, and placed with specialized equipment certified by manufacturer.
5. Final finish surface shall be within 0.50 inch of elevations indicated on the Drawings.
6. On completion of cellular concrete placement, remove all waste material, spilled grout or concrete, and construction debris from job site.

3.02 FIELD QUALITY CONTROL

- A. Testing of cellular concrete:
 1. During progress of construction, Owner will have tests made to determine whether cellular concrete, as being produced, complies with specified requirements.
 2. Test cellular concrete compressive strength in accordance with ASTM C 495, and mimicking in-situ pressures except:
 - a. Cast cylinders using Styrofoam molds: Do not use plastic molds.
 - b. Do not oven cure test specimens.
 - c. Cap specimens with plaster of paris: Do not use sulfur caps.
 3. Test cellular concrete wet densities in accordance with ASTM C 567.
- B. Production testing:
 1. At batch plant:
 - a. Test and calibrate equipment to generate foam for cellular concrete each day for density and volume output.
 - b. Sample and test wet density of cellular concrete in accordance with ASTM C 796 prior to introduction of the foaming agent and noting the time and temperature:
 - 1) Every 45 minutes.
 - 2) For each batch mixed.
 - 3) Whenever compression test cylinders are made.
 2. At placement location:
 - a. Collect samples of cellular concrete at injection point or discharge point.
 - b. Compressive strength tests:
 - 1) Take 2 sets of 2 cylinders for every 200 cubic yards batched, but no less than 2 sets per day.
 - 2) Test 2 cylinders at 28 days in accordance with ASTM C 495, except do not oven cure test specimens.
 - a) Cap test cylinders with plaster of paris. Sulfur caps are not permitted.
 - b) Test additional 2 cylinders taken at 28 days.
 - c. Wet density test:
 - 1) In accordance with ASTM C 567.
 - 2) Sample at the connection port:
 - 3) Test every 30 minutes.
 - 4) Test after change in mix.
 - 5) Test whenever compressive strength test cylinders are made.
 - d. Immediately cease batching and placement if mix does not meet design unit weight requirement. Take corrective actions acceptable to Engineer before continuing with batching or placement.

- C. For cellular concrete with test results for strength that are not within the specified range, remove and replace with cellular concrete conforming to specifications.
 - 1. All works associated with removal and replacement, including any other impacts to work, shall be sole responsibility of Contractor at no additional cost to Owner.

END OF SECTION

SECTION 02318

TRENCHING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Trench excavation, fine grading, pipe bedding, backfilling, and compaction for the following, including requirements for ditch crossings:
 - 1. Pipes.
 - 2. Direct buried electrical and control conduits.
 - 3. Electrical and control duct banks.
 - 4. Manholes, valves, or other accessories.
 - 5. Potable water pipe appurtenances.
- B. Related sections:
 - 1. Section 02050 - Soils and Aggregates for Earthwork.
 - 2. Section 02240 - Dewatering.
 - 3. Section 02260 - Excavation Support and Protection.
 - 4. Section 02312 - Controlled Low Strength Material (CLSM).
 - 5. Section 15956 - Piping Systems Testing.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.
 - 2. D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 3. D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.03 SUBMITTALS

- A. Lab certification.
- B. Confirmation test reports.

1.04 QUALITY ASSURANCE

- A. Initial compaction demonstration:
 - 1. Adequacy of compaction equipment and procedures: Demonstrate adequacy of compaction equipment and procedures before exceeding any of following amounts of earthwork quantities:
 - a. 200 linear feet of trench backfill.
 - 2. Compaction sequence requirements: Until specified degree of compaction on previously specified amounts of earthwork is achieved, do not perform additional earthwork of the same kind.

3. After satisfactory conclusion of initial compaction demonstration and at any time during construction, provide confirmation tests as specified under "FIELD QUALITY CONTROL."

PART 2 PRODUCTS

2.01 MATERIALS

- A. Soil and rock materials:
 1. Aggregate base course material: As specified in Section 02050.
 2. Native material: As specified in Section 02050.
 3. Sand: As specified in Section 02050.
- B. Controlled low-strength material: As specified in Section 02312

PART 3 EXECUTION

3.01 PREPARATION

- A. General:
 1. Embankment condition:
 - a. Exists where width of trench exceeds limits specified in this Section.
 - b. Before laying pipes in fill, place fill and compact it to not less than 2 feet above top of pipe.
 - c. After placing and compacting fill, excavate pipe trench through fill.
- B. Protection: Stabilize trench excavations as specified in Section 02260.

3.02 INSTALLATION

- A. Trench excavation:
 1. General requirements:
 - a. If, because of soil conditions, safety requirements, or other reasons, trench width at top of pipe is increased beyond width specified in this Section, upgrade laying conditions or install stronger pipe designed in conformance with Specifications for increased trench width, without additional cost to Owner.
 - b. Excavate bottom of trench to depth indicated on the Drawings. The bottom of the trench excavation shall be firm and dry.
 2. The trench may be excavated by machinery to the grade indicated on the Drawings provided that the soil material remaining in the bottom of the trench is no more than slightly disturbed
 3. Rock:
 - a. Pipe: If bottom of trench excavation is found to consist of rock or any material that by reason of its hardness cannot be excavated to provide uniform bearing surface, remove such rock or other material to a depth of not less than 4 inches below bottom of fine grading material. Backfill overcut with aggregate base course material compacted to 95 percent of maximum density up to bottom of fine grading material.
 - b. Direct buried electrical and control conduits: If bottom of trench excavation is found to consist of rock or any material that by reason of its hardness

- cannot be excavated to provide uniform bearing surface, remove such rock or other material to a depth of not less than 4 inches below bottom of conduit bedding material. Backfill overcut with aggregate base course material up to bottom of conduit bedding material.
- c. Electrical and control ductbanks: If bottom of trench excavation is found to consist of rock or any material that by reason of its hardness cannot be excavated to provide uniform bearing surface, remove such rock or other material to a depth of not less than 4 inches below bottom of concrete ductbank. Backfill overcut with aggregate base course material up to bottom of concrete ductbank.
- 4. Overcut of trench bottom: Where the bottom of the trench is excavated below the depth indicated on the Drawings, restore trench bottom to proper grade by back filling with aggregate base course material compacted to 95 percent of maximum density, at no additional cost to Owner.
 - 5. Soft or unstable material:
 - a. If bottom of excavation is found to consist of soft or unstable material which is incapable of providing proper support, remove such material to a depth and for the length required, as determined by the Engineer. Backfill trench to bottom of fine grading material with aggregate base course material compacted to 90 percent of maximum density.
 - 6. Trench widths:
 - a. Minimum clear width of trench for pipe (measured at top of pipe):
 - 1) For pipe sizes 4 inches to and including 24 inches: Not less than outside diameter of pipe plus 18 inches.
 - 2) For pipe sizes larger than 24 inches: Not less than outside diameter of pipe plus 24 inches.
 - b. Maximum clear width of trench for pipe (measured at top of pipe):
 - 1) For pipe sizes 4 inches to and including 24 inches: Not to exceed outside diameter of pipe plus 24 inches.
 - 2) For pipe sizes larger than 24 inches: Not to exceed outside diameter of pipe plus 36 inches.
 - 7. For manholes, valves, or other accessories:
 - a. Provide excavations sufficient to leave at least 12 inches clear between their outer surfaces and sides of trench or shoring.
 - b. Backfilling of manhole excavation: Conform to backfilling requirements as specified for trenches in this Section.
 - c. Backfill under manholes, vaults, tanks, or valves with aggregate base course material. Do not backfill with soil.
 - d. Fill any unauthorized excess excavation below elevation indicated on the Drawings for foundation of any structure with aggregate base course material at no additional cost to Owner.
 - 8. Potable water pipe appurtenances:
 - a. Lay in trenches separate from those used for sewers.
 - b. Unless otherwise specified or indicated on the Drawings, lay in trenches having cover of not less than 3 feet below surface of ground and located at distance of not less than 10 feet from any parallel sewer trench.
 - 9. At road crossings or existing driveways:
 - a. Make provision for trench crossings at these points, either by means of backfills, tunnels, or temporary bridges.

B. Dewatering: As specified in Section 02240.

- C. Pipe fine grading:
 - 1. Schedule fine grading material as specified in this Section.
 - 2. For pipes 16 inches in nominal diameter and under.
 - a. Place 4 inches of fine grading material below bottom of pipe.
 - b. Place fine grading material at uniform density, with minimum possible compaction.
 - 3. For pipe over 16 inches in diameter.
 - a. Place 4 inches, or 1/12 the outside diameter of pipe, whichever is greater, of fine grading material below bottom of pipe.
 - b. Place fine grading material at uniform density, with minimum possible compaction.
 - 4. Bell or coupling holes:
 - a. Dig holes after trench bottom has been graded.
 - b. Provide holes of sufficient width to provide ample room for grouting, banding, or welding.
 - c. Excavate holes only as necessary for making joints and to ensure that pipe rests upon prepared trench bottom and not supported by any portion of the joint.
 - 5. Depressions for joints, other than bell-and-spigot:
 - a. Make in accordance with recommendations of joint manufacturer for particular joint used.
- D. Pipe bedding:
 - 1. Schedule bedding material as specified in this Section.
 - 2. After pipe laid:
 - a. Place bedding material under and around pipe in 6 inch maximum lifts of bedding material, to level 12 inches above top of pipe. Compact to 90 percent of maximum density.
 - 3. Pipe displacement:
 - a. Take necessary precautions in placement and compaction of bedding material to prevent displacement of piping.
 - b. In event there is movement or floating of the piping, re-excavate, re-lay, and backfill the pipe.
- E. Trench backfill above pipe bedding, electrical and control conduit bedding, and electrical and control ductbanks:
 - 1. Under structures:
 - a. Backfill trench up to underside of structure with aggregate base course material as specified in Section 02050 compacted to 95 percent of maximum density.
 - 2. Cuts across roadways and paved streets:
 - a. Backfill trench to underside of pavement with aggregate base course material as specified in Section 02050 compacted to 95 percent of maximum density.
 - 3. Under and parallel to roadways, paved areas, or storage areas:
 - a. Backfill trench up to within 2 feet of finish grade with native material compacted to 95 percent of maximum density.
 - b. Then backfill from 2 feet below finish grade to finish grade, or underside of aggregate base course or pavement as indicated on the Drawings with aggregate base course material as specified in Section 02050, compacted to 95 percent of maximum density.

4. In areas outside the improved section of roadways or in open country:
 - a. Backfill to finish grade with native material as specified in Section 02050 compacted to 90 percent of maximum density.
 5. Through earth slopes adjacent to, or supporting structures:
 - a. Backfill to finish grade with aggregate base course material or select material compacted to 95 percent of maximum density.
- F. Under existing intersecting pipes or conduits larger than 3 inches in diameter:
1. Backfill from bottom of new pipe trench to spring line of intersecting pipe or conduit with aggregate base course material, as specified in Section 02050, compacted to 90 percent of maximum density or controlled low-strength material as specified in Section 02312.
 2. Extend aggregate base course material as specified in Section 02050 or controlled low-strength material as specified in Section 02312 two feet on either side of intersecting pipe or conduit to ensure that material remains in place while other backfill is being placed.
 3. Backfill remainder of trench as specified in "Trench backfill above pipe bedding and for conduits and duckbanks" above.
- G. Compaction:
1. In-place density of compacted trench backfill, and bedding determined in accordance with ASTM D1556, or with ASTM D6938.
 2. Maximum density obtained in laboratory when tested in accordance with ASTM D1557.
 3. Consolidation:
 - a. Do not use water settling methods such as flooding, poling, or jetting.
- H. Excess material:
1. Remove excess excavated material from the Project site and dispose of legally off site.

3.03 FIELD QUALITY CONTROL

- A. Tests:
1. Confirmation tests:
 - a. Contractor's responsibilities:
 - 1) Accomplish specified compaction of trench backfill.
 - 2) Control operations by confirmation tests to verify and confirm that compaction work complies, and is complying at all times, with requirements specified in this Section concerning compaction, control, and testing.
 - 3) Cost of confirmation tests: Paid for by the Contractor.
 - 4) Qualifications of Contractor's testing laboratory: Acceptable to Engineer. Provide lab certification.
 - 5) Copies of confirmation test reports: Submit promptly to the Engineer.
 - b. Frequency of confirmation testing:
 - 1) Perform testing not less than as follows:
 - a) For trenches: At each test location include tests for each type or class of backfill from bedding to finish grade.

2. Compliance tests:
 - a. Frequency of testing: Periodic compliance tests will be made by the Engineer to verify that compaction is meeting requirements previously specified.
 - b. If compaction fails to meet specified requirements: Perform remedial work by one of the following methods:
 - 1) Remove and replace backfill at proper density.
 - 2) Bring density up to specified level by other means acceptable to the Engineer.
 3. Retesting:
 - a. Costs of retesting: Contractor is responsible for the costs of retesting required to confirm and verify that remedial work has brought compaction within specified requirements.
 - b. Contractor's confirmation tests during performance of remedial work:
 - 1) Performance: Perform tests in manner acceptable to the Engineer.
 - 2) Frequency: Double amount specified for initial confirmation tests.
- B. Piping system testing:
1. As specified in Section 15956.

3.04 SCHEDULES

- A. Pipe fine grading materials:
1. Fine grading material shall be the same as bedding material.
- B. Bedding materials:
1. Pipes:
 - a. For pipe less than 16-inch nominal size: Except as otherwise specified, use sand or aggregate base course or CLSM material.
 - b. For pipe from 16- inch to 48-inch nominal size: Except as otherwise specified, use aggregate base course or CLSM material.
 - c. For pipe over 48 inches: Aggregate base course material.
 - d. For polyvinyl chloride or other plastic pipe less than 2 inches in diameter: Sand.
 2. Direct buried electrical and control conduits: Sand.

END OF SECTION

SECTION 02501

SEWER CLEANING AND CCTV INSPECTION

PART 1 GENERAL

1.01 SUMMARY

- A. This specification defines the requirements for cleaning and internal closed circuit television (CCTV) inspection of sewer pipelines and laterals.
- B. Provide all materials, labor and equipment necessary to complete the sewer and lateral cleaning and CCTV work in a safe and responsible manner in accordance with all laws and regulations.
- C. Related Sections:
 - 1. Section 01300 - Submittals.
 - 2. Section 02552 - Temporary Bypass Pumping.

1.02 SYSTEM DESCRIPTION

- A. General:
 - 1. Inspect new pipeline interior to identify defects using CCTV equipment.
- B. Equipment:
 - 1. CCTV Equipment:
 - a. Lights, lens, cables, etc. shall be intrinsically safe and operational in submerged, partially submerged and 100 percent humidity conditions.
 - b. Designed to be completely operational in sanitary sewage environments found in sewer pipelines including but not limited to floating and submerged debris, high hydrogen sulfide concentrations, varying liquid levels, and varying temperatures.
 - c. Designed for use in pipelines of the same size and water depth as those anticipated in this project.
 - d. Maximum rate of travel while recording: 30 feet per minute.
 - e. Provide footage counter device measuring the distance traveled by the camera in the pipeline with a minimum accuracy of plus or minus 2 feet in 1,000 feet.
 - f. Provide a clear and in-focus view of the entire inside periphery of the pipeline.
 - g. Include pan and zoom capabilities.
 - h. Record in full color.
 - i. Camera lens with a minimum 65 degree viewing angle and either automatic or remain in focus and iris controls.
 - j. Image down the center axis of the pipe when the camera is in motion to provide a 360-degree view of the pipe interior.
 - 2. Cabling System:
 - a. Pull CCTV equipment through the pipeline using a mechanical or power driven winch.
 - b. Provide a camera capable of being pulled through the pipeline in either direction.

- c. Use a cabling system that will not obstruct the camera view or interfere with proper documentation of the pipeline conditions.
- d. The CONTRACTOR shall be responsible for modifications to his equipment and/or inspection procedures to achieve video and report materials of acceptable quality. No work shall commence prior to approval of the video and report materials by the OWNER or OWNER's Representative. Once accepted, the video and report materials shall serve as a standard for the remaining work.

1.03 SUBMITTALS

- A. Shop drawings or informational literature on the proposed debris basket or cleaning equipment.
- B. Qualifications of the personnel assigned to perform the pipeline cleaning and CCTV inspection work.
- C. Catalog cuts and supporting information on the proposed CCTV equipment to be used for this project.
- D. Documentation that the proposed equipment is of suitable size and construction to be used for the pipeline diameters and flows anticipated.
- E. Work example:
 - 1. One CD or DVD of previous inspection work completed with audio commentary and inspection logs.
 - 2. Showing operations and structural defects in pipelines of the same size and materials as the pipelines in this project.
 - 3. From the same equipment as that proposed for this project.
- F. Three copies of each finished CD or DVD showing the inspected pipelines.
 - 1. If the Engineer determines the video is defective or not of adequate quality, perform CCTV inspection of the pipeline again at no cost to the OWNER.

1.04 QUALIFICATIONS

- A. Minimum of 5 years of experience or 10,000 linear feet of pipeline cleaning and CCTV inspection experience.
- B. National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) and Manhole Assessment Certification Program (MACP) certified.

PART 2 PRODUCTS

2.01 DIGITAL MEDIA

- A. High capacity CD or DVDs.
- B. Recordings of all sewer line inspections shall be made in high quality .MPG Format on, -R/+R disks formatted for use with PC systems. The Audio portion of the

composite CD or DVD shall be sufficiently free from electrical interference and background noise to provide complete intelligibility of the oral report.

- C. Recordings shall be per PACP Standards.
- D. Digital Video equipment shall include genlocking capabilities to the extent that computer generated data, (i.e., footage, date, size, address, and location, etc.) as determined by the Owner can be overlaid onto video, and both indicated on the television monitor and permanently recorded on the inspection videotape.

PART 3 EXECUTION

3.01 SEWER CLEANING

- A. All sludge, debris, sand, rocks, bricks, wood, mud, grease, and any other solid or semi-solid material shall be removed from the sewer being cleaned. In no event shall any material be returned to the sewer or any adjacent storm drain.
- B. A debris basket or similar device designed to minimize debris from escaping down the sewer line shall be used in all cleaning operations. When hydraulic equipment is used, a suitable sand trap, weir, or dam shall be constructed in the downstream manhole in such a manner that the solids will be trapped.
- C. All debris removed from the sewer prior to construction shall be hauled and properly disposed of by the CONTRACTOR. Liquid waste from the sewer may be disposed of back into the sanitary sewer system.
- D. Transportation of any removed material shall be done in vehicles or equipment specifically designed to transport this type of material in an environmentally safe and acceptable manner without dripping, spilling, scattering, leaking or blowing any material from the vehicle.
- E. CONTRACTOR is responsible for cleaning up any debris or material that falls, drips, splashes, blows or otherwise leaves the vehicles that are transporting the debris.
- F. CONTRACTOR shall be responsible for all damage to public and private property as a result of cleaning operations. The cost of restoring any damaged areas shall be borne by the CONTRACTOR at no additional cost to the OWNER.
- G. If CCTV inspection shows the cleaning to be unsatisfactory, the CONTRACTOR shall re-clean the pipeline, at no additional cost to the OWNER.

3.02 CCTV INSPECTION

- A. Clean the pipeline prior to start of CCTV inspection.
- B. Implement a bypass pumping system as specified in Section 02552 to provide temporary dry conditions in the pipeline
 - 1. Coordinate any evening, night or weekend work with the OWNER.

- C. If sewer still has standing water after pipeline cleaning and bypass pumping is in place, contractor shall vacuum extract remaining liquids for discharge to sewer system or storage tank prior to CCTV inspection.
- D. Provide the OWNER or ENGINEER access to observe the video monitor and all other CCTV operations at all times.
- E. Video Documentation:
 - 1. Automatically record position of camera within the pipeline on the video.
 - 2. Include the audio report of the operator's descriptive narrative of condition observed and stationing along sewer.
 - 3. Stop the camera at each pipe joint, service, pipe defect, and structure and use pan and zoom to record a view of each.
 - a. For structures, direct the camera upward to view the interior of each structure from the pipe level to the inside of the cover.
 - b. At pipe joints pan and zoom the camera as necessary to clearly show a 360 degree view of the joint.
 - c. At services position the camera to clearly view the inside of the service if possible.
 - d. At pipe defects, position the camera to show the extent of the defect.
 - 4. Use PACP coding and databases.
- F. Written inspection log:
 - 1. Provide in a form acceptable to the OWNER.
 - 2. Provide a separate log for each reach inspected.
 - 3. If an intermediate structure is discovered during CCTV operations, provide a separate log for the additional pipe beyond the structure.
 - 4. Provide a separate log if a reverse set-up is required.
 - 5. Provide, at a minimum, the mandatory information required by PACP.

END OF SECTION

SECTION 02552

TEMPORARY BYPASS PUMPING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Mandatory temporary bypass pumping facilities and appurtenances.
- B. Description: Bypass pumping shall consist of furnishing, installing, and maintaining all power, primary and standby pumps, bypass piping, spill guards, and appurtenances as required to maintain existing flows and services. Bypass pumping and flow-through piping operations shall be monitored by a competent person at all times (24 hours a day) during its operation. Remove bypass pumping facilities upon successful completion of the intended use.
- C. Related section:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 01030 - Special Project Constraints.
 - b. Section 01300 - Submittals.

1.02 SUBMITTALS

- A. CONTRACTOR shall submit bypass pumping and piping plans to the ENGINEER for review and approval by OWNER, in accordance with the requirements of Section 01300, at least six (6) weeks prior to installation of each bypass operation. The bypass pumping and piping plans shall include the following information at a minimum:
 - 1. Location, number, and size of pumps, diameter and layout of piping and valves, description of spill guards, structure of manifolding, and description of power source.
 - 2. Identification of bypass pumping locations for each of the stages by which the CONTRACTOR proposes to accomplish the work.
 - 3. Detailed resume of the person or persons that will be monitoring the bypass operations, including education, experience, and relevant employment information. Persons shall demonstrate prior experience on at least 10 projects in the past 5 years with similar bypass pumping requirements.
 - 4. A written contingency plan that outlines the precautions to be implemented by the CONTRACTOR to prevent the flow being bypassed from spilling onto the site.

1.03 PROJECT CONDITIONS

- A. Environmental Requirements:
1. Bypass pumping shall be accomplished in a manner that does not damage OWNER's property, create a nuisance or public menace, or violate NPDES discharge permit requirements. The pumped flow shall be in an enclosed pipe that is adequately protected from traffic. Dumping or free flow of sewage on private property, gutters, streets, sidewalks, or into storm sewers is prohibited by law.
 2. The CONTRACTOR shall take all necessary precautions including continuous monitoring of bypass pumping operation to ensure that no spills occur. The CONTRACTOR shall be solely liable for all cleanup, damages, and resultant fines in the event of a spill.
 3. Bypass pumping operation requires the CONTRACTOR to provide 100 percent redundant pumping capability to be available at all times. All bypass pumping equipment and associated standby power facilities shall be provided by the CONTRACTOR.
 4. Electrical power will not be available on site for bypass pumping. Provide power supply and/or fuel necessary to power the bypass pumping system.

1.04 BYPASS PUMPING AND PIPING SYSTEM CHARACTERISTICS

- A. Bypass pumping operations shall be provided for the following conditions and be capable of handling the estimated flow range specified.
1. The following schedule includes key, mandatory, pumping operations. Additional bypass pumping operations not listed in the following schedule may be required to complete the WORK. CONTRACTOR shall provide all additional bypass pumping operations as necessary to complete the WORK, whether scheduled or not. District operators will operate or direct the operation of all live valves throughout construction.
 2. For bypass pumping, no existing electrical power source is available at site for Contractor use. Contractor shall provide individual diesel engine driven pumps or motor driven pumps and a generator with a backup to maintain electrical redundancy. Diesel engine driven pumps do not require backup supply.
 3. Condition 1: Temporary Bypass from SSMH 571000 to Highway Booster Pump Station Existing Wet Well
 - a. Description: Provide temporary bypass pumping system to allow construction of new sanitary sewer manhole and abandonment of existing sewer and manhole. Divert flow from the 10-inch sanitary sewer directly into the existing wet well. Remove bypass pumping system piping and equipment immediately upon acceptance of work.
 - b. Service: Raw, unscreened wastewater.
 - c. Estimated flow range:
 - 1) Dry weather (May 1 through September 30): 0 to 125 gpm.
 - 2) Wet weather (October 1 through April 30): 0 to 800 gpm.
 - d. Piping:
 - 1) Approximate length of bypass piping: 220 feet.
 - 2) Size: Sized by CONTRACTOR.
 - 3) Piping material: HDPE, fusion welded.
 - a) Heavy duty tank hose in a secondary containment may be used for connection at the discharge vault.

- e. Pumps:
 - 1) Type: Submersible, non-clog, motor driven. Capable of passing solids, rags and other debris found in municipal wastewater.
 - 2) Number of installed pumps: 2 minimum.
 - 3) Estimated static lift: 14 feet.
 - 4) Estimated dynamic losses in force main between sanitary sewer manhole and bypass pumping vault at 500 gpm flow rate: 60 feet.
 - 5) Power source: Contractor supplied.
- f. Electrical Equipment and Controls:
 - 1) Electrical equipment, instruments, and accessories:
 - a) Explosion proof, suitable for Class 1 Division 1 service as defined by NFPA 820 where located inside or below the top of wall of a structure containing wastewater.
 - b) Suitable for Class 1 Division 2 service as defined by NFPA 820 where located within 10 feet of channels, manholes or other open, wastewater containing structures.
 - 2) Provide soft starters or VFDs for pumping equipment to limit amperage draw on startup.
 - 3) Control system:
 - a) Provide instrumentation and controls for operation and monitoring of each pump.
 - b) Provide a control system based on maintaining a constant water level in withdrawal location.
 - c) Level measurement:
 - (1) Provide level element and indicating transmitter at withdrawal location.
 - (2) Provide a back-up level float to monitor high manhole level. Provide hardwired alarm from float on high manhole level.
 - d) Monitor upstream manhole to avoid surcharging gravity sewer system.
- g. Monitoring:
 - 1) Provide continuous (24 hours per day) on site monitoring by a competent person during the bypass period.
 - 2) CONTRACTOR shall inspect bypass pumping, upstream manhole level, and piping system at a frequency not less than 1 time per day. Record observations in an inspection log maintained at the site.
- h. Maintenance:
 - 1) Provide on-call maintenance technicians available 24 hours per day, 7 days per week until the bypass is no longer required. Maintenance technician shall be able to reach the job site within 30 minutes of notification.
- i. Sequencing requirements and constraints:
 - 1) See Section 01030.
 - 2) Minimize noise and visual impacts caused by bypass pumping system.
- 4. Condition 2: Flow from New Sewer Manhole to Force Main
 - a. Description: Provide temporary flow-through bypass piping at new sanitary sewer manhole to existing bypass pumping vault to enable existing wet well and existing piping to be dewatered and abandoned; to allow for existing dry well top slab demolition and replacement; removal of existing pumps and accessories; concrete repair; and coating application; installation of new pumps, piping, and accessories. Piping shall direct flow

from the 10" SS to the existing bypass vault and through existing 6" connection to the 8" FM. The discharge connection to the force main is a 6" female camlock. See Drawing C03.

- b. Service: Raw, unscreened wastewater.
- c. Estimated flow range:
 - 1) Dry weather (May 1 through September 30): 0 to 500 gpm.
 - 2) Wet weather (October 1 through April 30): 0 to 500 gpm.
- d. Piping:
 - 1) Approximate length of bypass piping: 40 feet.
 - 2) Size: Sized by CONTRACTOR.
 - 3) Material: Selected by CONTRACTOR.
 - 4) Supplier: Plug-it Products, or equal.
- e. Pumps:
 - 1) Type: Submersible, non-clog, motor driven. Capable of passing solids, rags and other debris found in municipal wastewater.
 - 2) Number of installed pumps: 2 minimum.
 - 3) Estimated static lift: 14 feet.
 - 4) Estimated dynamic losses in force main between sanitary sewer manhole and bypass pumping vault at 500 gpm flow rate: 60 feet.
 - 5) Power source: Existing electrical switchgear. See electrical drawings for additional details regarding temporary power connections.
- f. Electrical Equipment and Controls:
 - 1) Electrical equipment, instruments, and accessories:
 - a) Explosion proof, suitable for Class 1 Division 1 service as defined by NFPA 820 where located inside or below the top of wall of a structure containing wastewater.
 - b) Suitable for Class 1 Division 2 service as defined by NFPA 820 where located within 10 feet of channels, manholes or other open, wastewater containing structures.
 - c) Location: As indicated on the electrical drawings.
 - d) 480 volt, 3 phase, 60 hertz.
 - 2) Provide soft starters or VFDs for pumping equipment to limit amperage draw on startup.
 - 3) Control system:
 - a) Provide instrumentation and controls for operation and monitoring of each pump.
 - b) Provide a control system based on maintaining a constant water level in withdrawal location.
 - c) Level measurement:
 - (1) Provide level element and indicating transmitter at withdrawal location.
 - (2) Provide a back-up level float to monitor high manhole level. Provide hardwired alarm from float on high manhole level.
- g. Monitoring:
 - 1) Provide continuous (24 hours per day) on site monitoring by a competent person during entire bypass period.
 - 2) CONTRACTOR shall provide a 24-hour watch anytime the bypass system is operating, and requires an auto-dialer tied to level floats when a monitoring person is not present AT THE SUCTION MANHOLE. The auto-dialer shall be programmed to contact the Contractor in the event of high levels as established by the District. The District will serve as backup to the Contractor. However, all

District costs associated with responding to alarms, including any fines associated with a directly related sewer spill, will be charged to the Contractor. The responsible on-call Contractor shall maintain a maximum response time of 30 minutes to reach the project site. Contractor shall inspect the entire bypass system including suction strainers a minimum of 2 times per day during construction and a minimum of 1 time a day when monitoring remotely.

h. Sequencing requirements and constraints:

1) See Section 01030.

- B. Values scheduled above are provided for CONTRACTOR's reference during bid period. CONTRACTOR shall field verify all values provided prior to submittal of the bypass pumping plan
- C. Values for dry weather flow ranges scheduled above are based on typical dry weather flows encountered during the dry weather period between May 1 and September 30. If bypass pumping must be performed outside of this time period, CONTRACTOR shall increase the size of bypass pumping facilities to accommodate higher wet weather flow rates at no additional cost to the OWNER.
- D. A value for static lift is provided above for CONTRACTOR's reference during bid period. Additional dynamic pressure losses in the pipeline may not be provided since these will be a function of the temporary bypass piping system chosen by the CONTRACTOR. CONTRACTOR shall account for dynamic losses in addition to the estimated static lift for proper selection of bypass pumping equipment.
- E. CONTRACTOR shall coordinate route of bypass piping with ENGINEER and OWNER during construction to determine final piping route and pump positions. Bypass pipe routing shall minimize the impact to traffic within the public right-of-way and minimize impact on pump station operations.
- F. Each bypass pumping system shall include stand-by pumps manifolded to the system for 100 percent pumping redundancy. In the event that any duty pump becomes inoperable, the standby pumps shall be capable of automatically starting to maintain the required capacity.
- G. Bypass pumps, engine generators and other bypass equipment shall be sound attenuated. Diesel bypass pumps shall be capable of maintaining a sound level of less than or equal to 75 dBA at 25 feet. Pumps shall be placed a minimum of 60 feet from the Buckeye Roadhouse parking lot to minimize noise. Noise level measured at the edge of the Buckeye parking lot closest to the pumps may not exceed 65 dBA. In the event these sound levels cannot be achieved due to availability of sound attenuated pumps, the Contractor shall construct sound dampening barriers to achieve this level. Vent exhaust away from adjacent buildings and restaurant, toward the Bay, to minimize impacts on local residents.
- H. Perform trial bypass testing for each condition as specified herein to demonstrate compliance with design requirements.

1.05 SEQUENCING AND SCHEDULING

- A. Notify ENGINEER in advance in accordance with shutdown before carrying out bypass pumping.

- B. Coordinate work with restrictions outlined elsewhere in the contract documents.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide and maintain during construction ample means and devices with which to completely and continuously provide bypass pumping.
- B. The CONTRACTOR shall perform a trial bypass at the maximum flow that successfully demonstrates each and every part of the diversion plan. If the trial bypass does not perform as described in the bypass pumping plan, the plan shall be considered unacceptable. In this event, the CONTRACTOR shall submit a revised bypass pumping plan to the ENGINEER for review and the trial bypass shall be repeated until satisfactory operation and/or performance is obtained.
- C. Bypass pumping equipment and piping shall be tested for leaks as part of the trial bypass pumping operation. Leak testing shall be performed any time the bypass pumping system is disassembled, reassembled, and/or modified. No leaks in the bypass piping operation shall be permitted. Pressure test bypass piping at minimum 125 percent of the maximum anticipated operating pressure.
- D. The CONTRACTOR shall provide all material, labor, and equipment to perform bypass pumping of the required flows. The CONTRACTOR shall provide fuel and fuel monitoring and delivery as needed. Bypass pipes, fittings, and manifolds shall be made of solid wall HDPE. Where bypass piping crosses intersecting roads or blocks access to driveways, the CONTRACTOR shall provide temporary vehicle access ramps across the driveways or roads over the bypass piping to protect it from in-plant traffic. The CONTRACTOR shall remove all bypass piping and barricades at the completion of the bypass pumping operations and shall restore the surface of the bypass piping route as needed to its original conditions at the start of the project.
- E. Bypass pumping and flow-through piping operations shall be monitored by a competent person at all times (24 hours per day) during its operation, unless specified otherwise.
- F. Remove bypass pumping facilities within 1 week of successful completion of the intended use.

END OF SECTION

SECTION 02620

FILTER FABRIC

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Nonwoven filter fabric.

1.02 REFERENCES

- A. ASTM International (ASTM):
 1. D 4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
 2. D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 3. D 4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
 4. D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 5. D 4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile.
 6. D 5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
 7. D 6241 - Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

1.03 DEFINITIONS

- A. Filter fabric: Nonwoven geotextile fabric manufactured from polypropylene fibers.

1.04 SUBMITTALS

- A. Product data.
- B. Samples.
- C. Quality control submittals:
 1. Certificates of Compliance.
 2. Manufacturer's Instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Storage and protection:
 1. Furnish filter fabric in protective covers capable of protecting the fabric from ultraviolet rays, abrasion, and water.

1.06 PROJECT CONDITIONS

- A. Take field measurements to determine the lengths and dimensions of the surfaces to receive the fabric.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. One of the following or equal:
1. Propex, Geotex 401.
 2. Ten Cate Geosynthetics, Mirafi 140N.

2.02 MATERIAL REQUIREMENTS

- A. Physical properties: Meet the following minimum requirements:

Property⁽¹⁾	Test Method	Unit	Requirements⁽¹⁾
Minimum Weight	ASTM D 5261	oz	4.0
Grab Tensile Strength	ASTM D 4632	lbs	100
Grab Elongation	ASTM D 4632	%	50
Trapezoid Tear Strength	ASTM D 4533	lbs	50
CBR Puncture Resistance	ASTM D 6241	lbs	300
UV Resistance (strength retained at 500 hrs)	ASTM D 4355	%	70
Apparent Opening Size (AOS)	ASTM D 4751	US sieve	70
Permittivity	ASTM D 4491	sec ⁻¹	1.7
Flow Rate	ASTM D 4491	gpm/ft ²	130
(1) Minimum average roll values.			

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions: Verify that conditions are satisfactory for the installation of filter fabric.

3.02 PREPARATION

- A. Surface preparation:
1. During grading operations, take care not to disturb the subgrade.
 2. This may require use of lightweight dozers for low strength soils such as saturated, cohesionless, or low cohesion soils.
- B. Prior to placement of fabric: Prepare surface to smooth condition free of debris, depressions, or obstructions that may damage the fabric.

3.03 INSTALLATION

- A. Follow manufacturer's installation instructions and as complimented herein.
- B. Place the filter fabric smoothly without folds or wrinkles.
- C. Use special care when placing the filter in contact with the soil so that no void spaces occur between the filter and the prepared surface.

- D. Overlap the parallel rolls and ends of rolls a minimum of 24 inches and not less than manufacturer's instructions.
- E. Do not drag filter fabric across subgrade.
- F. Make overlaps at ends of rolls in the direction of the aggregate placement with the previous roll on top.
- G. Use lightweight dozers if necessary. Do not allow equipment directly on filter fabric.

3.04 FIELD QUALITY CONTROL

- A. Inspection:
 - 1. Before covering, the condition of the fabric will be observed by the Engineer to determine that no holes or rips exist in the fabric.
 - 2. Repair all holes and rips by placing a new layer of fabric extending beyond the defect in all directions a distance equal to the minimum overlap required for adjacent rolls.

END OF SECTION

SECTION 02820

FENCES AND GATES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Fence, framework, fabric, and accessories.
 - 2. Excavation for post bases and concrete foundation for posts.
 - 3. Manual gates and related hardware.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. A 121 - Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
 - 2. A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 4. A 385 - Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
 - 5. A 392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
 - 6. A 702 - Standard Specification for Steel Fence Posts and Assemblies, Hot-Wrought.
 - 7. F 626 - Standard Specification for Fence Fittings.
 - 8. F 668 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.
 - 9. F 1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework.
 - 10. F 1184 - Standard Specification for Industrial and Commercial Horizontal Slide Gates.
- B. State of California Department of Transportation (Caltrans).
 - 1. Underwriters Laboratories, Inc. (UL):325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

1.03 SUBMITTALS

- A. Product data: Submit data completely describing products.

- B. Samples: Provide for polyvinyl chloride coated fabric and accessories.
- C. Submit privacy slat color swatches to Owner for selection of color prior to purchasing.
- D. Quality control submittals:
 - 1. Certificates of compliance: Provide certification that materials conform to referenced specifications.
 - 2. Qualifications: Provide installer's references and list of local references.

1.04 QUALITY ASSURANCE

- A. Pre-installation conference: Participate in conference, if required.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Storage and handling: Unload, store, and protect materials such that they are not damaged.

1.06 PROJECT CONDITIONS

- A. Field measurements:
 - 1. Verify actual field distances so that post spacing can be made uniform.
 - 2. Verify and coordinate gate opening and column distances for driveway.

1.07 SEQUENCING AND SCHEDULING

- A. Fences and gates: May be constructed at any time after earthwork, pipe work, and structures to which fence is related has been completed, but prior to erosion control application.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Chain link fence and gates: One of the following or equal:
 - 1. Allied Tube and Conduit.
 - 2. Master-Halco.

2.02 MATERIALS

- A. Chain link fence:
 - 1. Fabric:
 - a. Height:
 - 1) Standby Generator fence: 8 feet 0 inch except where indicated otherwise on drawings
 - b. Mesh for privacy slats: 3-1/2 inches by 5 inches.
 - c. Size wire: 9 gauge
 - 1) Coating: Zinc coating, ASTM A 392, Class 1.
 - 2) Tensile strength: 80,000 pounds per square inch minimum.
 - 2. Framework: In accordance with ASTM F 1043 Group 1A or 1C. Pipe shall be straight and conform to the following weights:

Pipe Size Outside Diameter (Inches)	Group IA Weight (Lbs/ft)	Group IC Weight (Lbs/ft)
1-5/8	2.27	1.84
1-7/8	2.72	2.28
2-3/8	3.65	3.12
2-7/8	5.79	4.64
3-1/2	7.58	5.71
4	9.11	6.56
6-5/8	18.97	-
8-5/8	24.70	-

- a. Top rail:
 - 1) Size: 1-5/8 inches outside diameter.
 - 2) Tension wire: 7-gauge galvanized coil spring wire.
- b. Line posts:
 - 1) Size: 1-7/8-inch outside diameter.
- c. Terminal, corner, and pull posts:
 - 1) Size: 2-7/8-inch outside diameter.
- d. Coatings:
 - 1) Group IA: External coatings in accordance with ASTM F 1043 Type A; internal coatings in accordance with ASTM F 1043 Type A.
 - 2) Group IC: External coatings in accordance with ASTM F 1043 Type B; internal coatings in accordance with ASTM F 1043 Type D.
3. Accessories:
 - a. Fence fittings: In accordance with ASTM F 626.
 - 1) Post top fittings:
 - a) Provide post caps that fit snugly over posts to exclude moisture. Provide dome style caps for terminal posts and loop style caps for line posts.
 - 2) Rail and brace ends: Provide pressed steel or malleable castings that are cup shaped to receive rail and brace ends.
 - b. Fabric accessories:
 - 1) Wire clips: Minimum 6 gauge hot-dip galvanized.
 - 2) Tension bars: 1/4 inch by 3/4 inch, galvanized.
 - 3) Steel bands: 11 gauge, 1 inch wide, hot-dip galvanized.
 - 4) Bolts and nuts: 3/8-inch diameter.
 - 5) Hog rings: 11 gauge.
 - c. Privacy slats:
 - 1) Vinyl strips, sized to fit fabric weave, green color.

B. Chain link gates:

1. Gate posts and concrete foundations for gate posts: determine gate posts and concrete foundations for gate posts in accordance with following schedule:

Gate Leaf Widths (Feet)	Gate Posts	Foundations	
	Post O.D. ASTM F 1043 Group IA or IC (Inches)	Diameter (Inches)	Depth (Feet)
0 TO 6	2-7/8	12	4
Over 6 to 13	4	18	3
Over 13 to 18	6-5/8 (Group IA)	18	4
Over 18 to 25	8-5/8 (Group IA)	18	4.5

2. Chain link gates:
 - a. Frames and center supports: 1-7/8-inch outside diameter galvanized steel pipe that in accordance with ASTM F 1043 Group IA or IC.
 - b. Gate accessories:
 - 1) Post top fittings:
 - a) Provide post caps that fit snugly over posts to exclude moisture.
 - b) Provide dome style caps for terminal posts and loop style caps for line posts.
 - 2) Corner fittings: Heavy pressed steel or malleable castings.
 - 3) Gate tensioning:
 - a) Cross tensioning rods: 3/8 inch, galvanized.
 - b) Turnbuckles: Heavy duty.
 - 4) Tension rods for 4-foot gates: 3/8 inch, easily adjustable, galvanized.
 - 5) Gate frame corner fittings: Fitting designed for purpose, Manufacturer's standard.
 - 6) Horizontal gate stiffeners: 1-5/8-inch outside diameter galvanized steel pipe that in accordance with ASTM F 1043 Group IA or IC.
 - 7) Gate hardware:
 - a) Catch and locking attachment: Combination steel or malleable iron catch and locking attachment of acceptable design.
 - b) Stops:
 - (1) Type 1: Capable of holding gates open.
 - (2) Type 2: Center rest with catch.
 - c) Color: Match color of fabric.

2.03 EQUIPMENT

- A. Post mounted gate locks: Provide locks that:
 1. Are electrically operated, post mounted type, and capable of positively locking gates to latch post.
 2. Include manual key lock for disconnect in event of power failure.
 3. Are designed to operate on 120 volts alternating current and that are suitable for outdoor use.
 4. Manufacturers: One of the following or equal:
 - a. Stanley Vemco, Number 420-141 for slide gate.

2.04 FABRICATION

- A. Shop finishing:
 - 1. Galvanizing: For items not fabricated of galvanized materials hot-dip galvanize products after fabrication in accordance with following as applicable:
 - a. ASTM A 123.
 - b. ASTM A 153.
 - c. ASTM A 385.
 - 2. Mark galvanized products with name of galvanize, applicable ASTM designation, and weight of zinc coating.
 - 3. Galvanize fabricated items complete, or in largest practicable sections.
 - 4. Provide galvanizing at rate of 2.0 ounces per square foot, minimum.
 - 5. Hardware:
 - a. Padlocks: Cadmium plated.
 - b. Chain: Galvanized.
- B. Finish schedule:
 - 1. Ferrous metal:
 - a. Typical: Clean, then hot-dip galvanize in accordance with galvanizing standards.
- C. Field finish touch-up painting:
 - 1. Galvanized repair paint: Apply paint having minimum dry film thickness of 2.0 to 3.5 mils.

2.05 CANTILEVER GATE

- A. Material:
 - 1. Fabricated from 6063-T5 aluminum alloy extrusions:
 - a. The primary members (top and bottom) shall be "P" shaped in cross section weighing not less than 1.6 pounds per linear foot.
 - 1) This member shall be "keyed" to interlock with the "keyed" track member.
 - 2) The vertical members at the ends of the frame shall be square in cross section with nominal base dimensions of no less than 2 inches by 2 inches weighing not less than 1.1 pounds per linear foot.
 - b. Intermediate vertical members shall alternate between 1 inch by 2 inches and 1 inch by 1 inch in cross section weighing not less than .82 pounds per linear foot and .52 pounds per linear foot respectively. Intermediates shall be spaced at a maximum of 3-foot centers.
- B. Gate frame:
 - 1. Fabricate in modular sections or in single units depending on size constraints then shop or field assembled for the specified opening.
 - 2. The gate frame shall have a separate semi-enclosed "keyed" track:
 - a. Track: extruded from 6105-T5-aluminum alloy, weighing not less than 2.9 pounds per linear foot.
 - b. When interlocked with the top member, and welded to it, it forms a composite structure with the top of the gate frame.
 - c. Welds to be placed alternately along the top and side of the track at 9-inch centers with welds being a minimum of 2 inches long.

3. The gate frame is to be supported from the track by 2-swivel type, self-aligning, 4-wheeled, sealed lubricant, and ball bearing truck assemblies.
 - a. The bottom of the support posts shall be equipped with 2 pairs of 3-inch rubber guide wheels.
 4. Diagonal "X" bracing of 3/16 inch minimum diameter stainless steel aircraft cable shall be installed to brace the gate panels.
- C. The gate shall be completed by installation of an approved filler as specified. It shall extend the entire length of the gate, which includes the opening and counterbalance, secured at the ends with standard fence industry tension bars and tied with standard fence industry ties at each 2-inch by 2-inch vertical member.
- D. Support posts shall be 4-inch OD galvanized steel with concrete footings as specified by the Engineer.
- E. Gate and installation: In accordance with ASTM F 1184 standards for aluminum cantilever slide gates, Type II, Class 2.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions: Verify field conditions prior to construction.

3.02 PREPARATION

- A. Surface preparation:
1. Before locating fence posts grade ground to permit grade of fence to remain constant over any local elevations or depressions in ground line.

3.03 INSTALLATION

- A. Chain link fences and gates:
1. General:
 - a. Install chain link fence and gates as indicated on the Drawings and specified in this Section.
 - b. Provide fence systems that are plumb, taut, true to line and grade, and complete in all details.
 - c. Install fencing to generally follow finish grade of ground and provide pull posts at points where required to conform to change in grade.
 - d. Install fencing such that space between bottom of fence and finish ground line does not exceed 3 inches.
 2. Concrete foundation for fence posts:
 - a. Set fence posts in concrete foundations, that extend at least 3 feet into ground, and space posts not over 10 feet apart.
 - b. Provide concrete foundations having minimum of 10 inches in diameter for line posts and 12 inches in diameter for corners and gates.
 - c. Provide foundations that extend minimum of 1 inch above finish grade and have tops that are shaped to slope to drain away from posts.
 - d. Trowel finish tops of footings, and slope or dome to direct water away from posts.

- e. Set keepers, stops, sleeves, tracks, eye bolts, and other accessories into concrete as required.
- f. Wheel rolling area for sliding gates shall be steel-trowel smooth finish concrete.
- 3. Post bracing:
 - a. End corner, pull, and gate posts: Brace with same material as top rail and trussed to line posts with 3/8-inch rods and tighteners.
 - b. Bracing end, corner, slope, and gate posts:
 - 1) Brace to midpoint of nearest line post or posts with horizontal braces used as compression members.
 - 2) Then from such line posts truss from brace back to bottom of end, corner, slope, or gate post with 3/8-inch steel truss rods with turnbuckles or other suitable tightening devices used as tension members.
- 4. Top rail:
 - a. Unless otherwise specified or indicated on the Drawings, install fencing with top rail and bottom tension wire.
- 5. Fabric:
 - a. Place fabric on outward facing side of the posts and install so that top edge projects over top rail of fence.
 - b. Stretch fabric taut and securely fasten to posts, top rail, and bottom tension wire.
 - c. Install tension wire parallel to line of fabric.
 - d. Fabric: Connect fabric to:
 - 1) Line posts with wire clips minimum every 14 inches.
 - 2) Terminal, corner, and gate posts with tension bars tied to posts minimum 14 inches on center and with steel bands and bolts and nuts.
 - 3) Tension wires with hog rings minimum 24 inches on center.
- 6. Post top fittings: Provide post tops with extension arms.
- 7. Swing gates:
 - a. Provide chain link fencing with swing gates, unless otherwise indicated on the Drawings or specified in this Section.
 - b. Provide swing chain link gates where indicated on the Drawings.
 - c. Provide gates with 2 leaves at each gate location. Hang gates by at least 2 hinges.
- B. Electrical lock:
 - 1. Install on each entrance gate.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's field service: Manufacturer shall check and test all powered gates and accessories before acceptance.

3.05 ADJUSTING

- A. Adjust gate travel, stops, and operator position to meet field conditions.

3.06 CLEANING

- A. Clean up surplus dirt, concrete, and other waste material and dress grade up upon completion of the work.

3.07 PROTECTION

- A. Protect installed fences and gates against damage and, if damaged, repair prior to final acceptance.

END OF SECTION

SECTION 03055

ADHESIVE-BONDED REINFORCING BARS AND ALL THREAD RODS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Bonding reinforcing bars and all thread rods in concrete using adhesives as specified.
- B. Related sections:
 - 1. Section 01410 - Regulatory Requirements.
 - 2. Section 03200 - Concrete Reinforcing.
 - 3. Section 05120 - Structural Steel.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. Standard B212.15 - Carbide Tipped Masonry Drills and Blanks for Carbide Tipped Masonry Drills.
- B. ASTM international (ASTM):
 - 1. C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- C. ICC Evaluation Service, Inc. (ICC-ES):
 - 1. AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
- D. Society for Protective Coatings (SSPC):
 - 1. Surface Preparation Standards (SP).
 - a. SP-1 - Solvent Cleaning.

1.03 SUBMITTALS

- A. Product Data: Furnish technical data for adhesives, including:
 - 1. Manufacturer's printed installation instructions (MPII).
 - 2. Independent laboratory test results.
 - 3. Handling and storage instructions.
- B. Quality control submittals:
 - 1. Adhesive manufacturer's past project experience data on at least 3 similar projects supplied with proposed products within the last 3 years.
 - 2. Special inspection: Provide detailed step-by-step instructions for the special inspection procedure in accordance with the building code as specified in Section 01410.
 - 3. ICC Evaluation Service, Inc., Evaluation Services Report in compliance with the AC308-Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

4. Installer qualifications: Submit evidence of successful completion of certification program for each installer of work described in this Section.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 1. Installer qualifications:
 - a. All individuals performing the work described in this Section shall be certified by a qualified organization to install adhesive anchors by following the MPII. Those organizations deemed to be qualified are:
 - 1) ACI-CRSI Adhesive Anchor Installer Certification Program.
 - 2) An adhesive anchor manufacturer's certification program, subject to acceptance by the Engineer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Storage and protection:
 1. Store adhesives and adhesive components on pallets or shelving in a covered-storage area.
 2. Control temperature above 60 degrees Fahrenheit and dispose of product if shelf life has expired.
 3. If stored at temperatures below 60 degrees Fahrenheit, test components prior to use to determine if they still meet specified requirements.

1.06 PROJECT CONDITIONS

- A. Seismic design category: D.

PART 2 PRODUCTS

2.01 GENERAL

- A. Like items of materials: Use end products of one manufacturer in order to achieve structural compatibility and singular responsibility.

2.02 ADHESIVE FOR SELF-CONTAINED CARTRIDGE SYSTEM

- A. Adhesive shall have a current ICC Evaluation Service report documenting acceptance under AC308 for use with cracked concrete and for the seismic design categories specified.
- B. Materials:
 1. In accordance with ASTM C881, Type IV, Grade 3, Class B or C depending on site conditions.
 2. 2-component, 100 percent solids, insensitive to moisture.
 3. Cure temperature, pot life, and workability: Compatible with intended use and environmental conditions.
- C. Packaging:
 1. Furnished in side-by-side cartridges with resin and hardener components isolated until mixing through manufacturer's static mixing nozzle. Nozzle

designed to thoroughly blend the components for injection from the nozzle directly into prepared hole.

2. Container markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

D. Manufacturers: One of the following or equal:

1. Hilti, Inc., Tulsa, OK: RE 500-SD.
2. Simpson Strong-Tie Company, Inc., Pleasanton, CA: SET-XP.

2.03 ALL THREAD RODS

- A. Materials: As specified in Section 05120.

2.04 REINFORCING BARS

- A. As specified in Section 03200.

PART 3 EXECUTION

3.01 GENERAL

- A. Execution of this work is restricted to those installers certified through a qualified certification program described under Quality Assurance and accepted by the Engineer.
- B. The work shall be performed in strict accordance with the accepted MPII and the following instructions. Where the accepted MPII and the following instructions conflict, the MPII shall prevail.
- C. Provide adhesive packaged as follows:
1. Disposable, self-contained cartridge system capable of dispensing multiple adhesive components in the proper mixing ratio, and fit into a manually or pneumatically operated caulking gun.
 2. Dispense components through a mixing nozzle that thoroughly mixes components.

3.02 HOLE SIZING AND INSTALLATION

- A. Drilling holes:
1. Determine location of reinforcing bars or other obstructions with a non-destructive indicator device, and mark locations with construction crayon on the surface of the concrete.
 2. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without acceptance by Engineer.
- B. Hole drilling equipment:
1. Electric or pneumatic rotary impact type with medium or light impact.
 2. Drill bits: Carbide-tipped in accordance with ANSI B212-15 unless otherwise recommended by the manufacturer or required as a "condition of use" in the ICC Evaluation Report submitted.

3. Hollow drill bits with flushing air systems are preferred. Air supplied to hollow drill bits shall be free of oil, water, or other contaminants that will reduce bond.
 4. Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and concrete spalling during drilling process.
- C. Hole diameter: Reinforcing bar diameter or all thread rod diameter plus 1/8 inch.
- D. Obstructions in drill path:
1. If an existing reinforcing bar or other obstruction is hit while drilling hole, stop drilling hole and fill the hole with drypack mortar. Relocate the hole to miss the obstruction and drill another hole. Repeat the above until the hole has been drilled to the required depth.
 2. Avoid drilling an excessive number of holes in an area of a structural member, which would excessively weaken the structural member and endanger the stability of the structure. Drypack holes which hit obstructions and allow drypack to reach strength equal to the existing concrete before drilling adjacent holes. Epoxy grout may be substituted for drypack when acceptable to Engineer.
 3. When existing reinforcing steel is encountered during drilling and when acceptable to Engineer, enlarge the hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter.
 4. Bent bar reinforcing bars: Where edge distances are critical, and striking reinforcing steel is likely, and if acceptable to Engineer, drill hole at 10 degree angle or less from axis of reinforcing bar or all thread rod being installed.
- E. Install reinforcing bars and all thread rods to depth, spacings, and locations as indicated on the Drawings.
1. Do not install adhesive-bonded all-thread rods or reinforcing bars in overhead applications.
- F. Cleaning holes:
1. Insert long air nozzle into hole and blow out loose dust. Use compressed air that is free of oil, water, or other contaminants that will reduce bond.
 2. Use a stiff bristle brush to vigorously brush hole to dislodge compacted drilling dust.
 3. Repeat step 1.
 4. Repeat above steps as required to remove drilling dust or other material that will reduce bond. The hole shall be clean and dry.
- G. Cleaning reinforcing bars and all thread rods:
1. Clean reinforcing bars and all thread rods over embedment length to bare metal, free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.
 2. Solvent clean reinforcing bar and all thread rods over the embedment length in accordance with SSPC SP-1 Solvent Cleaning. Provide an oil and grease free surface to promote bonding of adhesive to steel.
- H. Filling hole with adhesive:
1. Fill hole with adhesive before inserting the reinforcing bar or all thread rod. Fill hole with adhesive starting from bottom of hole. Fill hole without creating air voids.

2. Fill hole with sufficient adhesive so that excess adhesive is extruded out of the hole when the reinforcing bar or all thread rod is inserted into the hole.

END OF SECTION

SECTION 03071

EPOXIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Epoxy.
 - 2. Epoxy bonding agent.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 03072 - Epoxy Resin/Portland Cement Bonding Agent.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C 881 – Standard Specification for Epoxy-Resin-Base Systems for Concrete.
 - 2. C 882 – Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
 - 3. D 638 - Standard Test Method for Tensile Properties of Plastics.
 - 4. D 695 - Standard Test Method for Compressive Properties of Rigid Plastics.

1.03 SYSTEM DESCRIPTION

- A. Performance requirements:
 - 1. Provide epoxy materials that are new.
 - 2. Store and use products within shelf life limitations set forth by manufacturer.
 - 3. Perform and conduct work of this Section in neat orderly manner.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's data completely describing epoxy materials.
 - 1. Submit evidence of conformance to ASTM C 881. Include manufacturer's designations of Type Grade, Class, and Color.
 - 2. Submit evidence that materials meet or exceed the specified physical characteristics.
- B. Quality control submittals:
 - 1. Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General: Moisture tolerant, water-insensitive, two-component epoxy resin adhesive material containing 100 percent solids, and meeting or exceeding the performance properties specified when tested in accordance with the standards specified.
- B. Epoxy: Low viscosity product in accordance with ASTM C 881; Types I, II and V; Grade 1; Class C.
1. Manufacturers: One of the following or equal:
 - a. BASF, Concreive Standard LVI.
 - b. Sika Corporation, Sikadur 35 Hi-Mod LV.
 2. Required properties:

Table 1: Material Properties – Epoxy.		
Property	Test Method	Required Results (“neat”)
Tensile Strength (7-day)	ASTM D 638	7,500 pounds per square inch, minimum.
Compressive Strength, (7-day)	ASTM D 695	11,000 pounds per square inch, minimum.
Bond Strength (2-day)	ASTM C 882	Concrete shall fail before failure of epoxy.
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

- C. Epoxy bonding agent: Non-sagging product in accordance with ASTM C 881, Type II, Grade 1, Class C.
1. Manufacturers: One of the following or equal:
 - a. BASF, Concreive Liquid LPL.
 - b. Sika Chemical Corp., Sikadur 32 Hi-Mod LPL.

2. Required properties.

Table 3 – Material Properties – Epoxy Bonding Agent		
Property	Test Method	Required Results
Tensile Strength (7-day)	ASTM D 638	4,400 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D 695	8,300 pounds per square inch, minimum.
Bond Strength (14-days)	ASTM C 882	1,800 pounds per square inch, minimum. Concrete shall fail before failure of epoxy bonding agent.
Pot Life	-	Minimum 70 minutes at 77 degrees Fahrenheit or Minimum 90 minutes at 73 degrees Fahrenheit
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

3. If increased contact time is required for concrete placement, epoxy resin/portland cement bonding agent as specified in Section 03072 may be used instead of epoxy bonding agent.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.
- B. Epoxy:
 - 1. Apply in accordance with manufacturer's installation instructions.
- C. Epoxy gel:
 - 1. Apply in accordance with manufacturer's installation instructions.
 - 2. Use for vertical or overhead work, or where high viscosity epoxy is required.
 - 3. Epoxy gel used for vertical or overhead work may be used for horizontal work.
- D. Epoxy bonding agent:
 - 1. Apply in accordance with manufacturer's installation instructions.
 - 2. Bonding agent will not be required for filling form tie holes or for normal finishing and patching of similar sized small defects.

END OF SECTION

SECTION 03072

EPOXY RESIN/PORTLAND CEMENT BONDING AGENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Epoxy resin/portland cement bonding agent.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
 - 2. C 348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.
 - 3. C 496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
 - 4. C 882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
- B. Federal Highway Administration (FHWA):
 - 1. FHWA-RD-86-193 - Highway Concrete Pavement Technology Development and Testing Volume V: Field Evaluation of SHRP C9206 Test Sites (Bridge Deck Overlays).

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sika Corporation, Lyndhurst, New Jersey, Sika Armatec 110.
- B. Substitutions: The use of other than the specified product will be considered, providing the Contractor requests its use in writing to the Engineer. This request shall be accompanied by:
 - 1. A certificate of compliance from an approved independent testing laboratory that the proposed substitute product meets or exceeds specified performance criteria, tested in accordance with the specified test standards.
 - 2. Documented proof that the proposed substitute product has a 1-year proven record of performance of bonding portland cement mortar/concrete to hardened portland cement mortar/concrete, confirmed by actual field tests and 5 successful installations that the Engineer can investigate.

2.02 MATERIALS

- A. Epoxy resin/portland cement adhesive:
 - 1. Component "A" shall be an epoxy resin/water emulsion containing suitable viscosity control agents. It shall not contain butyl glycidyl ether.
 - 2. Component "B" shall be primarily a water solution of a polyamine.

3. Component "C" shall be a blend of selected portland cements and sands.
4. The material shall not contain asbestos.

2.03 PERFORMANCE CRITERIA

- A. Properties of the mixed epoxy resin/portland cement adhesive:
 1. Pot life: 75 to 105 minutes.
 2. Contact time: 24 hours.
 3. Color: Dark gray.
- B. Properties of the cured epoxy resin/portland cement adhesive:
 1. Compressive strength in accordance with ASTM C 109:
 - a. 3 day: 4,500 pounds per square-inch minimum.
 - b. 7 days: 6,500 pounds per square-inch minimum.
 - c. 28 days: 8,500 pounds per square-inch minimum.
 2. Splitting tensile strength in accordance with ASTM C 496:
 - a. 28 days: 600 pounds per square-inch minimum.
 3. Flexural strength:
 - a. 1,100 pounds per square-inch minimum in accordance with ASTM C 348.
 4. Bond strength in accordance with ASTM C 882 modified at 14 days:
 - a. 0 hours open time: 2,800 pounds per square-inch minimum.
 - b. 24 hours open time: 2,600 pounds per square-inch minimum.
 5. The epoxy resin/portland cement adhesive shall not produce a vapor barrier.
 6. Material must be proven to prevent corrosion of reinforcing steel when tested under the procedures as set forth by the FHWA Program Report Number FHWA-RD-86-193. Proof shall be in the form of an independent testing laboratory corrosion report showing prevention of corrosion of the reinforcing steel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Mixing the epoxy resin: Shake contents of Component "A" and Component "B." Empty all of both components into a clean, dry mixing pail. Mix thoroughly for 30 seconds with a jiffy paddle on a low-speed with 400 to 600 revolutions per minute drill. Slowly add the entire contents of Component "C" while continuing to mix for a minimum of 3 minutes and until uniform with no lumps. Mix only the quantity that can be applied within its pot life.
- B. Placement procedure:
 1. Apply to prepared surface with stiff-bristle brush, broom, or "hopper-type" spray equipment:
 - a. For hand applications: Place fresh plastic concrete/mortar while the bonding bridge adhesive is wet or dry, up to 24 hours.
 - b. For machine applications: Allow the bonding bridge adhesive to dry for 12 hours minimum.
- C. Adhere to all limitations and cautions for the epoxy resin/portland cement adhesive in the manufacturer's current printed literature.

3.02 CLEANING

- A. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

END OF SECTION

SECTION 03102
CONCRETE FORMWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Concrete formwork.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 03300 - Cast-in-Place Concrete.
 - b. Section 03600 - Grouting.
 - c. Section 07900 - Joint Sealants.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 117 - Specifications for Tolerances for Concrete Construction and Materials and Commentary.
- B. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.
- C. Underwriters Laboratories (UL).

1.03 DEFINITIONS

- A. Green concrete: Concrete with less than 100 percent of the minimum specified compressive strength (f'_c).

1.04 SYSTEM DESCRIPTION

- A. Design requirements:
 - 1. Design of concrete forms, falsework, and shoring in accordance with local, state, and federal regulations.
 - 2. Design forms and ties to withstand concrete pressures without bulging, spreading, or lifting of forms.

- B. Performance requirements:
 - 1. Construct forms so that finished concrete conforms to shapes, lines, grades, and dimensions indicated on the Drawings.
 - 2. It is intended that surface of concrete after stripping presents smooth, hard, and dense finish that requires minimum amount of finishing.
 - 3. Provide sufficient number of forms so that the work may be performed rapidly and present uniform appearance in form patterns and finish.
 - 4. Use forms that are clean and free from dirt, concrete, and other debris.
 - a. Coat with form release agent if required, prior to use or reuse.

1.05 SUBMITTALS

- A. Information on proposed forming system:
 - 1. Submit in such detail as the Engineer may require to assure himself that intent of the Specifications can be complied with by use of proposed system.
 - 2. Alternate combinations of plywood thickness and stud spacing may be submitted.
- B. Form release agent. NSF 61 certification prepared by NSF, Underwriters Laboratories (UL) or other, similar, nationally recognized testing laboratory acceptable to the Engineer.

1.06 QUALITY ASSURANCE

- A. Qualifications of formwork manufacturers: Use only forming systems by manufacturers having a minimum of 5 years' experience, except as otherwise specified, or accepted in writing by the Engineer.
- B. Regulatory requirements: Install work of this Section in accordance with local, state, and federal regulations.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Forms: Built-up plywood:
 - 1. Built-up plywood forms may be substituted for prefabricated forming system subject to following minimum requirements:
 - a. Size and material:
 - 1) Use full size 4-foot by 8-foot plywood sheets, except where smaller pieces are able to cover entire area.
 - 2) Sheet construction: 5-ply plywood sheets, 3/4-inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.
 - b. Wales: Minimum 2-inch by 4-inch lumber.
 - c. Studding and wales: Contain no loose knots and be free of warps, cups, and bows.

- B. Forms: Steel or steel framed:
 - 1. Steel forms:
 - a. Rigidly constructed and capable of being braced for minimum deflection of finish surface.
 - b. Capable of providing finish surfaces that are flat without bows, cups, or dents.
 - 2. Steel framed plywood forms:
 - a. Provide forms that are rigidly constructed and capable of being braced.
 - b. Plywood paneling: 5-ply, 5/8-inch nominal or 3/4-inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.
- C. Form release agent.
 - 1. Effective, non-staining, bond-breaking coating compatible with form surfaces and concrete mixes used.
 - 2. Certified for conformance to NSF 61 and leaving no taste or odor on the concrete surface.
- D. Form ties:
 - 1. General:
 - a. Provide form ties for forming system selected that are manufactured by recognized manufacturer of concrete forming equipment.
 - b. Do not use wire ties or wood spreaders of any form.
 - c. Provide ties of type that accurately tie, lock, and spread forms.
 - d. Provide form ties of such design that when forms are removed, they locate no metal or other material within 1-1/2 inches of the surface of the concrete.
 - e. Do not allow holes in forms for ties to allow leakage during placement of concrete.
 - 2. Cone-snap ties:
 - a. Cone-snap ties shall form a cone shaped depression in the concrete with minimum diameter of 1 inch at the surface of the concrete and minimum depth of 1-1/2 inches.
 - b. Provide neoprene water seal washer that is located near the center of the concrete.
 - 3. Taper ties:
 - a. Neoprene plugs for taper tie holes: Size so that after they are driven, plugs are located in center third of wall thickness.
- E. Incidentals:
 - 1. External angles:
 - a. Where not otherwise indicated on the Drawings, provide with 3/4-inch bevel, formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, slabs, walls, beams, columns, and openings.
 - b. Provide 1/4-inch bevel formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, walls, and slabs at expansion, and construction joints..

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site verification of conditions:
 - 1. Do not place concrete until forms have been checked for alignment, level, and strength, and mechanical and electrical inserts or other embedded items for correct location.

3.02 INSTALLATION

- A. Forms: Built-up plywood:
 - 1. Studding:
 - a. Spaced at 16 inches or 24 inches on center.
 - b. Closer spacing may be required depending upon strength requirements of the forms, in order to prevent any bulging surfaces on faces of finished concrete work.
 - c. Install studs perpendicular to grain of exterior plys of plywood sheets.
 - 2. Wales: Form wales of double lumber material with minimum size as specified in this Section.
 - 3. Number of form reuses: Depends upon durability of surface coating or overlay used, and ability to maintain forms in condition such that they are capable of producing flat, smooth, hard, dense finish on concrete when stripped.
- B. Forms: Steel or steel framed:
 - 1. Steel forms:
 - a. Adequately brace forms for minimum deflection of finish surface.
 - 2. Steel framed plywood forms:
 - a. Rigidly construct and brace with joints fitting closely and smoothly.
 - b. Number of form reuses: Depends upon durability of surface coating or overlay used.
 - 3. Built-up plywood forms: As specified in this Section may be used in conjunction with steel forms or steel framed plywood forms for special forming conditions such as corbels and forming around items which will project through forms.
- C. Forms: Incidental construction:
- D. Form bracing and alignment:
 - 1. Line and grade: Limit deviations to tolerances which will permit proper installation of structural embedded items or mechanical and electrical equipment and piping.
 - 2. Formwork:
 - a. Securely brace, support, tie down, or otherwise hold in place to prevent movement.
 - b. Make adequate provisions for uplift pressure, lateral pressure on forms, and deflection of forms.
 - 3. When second lift is placed on hardened concrete: Take special precautions in form work at top of old lift and bottom of new lift to prevent:
 - a. Spreading and vertical or horizontal displacement of forms.
 - b. Grout "bleeding" on finish concrete surfaces.
 - 4. Pipe stubs, anchor bolts, and other embedded items: Set in forms where required.

5. Cracks, openings, or offsets at joints in formwork: Close those that are 1/16-inch or larger by tightening forms or by filling with acceptable crack filler.
- E. Forms: Incidentals:
1. Keyways: Construct as indicated on the Drawings.
 2. Reentrant angles: May be left square.
 3. Level strips: Install at top of wall concrete placements to maintain true line at horizontal construction joints.
 4. Inserts:
 - a. Encase pipes, anchor bolts, steps, reglets, castings, and other inserts, as indicated on the Drawings or as required, in concrete.
 5. Pipe and conduit penetrations:
 - a. Install pipe and conduit in structures as indicated on the Drawings, and seal with materials as specified in Section 07900.
- F. Form release agent:
1. Apply in accordance with manufacturer's instructions.
- G. Form ties:
1. Cone-snap ties: Tie forms together at not more than 2-foot centers vertically and horizontally.

3.03 FORM REMOVAL

- A. Keep forms in place for at least the periods indicated in the following paragraphs.
1. Vertical forms:
 - a. Keep vertical forms in place for a minimum of 24 hours after concrete is placed.
 - b. If, after 24 hours, concrete has sufficient strength and hardness to resist surface or other damage, forms may be removed.
 2. Other forms and shoring: Keep in place:
 - a. Sides of footings: 24 hours minimum.
 - b. Vertical sides of beams, girders, and similar members: 48 hours minimum.
 - c. Bottom of slabs, beams, and girders: Until concrete strength reaches specified strength f'_c or until shoring is installed.
 - d. Shoring for slabs, beams, and girders: Shore until concrete strength reaches specified strength.
 - e. Wall bracing: Brace walls until concrete strength of beams and slabs laterally supporting wall reaches specified strength.
- B. Green concrete:
1. No heavy loading on green concrete will be permitted.

3.04 SURFACE REPAIRS AND FINISHING

- A. Immediately after forms are removed, carefully examine concrete surfaces, and repair any irregularities in surfaces and finishes as specified in Section 03300.
- B. Form ties: Remove form ties from surfaces. Fill tie holes as follows:
1. Remove form ties from surfaces.
 2. Roughen cone shaped tie holes by heavy sandblasting before repair.
 3. Dry pack cone shaped tie holes with dry-pack mortar as specified in Section 03600.

4. Taper ties:
 - a. After forms and taper ties are removed from wall, plug tie holes with neoprene plug as follows:
 - 1) Heavy sandblast and then clean tie holes.
 - 2) After cleaning, drive neoprene plug into each of taper tie holes with steel rod. Final location of neoprene plug shall be in center third of wall thickness. Bond neoprene plug to concrete with epoxy.
 - 3) Locate steel rod in cylindrical recess and against middle of plug during driving.
 - a) At no time are plugs to be driven on flat area outside cylindrical recess.
 - b. Dry-pack of taper tie holes:
 - 1) After installing plugs in tie holes, coat tie hole surface with epoxy bonding agent and fill with dry-pack mortar as specified in Section 03600.
 - a) Place dry-pack mortar in holes in layers with thickness not exceeding tie hole diameter and heavily compact each layer.
 - b) Dry-pack the outside of the hole no sooner than 7 days after the inside of the hole has been dry packed.
 - c) Wall surfaces in area of dry-packed tie holes: On the water side of water containing structures and the outside of below grade walls:
 - (1) Cover with minimum of 10 mils of epoxy gel.
 - (2) Provide epoxy gel coating on wall surfaces that extend minimum of 2 inches past dry-pack mortar filled tie holes.
 - (3) Provide finish surfaces that are free from sand streaks or other voids.

3.05 TOLERANCES:

- A. Finished concrete shall conform to shapes, lines, grades, and dimensions indicated on the Drawings.
- B. Construct work within the tolerances in accordance with ACI 117, except as modified in the following paragraphs or as indicated on the Drawings.
 1. General:
 - a. At certain locations in the Work, tolerances required for equipment placement and operation may be more restrictive than the general tolerance requirements of this Section.
 - b. Confirm equipment manufacturers' required tolerances for location and operation of equipment that will be installed, and construct concrete to satisfy those requirements.
 2. Slabs:
 - a. Slope: Uniformly sloped to drain when slope is indicated on the Drawings.
 - b. Slabs indicated to be level: Have maximum vertical deviation of 1/8-inch in 10-foot horizontal length without any apparent changes in grade.
 3. Circular tank walls:
 - a. The Contractor may deviate from finish line indicated on the Drawings by use of forms with chord lengths not to exceed 2 feet.
 4. Inserts and embedments:
 - a. Set inserts and embedments to tolerances required for proper installation and operation of equipment or systems to which insert pertains.

- b. Maximum tolerances: As follows:

Item	Tolerance
Sleeves and inserts	Plus 1/8 Minus 1/8 inches.
Anchor bolts:	
Projected ends	Plus 1/4 Minus 0.0 inches.
Axial alignment	Not more than 2 degrees off the axis indicated on the Drawings.
Setting location	Plus 1/16 Minus 1/16 inches.

- C. Remove and replace work that does not conform to required tolerances. Procedures and products employed in and resulting from such re-work shall be acceptable to the Engineer.

END OF SECTION

SECTION 03154

HYDROPHILIC RUBBER WATERSTOP

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Hydrophilic rubber waterstop.

1.02 SUBMITTALS

- A. General:
 - 1. Submit the following items for each type, style and size of hydrophilic waterstop to be installed.
 - 2. Product data:
 - a. Manufacturer's product data sheets.
 - 1) Include complete physical dimensions, expansion characteristics, and laboratory test reports indicating that average material properties conform to the requirements specified.
 - 2) Provide data sheets for all materials to be included in the waterstop system.
 - 3. Samples:
 - a. Minimum 6-inch long samples of each type of waterstop to be used if requested by the Engineer.
 - 4. Manufacturer's installation instructions:
 - a. Installation instructions and recommended installation details for the complete waterstop system, and for each component used in that system.

PART 2 PRODUCTS

2.01 HYDROPHILIC RUBBER WATERSTOP

- A. General:
 - 1. System composed of flexible hydrophilic urethane polymer with preformed strips, adhesives, paste, fasteners, and other accessories required for a complete and watertight installation.
 - a. To ensure compatibility of materials, a single manufacturer shall provide all products and accessories for the hydrophilic waterstop system.
 - b. Products incorporating bentonite are not acceptable under this Section.
 - c. Provide waterstop and accessories resistant to degradation under cyclic wetting and drying.
- B. Hydrophilic strip waterstop.
 - 1. Pre-formed strips of flexible hydrophilic rubber designed to undergo controlled expansion when exposed to moisture.
 - a. Strips manufactured to limit expansion in directions parallel to the plane of the joint, and to direct expansion against confining material perpendicular to that plane.

2. Provide normal or low-expansion pressure as scheduled and as indicated on the Drawings.
3. Manufacturers. One of the following, or equal.
 - a. Hydrophilic strip - Joint.
 - 1) Adeka Ultra Seal USA: MC-2010MN.
 - 2) Greenstreak: Hydrotite CJ1020-2K.
 - b. Low expansion hydrophilic strip.
 - 1) Adeka Ultra Seal USA: KBA-1510FP.
 - 2) Greenstreak: Hydrotite CJ0725-3K.
- C. Hydrophilic paste waterstop.
 1. Single-component gun grade paste of hydrophilic rubber designed to undergo controlled expansion when exposed to moisture after initial curing.
 2. Manufacturers: One of the following, or equal.
 - a. Adeka Ultra Seal USA: P-201.
 - b. Greenstreak: Leakmaster LV-1.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and recommended details.
- B. Prepare concrete joint surfaces:
 1. Use wire brushing or scraping to expose an uncontaminated, solid surface.
 2. Clean prepared surface with high-pressure air or water to remove residue and debris.
 3. Confirm that prepared surfaces conform to manufacturer's recommendations for surface profile and moisture conditions before installing materials.
- C. Provide manufacturer's recommended lap, splice, and corner details for hydrophilic waterstops.
 1. Use hydrophilic paste at all corner joints and overlap splices of hydrophilic strips.
- D. Hydrophilic strip waterstop.
 1. Install primers and adhesives when recommended by the manufacturer before setting hydrophilic strips.
 2. Keep hydrophilic strip taut during the fastening process.
 3. Secure hydrophilic strip in place with concrete nails, screws, or adhesive.
 4. Provide installation with no gap between the hydrophilic strip and the concrete to which it is attached. At rough or irregular surfaces, set hydrophilic strip waterstop strip in a bead of hydrophilic paste.
 - a. Fill all voids and rough areas under the hydrophilic strip with hydrophilic paste.
 - b. Allow hydrophilic paste to cure in accordance with manufacturer's recommendations before encapsulating paste in fresh concrete.

3.02 SCHEDULE

- A. At the following joint locations/conditions, use the hydrophilic strip waterstop configuration noted.
- B. Concrete construction joints:
 - 1. Under all of the following conditions, use hydrophilic strip waterstop set in a bed of hydrophilic paste waterstop, and screw strip waterstop to concrete surface:
 - a. Slab or wall thickness is greater than 10 inches.
 - b. Waterstop is placed between 2 rows of steel reinforcement.
 - c. Concrete cover from waterstop to nearest concrete face is at least 4 inches.
 - 2. Under any one of the following conditions, use low-expansion hydrophilic strip waterstop set in bed of hydrophilic paste waterstop and screw strip to concrete surface:
 - a. Waterstop is placed on 1 side of a single row of steel reinforcement, or
 - b. Concrete cover from waterstop to nearest concrete face is less than 4 inches.
- C. Pipe penetrations through concrete:
 - 1. Pipe diameter less than 4 inches: Not allowed.
 - 2. Pipe diameter of 4 inches: Continuous bead of hydrophilic paste waterstop, minimum 1/4 inch high by 1/2 inch wide, encircling pipe.
 - 3. Pipe diameter greater than 4 inches: Continuous low expansion hydrophilic strip waterstop around perimeter of pipe, with hydrophilic paste seal at lapped ends of strip.

END OF SECTION

SECTION 03200
CONCRETE REINFORCING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Bar supports.
 - 2. Reinforcing bars.
 - 3. Thread bars.
 - 4. Tie wires.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 318 - Building Code Requirements for Structural Concrete and Commentary.
 - 2. 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary.
 - 3. SP-66 - ACI Detailing Manual.
- B. American Welding Society (AWS):
 - 1. D1.4 - Structural Welding Code - Reinforcing Steel.
- C. ASTM International (ASTM):
 - 1. A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - 2. A615 - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
 - 3. A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

1.03 DEFINITIONS

- A. Give away bars:
 - 1. Reinforcing bars that are not required by Contract Documents, but are installed by Contractor to support required reinforcing bars.

1.04 SYSTEM DESCRIPTION

- A. Drawings contain general notes concerning amount of reinforcement and placing, details of reinforcing bars at wall corners and intersections, and details of extra reinforcing bars around openings in concrete.

1.05 SUBMITTALS

- A. Shop drawings:
 - 1. Changes to reinforcement in contract drawing:
 - a. Indicate in separate letter submitted with shop drawings any changes to requirements in Contract Document for reinforcement.

- b. Such changes will not be acceptable unless Engineer has accepted such changes in writing.
 - 2. Reinforcement shop drawings:
 - a. Review of reinforcement shop drawings by Engineer will be limited to general compliance with Contract Documents.]
 - b. Submit reinforcement shop drawings for each specific structure in complete package. Partial submittals will be rejected.
 - c. Reinforcement mill certificates.
- B. Samples:
- 1. Submit samples of bar support chairs proposed for use along with letter stating where each type of chair will be used.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping:
- 1. Deliver bars bundled and tagged with identifying tags.
- B. Acceptance at site:
- 1. Reinforcing bars:
 - a. Deliver reinforcing bars lacking grade identification marks accompanied by manufacturer's guarantee of grade.

1.07 SEQUENCING AND SCHEDULING

- A. Bar supports:
- 1. Do not place concrete until samples and product data for bar supports have been accepted by Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Bar supports:
- 1. Wire bar supports located between reinforcing bars and face of concrete:
 - 2. Wire bar supports located between mats of reinforcing bars:
 - a. Steel bar supports.
- B. Reinforcing bars:
- 1. Reinforcing bars embedded in concrete:
 - a. In accordance with ASTM A615 or A706 Grade 60, deformed reinforcing bars.
 - 2. Reinforcing bars that are required to be welded shall meet the following requirements:
 - a. Low-alloy, Grade 60, deformed reinforcing bars in accordance with ASTM A706.
 - 3. Reinforcing bars that are required to resist earthquake-induced flexural and axial forces in concrete frame members and in concrete shear wall boundary members that meet following requirements:
 - a. Low-alloy, Grade 60, deformed reinforcing bars in accordance with ASTM A706.

- C. Tie wires:
 - 1. Annealed steel.
- D. Welded wire reinforcement:
 - 1. In accordance with ASTM A185.
 - 2. Provide welded wire reinforcement in flat sheet form.
 - 3. Welded wire reinforcement oil may be used in place of reinforcing bars if accepted by Engineer.
 - a. Provide welded wire reinforcement having cross-sectional area per linear foot of not less than cross-sectional area per linear foot of reinforcing bars indicated on the Drawings.

2.02 FABRICATION

- A. Shop assembly:
 - 1. Cut and bend reinforcing bars in accordance with ACI 318, ACI 350, and ACI SP-66.
 - 2. Bend reinforcing bars cold.
 - 3. Provide reinforcing bars free from defects and kinks and from bends not indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions:
 - 1. Reinforcing bars and welded wire reinforcement: Verify that reinforcement is new stock free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings that will adversely affect bonding capacity when placed in work.

3.02 PREPARATION

- A. Surface preparation:
 - 1. Reinforcing bars:
 - a. Thin coating of red rust resulting from short exposure will not be considered objectionable.
 - b. Thoroughly clean any reinforcing bars having rust scale, loose mill scale, or thick rust coat.
 - 2. Cleaning of reinforcement materials:
 - a. Remove concrete or other deleterious coatings from dowels and other projecting reinforcing bars by wire brushing or sandblasting before reinforcing bars are embedded in subsequent concrete placement.

3.03 INSTALLATION

- A. Reinforcing bars: General:
 - 1. Do not field blend reinforcing bars.
 - 2. Roll hoop bars to radius of structure.
- B. Placing reinforcing bars:
 - 1. Accurately place reinforcing bars in accordance with tolerances in ACI 318 and ACI 350 adequately secure them in position.

2. Lap length bars at lap splices as indicated on the Drawings or specified.
 - a. Unless specifically otherwise indicated on the Drawings, install bars at lap splices in contact with each other and fasten together with tie wire.
 - b. Where reinforcing bars are to be lap spliced at concrete joints, ensure that bars project from first concrete placement, length equal to or greater than minimum lap splice length indicated on the Drawings.
 - c. Where lap splice lengths are not indicated on the Drawings, provide lap splice lengths in accordance with ACI 318 and ACI 350.
 3. Reinforcing bar supports:
 - a. Do not use give away bars that have less cover than required by Contract Documents. Do not adjust location of reinforcement required by Contract Documents to provide cover to give away bars.
 - b. Do not use brick, concrete masonry units, spalls, rocks, wood, or similar materials for supporting reinforcing bars.
 - c. Provide sufficient number of bar supports to prevent sagging, and shifting, and to support loads during construction. In no case less bar support than quantities and at locations as indicated in ACI SP-66.
 4. If not indicated on the Drawings, provide protective concrete cover in accordance with ACI 350 and ACI SP-66.
- C. Tying of reinforcing bars:
1. Fasten reinforcing bars securely in place with wire ties.
 2. Tie reinforcing bars sufficiently often to prevent shifting.
 3. Provide at least 3 ties in each reinforcing bar length.
 - a. Does not apply to dowel lap splices or to reinforcing bars shorter than 4 feet, unless necessary for rigidity.
 4. Tie slab reinforcing bars at every intersection around periphery of slab.
 5. Tie wall reinforcing bars and slab bar intersections other than around periphery at not less than every fourth intersection, but not greater than following maximum spacings:

Bar Size	Slab Bar Spacing Inches	Wall Bar Spacing Inches
Bars Number 5 and Smaller	60	48
Bars Number 6 through Number 9	96	60
Bars Number 10 and Number 11	120	96

6. After tying wire ties, bend ends of wire ties in towards center of concrete section.
 - a. Cover for wire ties shall be same as cover requirements for reinforcing bars.

3.04 FIELD QUALITY CONTROL

- A. Inspection of welding of reinforcing bars:
1. Reinforcing bar welding will be continuously inspected by inspection laboratory hired by Owner.
 2. In addition to visual inspection, Owner may inspect reinforcing bar welds by other methods including radiographic inspection.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Cast-in-place concrete.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 03071 - Epoxies.
 - b. Section 03150 - Concrete Accessories.
 - c. Section 03366 - Tooled Concrete Finishing.
 - d. Section 03600 - Grouting.
 - e. Section 03931 - Epoxy Injection System.
 - f. Section 07900 - Joint Sealants.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 305 - Hot Weather Concreting Standard.
 - 2. 306 - Cold Weather Concreting Standard.
 - 3. 318 - Building Code Requirements for Structural Concrete and Commentary.
 - 4. 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary.
 - 5. Manual of Concrete Practice.
- B. ASTM International (ASTM):
 - 1. C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - 2. C 33 - Standard Specification for Concrete Aggregates.
 - 3. C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 4. C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - 5. C 42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - 6. C 88 - Standard Test Method of Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
 - 7. C 94 - Standard Specification for Ready-Mixed Concrete.
 - 8. C 114 - Standard Test Methods for Chemical Analysis of Hydraulic Cement.

9. C 117 - Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
 10. C 123 - Standard Test Method for Lightweight Particles in Aggregate.
 11. C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 12. C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 13. C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregate.
 14. C 143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
 15. C 150 - Standard Specification for Portland Cement.
 16. C 156 - Standard Test Method for Water Loss [from a Mortar Specimen] Through Liquid Membrane-Forming Curing Compounds for Concrete.
 17. C 157 - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
 18. C 171 - Standard Specifications for Sheet Materials for Curing Concrete.
 19. C 172 - Standard Practice for Sampling Freshly Mixed Concrete.
 20. C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 21. C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 22. C 289 - Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).
 23. C 295 - Standard Guide to Petrographic Examination of Aggregates for Concrete.
 24. C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 25. C 311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete.
 26. C 494 - Standard Specification for Chemical Admixtures for Concrete.
 27. C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 28. C 856 - Standard Practice for Petrographic Examination of Hardened Concrete.
 29. D 75 - Standard Practice for Sampling Aggregates.
 30. D 2103 - Standard Specification for Polyethylene Film and Sheeting.
- C. NSF International (NSF):
1. 61 - Drinking Water System Components - Health Effects.

1.03 DEFINITIONS

- A. Alkali: Sum of sodium oxide and potassium oxide calculated as sodium oxide.
- B. Cementitious materials: Portland cement and fly ash.
- C. Cold weather: A period when for more than 3 consecutive days, the average daily outdoor temperature drops below 40 degrees Fahrenheit. The average daily temperature is the average of the highest and lowest temperatures during the period from midnight to midnight. When temperatures above 50 degrees Fahrenheit occur during more than half of any 24-hour duration, the period shall no longer be regarded as cold weather.

- D. Cold weather concreting: Operations for placing, finishing, curing, and protection of concrete during cold weather.
- E. Green concrete: Concrete with less than 100 percent of the specified strength.
- F. Hairline crack: Crack with a crack width of less than 4 thousandths of an inch.
- G. Hot weather: A period when project conditions such as low humidity, high temperature, solar radiation, and high winds, promote rapid drying of freshly placed concrete.
- H. Hot weather concreting: Operations for placing, finishing, curing, and protection of concrete during hot weather.

1.04 SYSTEM DESCRIPTION

- A. Performance requirements:
 - 1. General:
 - a. Except as otherwise specified, provide concrete composed of portland cement, fly ash, fine aggregate, coarse aggregate, admixtures and water so proportioned and mixed as to produce plastic, workable mixture in accordance with requirements as specified in this Section and suitable to specific conditions of placement.
 - b. Proportion materials in a manner that will secure lowest water-cementitious materials ratio that is consistent with good workability, plastic and cohesive mixture, and a mixture that is within specified slump range.
 - c. Proportion fine and coarse aggregates in manner such as not to produce harshness in placing or honeycombing.
 - 2. It is the intent of this Section to secure for every part of the Work concrete with homogeneous mixture, which when hardened will have required strength, watertightness, and durability:
 - a. It is recognized that some surface hairline cracks and crazing will develop in the concrete surfaces.
 - b. Construction and expansion joints have been specified and positioned in structures as indicated on the Drawings, and curing methods specified, for purpose of reducing number and size of cracks, due to normal expansion and contraction expected from specified concrete mixes.
 - c. Repair cracks which develop in walls or slabs and repair cracks which show any signs of leakage until all leakage is stopped.
 - d. Pressure inject visible cracks, other than hairline cracks and crazing, in following areas with epoxy as specified in Section 03931:
 - 1) Floors and walls of water bearing structures.
 - 2) Walls and overhead slabs of passageways or occupied spaces, outsides of which are exposed to weather or may be washed down and are not specified to receive separate waterproof membrane.
 - 3) Other items not specified to receive separate waterproof membrane: Slabs over water channels, wet wells, reservoirs, and other similar surfaces.
 - e. Walls or slabs, as specified above, that leak or sweat because of porosity or cracks too small for successful pressure injection with epoxy: Seal on water or weather side by coatings of surface sealant system, as specified in this Section.

- f. Pressure injection and sealing: Continue as specified above until structure is watertight and remains watertight for not less than 1 year after final acceptance or date of final repair, whichever occurs later in time.
- 3. Workmanship and methods: Provide concrete work, including detailing of reinforcing, conforming with best standard practices and as set forth in ACI 318, ACI 350, Manual of Concrete Practices, and recommended practices.

1.05 SUBMITTALS

- A. Cement mill tests: Include alkali content, representative of each shipment of cement for verification of compliance with specified requirements.
- B. Cold weather concreting:
 - 1. Procedures for the production, transportation, placement, protection, curing, and temperature monitoring for concrete during cold weather.
 - 2. Procedures to be implemented upon abrupt changes in weather conditions or equipment failures.
- C. Concrete mixes: Full details, including mix design calculations for concrete mixes proposed for use for each class of concrete:
 - 1. Include information on correction of batching for varying moisture contents of fine aggregate.
 - 2. Source quality test records with mix design submittal:
 - a. Include calculations for required compressive strength (f'_{cr}) based on source quality test records.
- D. Concrete aggregate tests: Certified copies in triplicate of commercial laboratory tests not more than 90 days old of all samples of concrete aggregates:
 - 1. Coarse aggregate:
 - a. Abrasion loss.
 - b. Clay lumps and friable particles.
 - c. Coal and lignite.
 - d. Materials finer than 200 sieve.
 - e. Reactivity.
 - f. Shale and chert.
 - g. Soundness.
 - 2. Fine aggregate:
 - a. Clay lumps.
 - b. Color.
 - c. Decantation.
 - d. Reactivity.
 - e. Shale and chert.
 - f. Soundness.
- E. Drying shrinkage test data.
- F. Fine or coarse aggregate batched from more than 1 bin: Analyses for each bin, and composite analysis made up from these, using proportions of materials to be used in mix.
- G. Fly ash Certificate of Compliance: Identify source of fly ash and certify compliance in accordance with ASTM C 618.

- H. For conditions that promote rapid drying of freshly placed concrete such as low humidity, high temperature, and wind: Corrective measures for use prior to placing concrete.
- I. Hot weather concreting: Procedures for production, placement, finishing, curing, protection, and temperature monitoring for concrete during hot weather and appropriate corrective measures.
- J. Heating equipment for cold weather concreting: Information on type of equipment used for heating materials and new concrete in process of curing during excessively cold weather.
- K. Information on mixing equipment.
- L. Product data: Submit data completely describing products.
- M. Sequence of concrete placing: Submit proposed sequence of placing concrete showing proposed beginning and ending of individual placements.
- N. Sieve analysis: Submit sieve analyses of fine and coarse aggregates being used in triplicate at least every 3 weeks and at any time there is significant change in grading of materials.
- O. Trial batch test data:
 - 1. Submit data for each test cylinder.
 - 2. Submit data that identifies mix and slump for each test cylinder.
- P. Weather monitoring: Records of:
 - 1. Relative humidity.
 - 2. Site ambient temperature.
 - 3. Wind speed.
- Q. Temperature of freshly placed concrete.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping:
 - 1. Deliver, store, and handle concrete materials in manner that prevents damage and inclusion of foreign substances.
 - 2. Deliver and store packaged materials in original containers until ready for use.
 - 3. Deliver aggregate to mixing site and handle in such manner that variations in moisture content will not interfere with steady production of concrete of specified degree of uniformity and slump.
- B. Acceptance at site: Reject material containers or materials showing evidence of water or other damage.

1.07 PROJECT CONDITIONS

- A. Environmental requirements:
 - 1. Monitoring weather conditions:
 - a. Install an outdoor weather station capable of measuring and recording ambient temperature, wind speed, and humidity. Furnish instruments

- accurate to within 2 degrees Fahrenheit, 5 percent relative humidity, and 1 mile per hour wind speed.
- b. Measure and record temperature of fresh concrete. Furnish and use sufficient number of maximum and minimum self-recording thermometers to adequately measure temperature of concrete.
 - c. Monitor and keep records of the weather forecast starting at least 48 hours prior to placing concrete in order to allow enough time for taking appropriate measures pertaining to Hot or Cold weather concreting.
2. Hot weather concreting:
- a. Initiate evaporation control measures when concrete and air temperatures, relative humidity of the air, and the wind velocity have the capacity to evaporate water from a free surface at a rate that is equal to or greater than 0.2 pounds per square feet per hour. Determine evaporation rate using the Menzel Formula and monograph in ACI 305 3.1.3.
 - b. When ambient air temperature is above 85 degrees Fahrenheit: Prior to placing concrete, cool forms and reinforcing steel by water cooling to below 90 degrees Fahrenheit.
 - c. Monitor weather conditions at the site including air temperature, humidity, and wind speed, to assess the need for evaporation control measures begin monitoring site conditions no later than 1 hour before the start of concrete placement. Continue to monitor site conditions at intervals of 30 minutes until concrete curing has begun.
 - d. Temperature of concrete mix at time of placement: Keep temperature below 90 degrees Fahrenheit by methods which do not impair quality of concrete.
 - e. For conditions that promote rapid drying of freshly placed concrete such as low humidity, high temperature, and wind: Take corrective measures to minimize rapid water loss from concrete:
 - f. Furnish and use sufficient number of maximum and minimum self-recording thermometers to adequately measure temperature around concrete.
3. Cold weather concreting:
- a. Concrete placed below ambient air temperature of 45 degrees Fahrenheit and falling or below 40 degrees Fahrenheit:
 - 1) Make provision for heating water.
 - b. Follow recommendations of ACI 306 for preparation, placement, and protection of concrete during cold weather.
 - c. If materials have been exposed to freezing temperatures to degree that any material is below 35 degrees Fahrenheit: Heat such materials.
 - d. Heating water, cement, or aggregate materials:
 - 1) Do not heat in excess of 160 degrees Fahrenheit.
 - e. Protection of concrete in forms:
 - 1) Do not remove forms from concrete when outside ambient air temperature is below 50 degrees Fahrenheit until concrete has attained its minimum specified compressive strength. Evidence of strength shall be based on by testing of cylinders stored in the field under equivalent conditions to those at the concrete structure.
 - 2) Protect by means of covering with tarpaulins, or other acceptable covering acceptable to Engineer.
 - 3) Provide means for circulating warm moist air around forms in manner to maintain temperature of 50 degrees Fahrenheit for at least 5 days.

1.08 SEQUENCING AND SCHEDULING

- A. Schedule placing of concrete in such manner as to complete any single placing operation to construction, or expansion joint.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Admixtures:
 - 1. General:
 - a. Do not use admixtures of any type, except as specified, unless written acceptance has been obtained from the Engineer.
 - b. Admixtures shall be compatible with concrete and other admixtures. Admixtures other than pozzolans shall be the products of a single manufacture to ensure compatibility.
 - c. Do not use admixtures containing chlorides calculated as chloride ion in excess of 0.5 percent by weight of cement.
 - d. Use in accordance with manufacturer's recommendations. Add each admixture to concrete mix separately.
 - 2. Air entraining admixture:
 - a. Provide concrete with 5 percent, within 1 percent, entrained air of evenly dispersed air bubbles at time of placement.
 - b. In accordance with ASTM C 260.
 - 3. Water reducing admixture:
 - a. May be used at the Contractor's option.
 - b. In accordance with ASTM C 494, Type A or Type D.
 - c. Not contain air-entraining agents.
 - d. Liquid form before adding to the concrete mix.
 - e. No decrease in cement is permitted as result of use of water reducing admixture.
 - 4. Super-plasticizers: Are not to be used without acceptance by Engineer.
- B. Aggregate:
 - 1. General:
 - a. Provide concrete aggregates that are sound, uniformly graded, and free of deleterious material in excess of allowable amounts specified.
 - b. Grade aggregate in accordance with ASTM C 136 and D 75.
 - c. Provide unit weight of fine and coarse aggregate that produces in place concrete with weight of not less than 140 pounds per cubic foot.
 - d. Do not use aggregate made from recycled materials such as crushed and screened hydraulic-cement concrete, brick, and other construction materials.
 - 2. Fine aggregate:
 - a. Provide fine aggregate for concrete or mortar consisting of clean, natural sand or of sand prepared from crushed stone or crushed gravel.
 - b. Do not provide aggregate having deleterious substances in excess of following percentages by weight of contaminating substances.
 - 1) In no case shall total exceed percent listed.

Item	Test Method	Percent
Removed by decantation (dirt, silt, etc.)	ASTM C 117	3
Shale or Chert	ASTM C 123 ASTM C 295*	1 1
Clay Lumps	ASTM C 142	1
* Test Method C 123 is used to identify particles in the sample lighter than 2.40 Specific Gravity. Test Method C 295 is used to identify which of the lightweight particles are shale or chert. If the results of Test Method C 123 are less than 1 percent, Test Method C 295 is not required.		

- c. Except as otherwise specified, grade fine aggregate from coarse to fine in accordance with ASTM C 33.
- d. In accordance with NSF 61.
- 3. Coarse aggregate:
 - a. Provide coarse aggregate consisting of gravel or crushed stone made up of clean, hard, durable particles free from calcareous coatings, organic matter, or other foreign substances.
 - b. Not exceeding 15 percent by weight, of thin or elongated pieces having length greater than 5 times average thickness.
 - c. In accordance with NSF 61.
 - d. Deleterious substances: Not in excess of following percentages by weight, and in no case having total of all deleterious substances exceeding 2 percent.

Item	Test Method	Percent
Shale or chert	ASTM C 123 ASTM C 295**	1.25 1
Coal and lignite	ASTM C 123	1/4
Clay lumps and friable particles	ASTM C 142	1/4
Materials finer than Number 200 sieve	ASTM C 117	1/2*

- e. Grading:
 - 1) Aggregate for Class A, B, C, and D concrete: In accordance with ASTM C 33, Size Number 57, except as otherwise specified or authorized in writing by the Engineer.
 - 2) Aggregate for Class CE concrete for encasement of electrical conduits:
 - a) Graded in accordance with ASTM C 33, Size Number 8.
- C. Concrete sealer:
 - 1. Manufacturers: One of the following or equal:
 - a. Euclid Chemical Company: Diamond Hard.
 - b. L&M Construction Chemicals: SealHard.

- D. Conduit encasement coloring agent:
 - 1. Color: Red color concrete used for encasement of electrical ducts, conduits, and similar type items.
 - 2. Manufacturers: One of the following or equal:
 - a. Davis Company, #100 Utility Red.
 - b. I. Reiss Company, Inc., equivalent product.
 - c. Euclid Chemical Company, Increte Division, "Colorcrete Brick Red."
 - 3. Conduit encasement concrete: Mix into each cubic yard of concrete 10 pounds of coloring agent.
- E. Evaporation retardant:
 - 1. Manufacturers: One of the following or equal:
 - a. BASF, Cleveland, Ohio, Confilm.
 - b. Euclid Chemical Company, Cleveland, Ohio, Eucobar.
- F. Fly ash:
 - 1. Fly ash in accordance with ASTM C 618, Class F, may be used in concrete made with Type II portland cement.
 - 2. Maximum of 15 percent by weight of fly ash to total weight of cementitious materials.
 - a. The total weight of cementitious materials shall not be less than minimum cementitious materials listed in Table A.
 - 3. Do not use in concrete made with portland-pozzolan cement.
 - 4. Loss on ignition: Not exceed 4 percent.
 - 5. In accordance with NSF 61.
- G. Keyway material: Steel, plastic, or lumber.
- H. Nonslip abrasive:
 - 1. Aluminum oxide abrasive size 8/16, having structure of hard aggregate that is, homogenous, nonglazing, rustproof, and unaffected by freezing, moisture, or cleaning compounds.
 - 2. Manufacturers: One of the following or equal:
 - a. Exolon Company, Tonawanda, New York.
 - b. Abrasive Materials, Incorporated, Hillsdale, Michigan.
 - c. "Non-Slip Aggregate", Euclid Chemical Company, Cleveland, Ohio.
- I. Portland cement:
 - 1. Conform to specifications and tests in accordance with ASTM C 150, Types II or III, low alkali, except as specified otherwise.
 - 2. Have total alkali containing not more than 0.60 percent.
 - 3. Exposed concrete in any individual structure: Use only one brand of portland cement.
 - 4. Cement for finishes or repairs: Provide cement from same source and of same type as concrete to be finished or repaired.
 - 5. In accordance with NSF 61.
- J. Sheet membrane for curing:
 - 1. Polyethylene film:
 - a. In accordance with ASTM C 171.
 - b. Color: White.

- c. Thickness: Nominal thickness of polyethylene film shall not be less than 0.0040 inches when measured in accordance with ASTM D 2103. Thickness of polyethylene film at any point shall not be less than 0.0030 inches.
 - d. Loss of moisture: Not exceed 0.055 grams per square centimeter of surface when tested in accordance with ASTM C 156.
- K. Sprayed membrane curing compound: Clear type with fugitive dye in accordance with ASTM C 309, Type 1D.
- L. Surface sealant system: Manufacturers: One of the following or equal:
 - 1. Radcon Laboratories, Inc., Las Vegas, Nevada, Formula Number 7.
 - 2. IPA Systems, Philadelphia, Pennsylvania, Duripal.
- M. Water:
 - 1. Water for concrete, washing aggregate, and curing concrete: Clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances.
 - 2. Chlorides and sulfate ions:
 - a. Water for conventional reinforced concrete: Use water containing not more than 1,000 milligrams per liter of chlorides calculated as chloride ion, nor more than 1,000 milligrams per liter of sulfates calculated as sulfate ion.
 - b. Water for prestressed or post-tensioned concrete: Use water containing not more than 650 milligrams per liter of chlorides calculated as chloride ion, or more than 800 milligrams per liter of sulfates calculated as sulfate ion.

2.02 EQUIPMENT

- A. Mixing concrete:
 - 1. Mixers may be of stationary plant, paver, or truck mixer type.
 - 2. Provide adequate equipment and facilities for accurate measurement and control of materials and for readily changing proportions of material.
 - 3. Mixing equipment:
 - a. Capable of combining aggregates, cementitious materials, and water within specified time into thoroughly mixed and uniform mass and discharging mixture without segregation.
 - b. Maintain concrete mixing plant and equipment in good working order and operated at loads, speeds, and timing recommended by manufacturer or as specified.
 - c. Proportion cementitious materials and aggregate by weight.
- B. Machine mixing:
 - 1. Batch plant shall be capable of controlling delivery of all material to mixer within 1 percent by weight of individual material.
 - 2. If bulk cementitious materials are used, weigh them on separate visible scale which will accurately register scale load at any stage of weighing operation from zero to full capacity.
 - 3. Prevent cementitious materials from coming into contact with aggregate or with water until materials are in mixer ready for complete mixing with all mixing water.

4. Procedure of mixing cementitious materials with sand or with sand and coarse aggregate for delivery to project site, for final mixing and addition of mixing water will not be permitted.
 5. Retempering of concrete will not be permitted.
 6. Discharge entire batch before recharging.
 7. Volume of mixed material per batch: Not exceed manufacturer's rated capacity of mixer.
 8. Mixers:
 - a. Perform mixing in batch mixers of acceptable type.
 - b. Equip each mixer with device for accurately measuring and indicating quantity of water entering concrete, and operating mechanism such that leakage will not occur when valves are closed.
 - c. Equip each mixer with device for automatically measuring, indicating, and controlling time required for mixing:
 - 1) Interlock device to prevent discharge of concrete from mixer before expiration of mixing period.
- C. Transit-mixed concrete:
1. Mix and deliver in accordance with ASTM C 94.
 2. Total elapsed time between addition of water at batch plant and discharging completed mix:
 - a. Not to exceed 90 minutes.
 - b. Elapsed time at project site shall not exceed 30 minutes.
 3. Under conditions contributing to quick setting, total elapsed time permitted may be reduced by the Engineer.
 4. Equip each truck mixer with device interlocked to prevent discharge of concrete from drum before required number of turns and furnish device that is capable of counting number of revolutions of drum.
 5. Continuously revolve drum after it is once started until it has completely discharged its batch:
 - a. Do not add water until drum has started revolving.
 - b. Right is reserved to increase required minimum number of revolutions or to decrease designated maximum number of revolutions allowed, if necessary, to obtain satisfactory mixing. The Contractor will not be entitled to additional compensation because of such increase or decrease.
- D. Other types of mixers: In case of other types of mixers, mixing shall be as follows:
1. Mix concrete until there is uniform distribution of materials, and discharge mixer completely before recharging.
 2. Neither speed nor volume loading of mixer shall exceed manufacturer's recommendations.
 3. Continue mixing for minimum of 1-1/2 minutes after all materials are in drum, and for batches larger than 1 cubic yard increase minimum mixing time 15 seconds for each additional cubic yard or fraction thereof.

2.03 MIXES

- A. Measurements of materials:
1. Measure materials by weighing, except as otherwise specified or where other methods are specifically authorized in writing by the Engineer.
 2. Furnish apparatus for weighing aggregates and cementitious materials that is suitably designed and constructed for this purpose.

3. Accuracy of weighing devices: Furnish devices that have capability of providing successive quantities of individual material that can be measured to within 1 percent of desired amount of that material.
 4. Measuring or weighing devices: Subject to review by the Engineer. Shall bear valid seal of the Sealer of Weights and Measures having jurisdiction.
 5. Weighing cementitious materials:
 - a. Weigh cementitious materials separately.
 - b. Cement in unbroken standard packages (sacks): Need not be weighed.
 - c. Weigh bulk cementitious materials and fractional packages.
 6. Measure mixing water by volume or by weight.
- B. Concrete proportions and consistency:
1. Provide concrete that can be worked readily into corners and angles of forms and around reinforcement without excessive vibration and without permitting materials to segregate or free water to collect on surface.
 2. Prevent unnecessary or haphazard changes in consistency of concrete.
 3. Ratio of coarse aggregate to fine aggregate: Not less than 1.0 or more than 2.0 for all concrete Classes, with exception of Class CE.
 4. Aggregate:
 - a. Obtain aggregate from source that is capable of providing uniform quality, moisture content, and grading during any single day's operation.
 5. Maximum concrete mix water to cementitious materials ratio, minimum cementitious materials content, and slump range: Conform to values specified in Table A in this Section.
 6. Concrete batch weights: Control and adjust to secure maximum yield. At all times, maintain proportions of concrete mix within specified limits.
 7. Mix modification: If required, by the Engineer, modify mixture within limits set forth in this Section.
- C. Concrete mixes:
1. Proportioning of concrete mix: Proportion mixes based on required compressive strength f'_{cr} .
 2. Mixes:
 - a. Adjusting of water: After acceptance, do not change mixes without acceptance by Engineer, except that at all times adjust batching of water to compensate for free moisture content of fine aggregate.
 - b. Total water content of each concrete class: Not exceed those specified in Table A in this Section.
 - c. Checking moisture content of fine aggregate: Furnish satisfactory means at batching plant for checking moisture content of fine aggregate.
 3. Change in mixes: Submit new mix design and perform new trial batch and test program as specified in this Section.
- D. Classes of concrete:
1. Provide concrete consisting of 5 classes: Classes A, B, C, and D. Use where specified or indicated on the Drawings.
 2. Weight of concrete classes: Provide classes of concrete having minimum weight of 140 pounds per cubic foot.
 3. Class B concrete: Class B concrete may be substituted for Class A concrete, when high-early strength concrete is needed in areas specifically accepted by the Engineer and that do not require sulfate resistant concrete.

4. Class C concrete: Class C concrete may be used for fill for unauthorized excavation, for thrust blocks and ground anchors for piping, for bedding of pipe, and where indicated on the Drawings.
5. Class D concrete: Use Class D for precast concrete items.
6. All other concrete, unless specified or otherwise indicated on the Drawings: Use Class A concrete.

TABLE A CONCRETE				
Class	Specified Compressive Strength f'_c at 28 Days (Pounds per Square Inch)	Water-to- Cementitious Materials Ratio	Cementitious Materials per Cubic Yard of Concrete by Weight (Pounds)	Slump Range (Inches)
A	4,000	0.40 to 0.45	564 to 658	2 to 4
B (Type III cement)	4,000	0.40 to 0.45	564 to 658	2 to 4
C	2,500	Maximum 0.62	Minimum 423	3 to 6
D	4,500	0.40 to 0.45	564 to 658	2 to 4

7. Pumped concrete: Provide pumped concrete that complies with all requirements of this Section.
8. Do not place concrete with slump outside limits indicated in Table A.
9. Classes:
 - a. Classes A, C, and D: Make with Type II low alkali portland cement.
 - b. Class B concrete: Make with Type III low alkali portland cement.
 - c. Admixtures: Provide admixtures as specified in this Section.

- E. Air entraining admixture:
1. Add agent to batch in portion of mixing water.
 2. Batch solution by means of mechanical batcher capable of accurate measurement.

2.04 SOURCE QUALITY CONTROL

- A. Tests:
1. Trial batches:
 - a. After concrete mix designs have been accepted by Engineer, have trial batches of the accepted Class A, Class B, and Class D concrete mix designs prepared by testing laboratory acceptable to the Engineer.
 - b. Prepare trial batches using cementitious materials and aggregates proposed to be used for the Work.
 - c. Prepare trial batches with sufficient quantity to determine slump, workability, consistency, and finishing characteristics, and to provide sufficient test cylinders.
 - d. Test cylinders: Provide cylinders having 6-inch diameter by 12-inch length and that are prepared in accordance with ASTM C 31 for tests specified in this Section.
 - e. Determine slump in accordance with ASTM C 143.

- f. Test cylinders from trial batch:
 - 1) Test 8 cylinders for compressive strength in accordance with ASTM C 39:
 - a) Test 4 cylinders at 7 days and 4 at 28 days.
 - b) Establish ratio between 7 day and 28 day strength for mix. 7-day strength may be taken as satisfactory indication of 28-day strength provided effects on concrete of temperature and humidity between 7 day and 28 day are taken into account.
 - 2) Average compressive strength of 4 test cylinders tested at 28 days: Equal to or greater than required average compressive strength (f'_{cr}) on which concrete mix design is based.
 - g. Drying shrinkage:
 - 1) Prepare 5 drying shrinkage specimens in accordance with ASTM C 157, except as modified in this Section.
 - 2) Remove drying shrinkage specimens from molds at age of 23 hours within 1 hour after trial batching, then immediately place them in water at 73 degrees Fahrenheit within 3 degrees for at least 30 minutes and then measure specimens within 30 minutes thereafter to determine original length.
 - a) Then submerge specimens in saturated limewater at 73 degrees Fahrenheit within 3 degrees for moist curing.
 - 3) Make measurement to determine expansion expressed as percentage of original length at age 7 days.
 - a) Use length at age 7 days as base length for drying shrinkage calculations.
 - 4) Immediately store specimens in humidity controlled room maintained at 73 degrees Fahrenheit within 3 degrees and 50 percent within 4 percent relative humidity for remainder of test.
 - 5) Make and report measurements to determine shrinkage expressed as percentage of base length separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.
 - 6) Drying shrinkage deformation:
 - a) Measure drying shrinkage deformation of each specimen as difference between base length and length after drying at each test age.
 - b) Measure average drying shrinkage deformation of specimens to nearest 0.0001 inch at each test age.
 - c) If drying shrinkage of any specimen departs from average of test age by more than 0.0004 inch, disregard results obtained from that specimen and test another specimen.
 - d) Shrinkage of trial batch concrete at 28 days drying age shall not exceed 0.045 percent maximum.
 - h. Perform test batches and tests required to establish trial batches and acceptability of materials without change in Contract Price.
 - i. Do not place concrete until the concrete mix design and trial batch have been accepted by Engineer.
2. Required average compressive strength:
 - a. Determine required average compressive strength (f'_{cr}) for selection of concrete proportions for mix design, for each class of concrete, using calculated standard deviation for its corresponding specified compressive strength (f'_c) in accordance with ACI 318 and ACI 350.

- b. When test records of at least 30 consecutive tests that span period of not less than 45 calendar days are available, establish standard deviation as in accordance with ACI 318 and ACI 350 and as modified in this Section.
- c. Provide test records from which to calculate standard deviation that represent materials, quality control procedures, and conditions similar to materials, quality control procedures, and conditions expected to apply in preparation of concrete for the Work.
- d. Provide test records with materials and proportions that are more restricted than those for the Work.
- e. Specified compressive strength (f'_c) of concrete used in test records: Within 1,000 pounds per square inch of that specified for the Work.
- f. When lacking adequate test records for calculation of standard deviation meeting requirements, determine required average compressive strength f'_{cr} from following Table B.

TABLE B REQUIRED AVERAGE COMPRESSION STRENGTH	
Specified Compressive Strength f'_c (pounds per square inch)	Required Average Compressive Strength f'_{cr} (pounds per square inch)
Less than 3,000	$f'_c + 1,000$
3,000 to 5,000	$f'_c + 1,200$
Over 5,000	$1.10f'_c + 700$

3. Aggregate:
 - a. Testing of concrete aggregate is at Contractor's expense.
 - b. If there is change in aggregate source or if there is a significant change in aggregate quality or sieve analysis from same source, submit new set of design mixes covering each class of concrete and prepare new trial batches before further placing of concrete.
 - c. Sieves: Use sieves with square openings for testing grading of aggregates.
 - d. Sample aggregate in accordance with ASTM C 136 and D 75.
 - e. Fine aggregate:
 - 1) Provide fine aggregate that does not contain strong alkali nor organic matter which gives color darker than standard color when tested in accordance with ASTM C 40.
 - 2) Provide aggregate having soundness in accordance with ASTM C 33 when tested in accordance with ASTM C 88.
 - 3) Provide aggregate complying with reactivity requirements in accordance with ASTM C 33 when tested in accordance with ASTM C 289.
 - f. Coarse aggregate:
 - 1) Soundness when tested in accordance with ASTM C 88: Have loss not greater than 10 percent when tested with sodium sulfate.
 - 2) Abrasion Loss: Not exceed 45 percent after 500 revolutions when tested in accordance with ASTM C 131.
 - 3) Reactivity: Not exceed limits specified in Appendix of ASTM C 33 when tested in accordance with ASTM C 289.

- 4) Fly ash:
 - a) Sampling and testing: Sample and test fly ash in accordance with ASTM C 311.
- 5) Portland cement:
 - a) Determination of alkali content: In accordance with ASTM C 114.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Liquid evaporation retardant:
 - 1. Under conditions that result in rapid evaporation of moisture from the surface of the concrete, immediately after the concrete has been screeded, coat the surface of the concrete with a liquid evaporation retardant.
 - 2. Apply the evaporation retardant again after each work operation as necessary to prevent drying shrinkage cracks.
 - 3. Conditions which result in rapid evaporation of moisture may include one or more of the following:
 - a. Low humidity.
 - b. Windy conditions.
 - c. High temperature.
- B. Surface sealant system:
 - 1. Apply as recommended by manufacturer published instructions.
 - 2. Where concrete continues to sweat or leak, apply additional coats of surface sealant until the sweating or leaks stop.
- C. Joints and bonding:
 - 1. As far as practicable construct concrete work as monolith.
 - 2. Locations of construction, expansion, and other joints are indicated on the Drawings or as specified in this Section.
 - 3. Time between placement of adjacent concrete separated by joints:
 - a. Provide not less than 3 days (72 hours) between placement of adjacent sections for the following:
 - 1) Slabs.
 - 2) Walls.
 - b. Provide not less than 7 days (168 hours) between placement of upper and lower pours for the following:
 - 1) Walls over slabs.
 - 2) Slabs over walls.
 - 3) Slabs keyed into the sides of walls.
 - 4. Construction joints:
 - a. Where construction joints are not indicated on the Drawings, provide construction joints in slabs and walls at intervals not greater than 35 feet.
 - b. In order to preserve strength and watertightness of structures, make no other joints, except as authorized the Engineer.
 - c. At construction joints, thoroughly clean concrete of laitance, grease, oil, mud, dirt, curing compounds, mortar droppings, or other objectionable matter by means of heavy sandblasting.

- d. Cleaning of construction joints:
 - 1) Wash construction joints free of sawdust, chips, and other debris after forms are built and immediately before concrete or grout placement.
 - 2) Should formwork confine sawdust, chips, or other loose matter in such manner that it is impossible to remove them by flushing with water, use vacuum cleaner for their removal, after which flush cleaned surfaces with water.
 - 3) Provide cleanout hole at base of each wall and column for inspection and cleaning.
- e. At horizontal joints: As initial placement over cold joints, thoroughly spread bed of cement grout as specified in Section 03600(with a thickness of not less than 1/2 inch nor more than 1 inch.
- 5. Take special care to ensure that concrete is well consolidated around and against waterstops and waterstops are secured in proper position.
- 6. Construction and expansion Joints:
 - a. Constructed where and as indicated on the Drawings.
 - b. Waterstops, expansion joint material, synthetic rubber sealing compound, and other similar materials: As specified in Sections 03150 and 07900.
- 7. Repair of concrete: Where it is necessary to repair concrete by bonding mortar or new concrete to concrete which has reached its initial set, first coat surface of set concrete with epoxy bonding agent as specified in Section 03071.

D. Conveying and placing concrete:

- 1. Convey concrete from mixer to place of final deposit by methods that prevent separation or loss of materials.
- 2. Use equipment for chuting, pumping, and conveying concrete of such size and design as to ensure practically continuous flow of concrete at delivery end without segregation of materials.
- 3. Design and use chutes and devices for conveying and depositing concrete that direct concrete vertically downward when discharged from chute or conveying device.
- 4. Keep equipment for conveying concrete thoroughly clean by washing and scraping upon completion of day's placement.

E. Placing concrete:

- 1. Place no concrete without prior authorization of the Engineer.
- 2. Do not place concrete until:
 - a. Reinforcement is secure and properly fastened in its correct position and loose form ties at construction joints have been retightened.
 - b. Dowels, bucks, sleeves, hangers, pipes, conduits, anchor bolts, and any other fixtures required to be embedded in concrete have been placed and adequately anchored.
 - c. Forms have been cleaned and oiled as specified.
- 3. Do not place concrete in which initial set has occurred, or that has been retempered.
- 4. Do not place concrete during rainstorms or high velocity winds.
- 5. Protect concrete placed immediately before rain to prevent water from coming in contact with such concrete or winds causing excessive drying.
- 6. Keep sufficient protective covering on hand at all times for protection of concrete.

7. After acceptance, adhere to proposed sequence of placing concrete, except when specific changes are requested and accepted by the Engineer.
 8. Notify the Engineer in writing of readiness, not just intention, to place concrete in any portion of the work:
 - a. Provide this notification in such time in advance of operations, as the Engineer deems necessary to make final inspection of preparations at location of proposed concrete placing.
 - b. Place forms, reinforcement, screeds, anchors, ties, and inserts in place before notification of readiness is given to the Engineer.
 - c. Depositing concrete:
 - 1) Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing.
 - 2) Do not deposit concrete in large quantities in one place and work along forms with vibrator or by other methods.
 - 3) Do not drop concrete freely into place from height greater than 5 feet.
 - 4) Use tremies for placing concrete where drop is over 5 feet.
 - 5) Commence placement of concrete on slopes, starting at bottom of slope.
 9. Place concrete in approximately horizontal layers not to exceed 24 inches in depth and bring up evenly in all parts of forms.
 10. Continue concrete placement without avoidable interruption, in continuous operation, until end of placement is reached.
 11. After concrete placement begins, continue concrete placement without significant interruption. Plan and implement precautions to prevent any delay, between layers being placed, from exceeding 20 minutes.
 12. If concrete is to be placed over previously placed concrete and more than 20 minutes has elapsed, spread layer of cement grout not less than 1/2 inch in thickness nor more than 1 inch in thickness over surface before placing additional concrete.
 13. Placement of concrete for slabs, beams, or walkways:
 - a. If cast monolithically with walls or columns, do not commence until concrete in walls or columns has been allowed to set and shrink.
 - b. Allow set time of not less than 1 hour for shrinkage.
- F. Consolidating concrete:
1. Place concrete with aid of acceptable mechanical vibrators.
 2. Thoroughly consolidate concrete around reinforcement, pipes, or other shapes built into the work.
 3. Provide sufficiently intense vibration to cause concrete to flow and settle readily into place and to visibly affect concrete over radius of at least 18 inches.
 4. Vibrators:
 - a. Keep sufficient vibrators on hand at all times to vibrate concrete as placed.
 - b. In addition to vibrators in actual use while concrete is being placed, have on hand minimum 1 spare vibrator in serviceable condition.
 - c. Do not place concrete until it has been ascertained that all vibrating equipment, including spares, are in serviceable condition.
 5. Take special care to place concrete solidly against forms to leave no voids.
 6. Take every precaution to make concrete solid, compact, and smooth. If for any reason surfaces or interiors have voids or are in any way defective, repair such concrete in manner acceptable to the Engineer.

- G. Footings and slabs on grade:
 - 1. Do not place concrete on ground or compacted fill until subgrade is in moist condition acceptable to the Engineer.
 - 2. If necessary, sprinkle subgrade with water not less than 6 or more than 20 hours in advance of placing concrete.
 - 3. If subgrade becomes dry prior to concrete placement, sprinkle again, without forming pools of water.
 - 4. Do not place concrete if subgrade is muddy or soft. Maximum deformation of the subgrade under a fully loaded ready mix truck shall not exceed 1/2 inch.
- H. Loading concrete:
 - 1. Green concrete:
 - a. No heavy loading of green concrete will be permitted.
 - 2. No backfill shall be placed against concrete walls, connecting slabs, or beams until the concrete has reached the specified strength.
 - 3. Use construction methods, sequencing, and allow time for concrete to reach adequate strength to prevent overstress of the concrete structure during construction.
- I. Curing concrete:
 - 1. General:
 - a. Cure concrete by methods specified in this Section.
 - b. Keep concrete continuously moist and at a temperature of at least 50 degrees Fahrenheit for minimum of 7 days after placement.
 - c. Cure concrete to be painted with water or sheet membrane.
 - d. Do not use sprayed membrane curing or sealing compounds on concrete surfaces that are to receive paint or upon which any material is to be bonded.
 - e. Water cure or sheet membrane cure concrete slabs that are specified to be sealed by concrete sealer.
 - f. Cure other concrete by water curing or sprayed membrane curing compound at the Contractor's option.
 - g. Floor slabs may be cured using sheet membrane curing.
 - 2. Water curing:
 - a. Keep surfaces of concrete being water cured constantly and visibly moist day and night for period of not less than 7 days.
 - b. Each day forms remain in place count as 1 day of water curing.
 - c. No further curing credit will be allowed for forms in place after contact has once been broken between concrete surface and forms.
 - d. Do not loosen form ties during period when concrete is being cured by leaving forms in place.
 - e. Flood top of walls with water at least 3 times per day, and keep concrete surfaces moist at all times during 7 day curing period.
 - 3. Sprayed membrane curing compound:
 - a. Apply curing compound to concrete surface after repairing and patching, and within 1 hour after forms are removed.
 - b. If more than 1 hour elapses after removal of forms, do not use curing compound, but use water curing for full curing period.
 - c. If surface requires repairing or painting, water cure such concrete surfaces.
 - d. Do not remove curing compound from concrete in less than 7 days.

- e. Curing compound may be removed only upon written request by Contractor and acceptance by Engineer, stating what measures are to be performed to adequately cure concrete.
 - f. Take care to apply curing compound to construction joints. Apply to all surfaces along full profile of joints.
 - g. After curing period is complete, remove curing compound placed within construction joint profile by heavy sandblasting prior to placing any new concrete.
 - h. Contractor's Option: Instead of using curing compound for curing of construction joints, such joints may be water cured.
 - i. Apply curing compound by mechanical, power operated sprayer and mechanical agitator that will uniformly mix all pigment and compound.
 - j. Apply curing compound in at least 2 coats.
 - k. Apply each coat in direction 90 degrees to preceding coat.
 - l. Apply curing compound in sufficient quantity so that concrete has uniform appearance and that natural color is effectively and completely concealed at time of spraying.
 - m. Continue to coat and recoat surfaces until specified coverage is achieved and until coating film remains on concrete surfaces.
 - n. Thickness and coverage of curing compound: Provide curing compound having film thickness that can be scraped from surfaces at any and all points after drying for at least 24 hours.
 - o. The Contractor is cautioned that method of applying curing compound specified in this Section may require more curing compound than normally suggested by manufacturer of curing compound and also more than is customary in the trade.
 - p. Apply amounts specified in this Section, regardless of manufacturer's recommendations or customary practice.
 - q. If the Contractor desires to use curing compound other than specified curing compound, coat sample areas of concrete wall with proposed curing compound and also similar adjacent area with specified compound in specified manner for comparison:
 - 1) If proposed sample is not equal or better, in opinion of the Engineer, in all features, proposed substitution will not be allowed.
 - r. Prior to final acceptance of the work, remove, by sandblasting or other acceptable method, any curing compound on surfaces exposed to view, so that only natural color of finished concrete is visible uniformly over entire surface.
4. Sheet membrane curing:
- a. Install sheet membrane as soon as concrete is finished and can be walked on without damage.
 - b. Seal joints and edges with small sand berm.
 - c. Keep concrete moist under sheet membrane.

3.02 CONCRETE FINISHING

- A. Provide concrete finishes as specified in Section 03366
- B. Edges of joints:
 - 1. Provide joints having edges as indicated on the Drawings.
 - 2. Protect wall and slab surfaces at edges against concrete spatter and thoroughly clean upon completion of each placement.

3.03 FIELD QUALITY CONTROL

- A. Testing of concrete:
 - 1. During progress of construction, the Owner will have tests made to determine whether the concrete, as being produced, complies with requirements specified.
 - 2. Tests will be performed in accordance with ASTM C 31, ASTM C 39, and ASTM C 172.
 - 3. The Engineer will make and deliver test cylinders to the laboratory and testing expense will be borne by the Owner.
 - 4. Furnish test equipment.
 - 5. Make provisions for and furnish concrete for test specimens, and provide manual assistance to the Engineer in preparing said specimens.
 - 6. Assume responsibility for care of and providing of curing conditions for test specimens in accordance with ASTM C 31.
 - 7. Sampling frequency:
 - a. 1 set of test cylinders for each 150 cubic yards of each class of concrete.
 - b. Minimum of 1 set of test cylinders for each class of concrete placed.
 - c. Not less than 1 set of test cylinders for each half-day's placement.
 - d. At least 2 sets of test cylinders for each structure.
- B. Compressive strength tests:
 - 1. Set of 3 cylinder specimens, 6-inch diameter by 12 inch long.
 - 2. Information: Test 1 cylinder at 7 days.
 - 3. Acceptance: Test 2 cylinders at 28 days.
- C. Slump tests:
 - 1. Test slump of concrete using slump cone in accordance with ASTM C 143.
 - 2. Do not use concrete that does not meet specification requirements in regards to slump:
 - a. Remove such concrete from project site.
 - b. Test slump at the beginning of each placement, as often as necessary to keep slump within the specified range, and when requested to do so by the Engineer.
- D. Air entrainment tests:
 - 1. Test percent of entrained air in concrete at beginning of each placement, as often as necessary to keep entrained air within specified range, and when requested to do so by the Engineer.
 - 2. Do not use concrete that does not meet Specification requirements for air entrainment.
 - a. Remove such concrete from project site.
 - 3. Test air entrainment in concrete in accordance with ASTM C 173.
 - 4. The Engineer may at any time test percent of entrained air in concrete received on project site.
- E. Enforcement of strength requirement:
 - 1. Concrete is expected to reach a compressive strength (f'_c) than that specified in Table A.

2. Strength level of concrete will be considered acceptable if following conditions are satisfied:
 - a. Averages of all sets of 3 consecutive strength test results is greater or equal to specified compressive strength(f'_c).
 - b. No individual strength test (average of 2 cylinders) falls below specified compressive strength (f'_c) by more than 500 pounds per square inch.
3. Non-compliant strength tests:
 - a. Mark non-compliant strength test reports to highlight that they contain non-complying results and immediately forward copies of test reports to all parties on the test report distribution list.
 - b. Provide treatment of non-compliant concrete at no additional cost to Owner and with no additional time added to project schedule:
 - c. Initial treatment may consist of additional curing and testing of the affected concrete.
 - 1) Provide additional curing of concrete using means and duration acceptable to the Engineer.
 - 2) Upon completion of the additional curing, provide additional testing designated by the Engineer.
 - a) Obtain and test core samples for compression strength in accordance with ASTM C 42, ACI 318, and ACI 350.
 - b) Provide not less than 3 cores for each affected area. Obtain Engineer's acceptance of proposed coring locations before proceeding with that work.
 - c) Submit report of compression strength testing for Engineer's review.
 - d) If required by the Engineer, provide additional cores and obtain petrographic examination in accordance with ASTM C 856. Submit report of petrographic analysis for Engineer's review.
 - 3) If additional curing does not bring average of 3 cores taken in affected area to at least the minimum specified compressive strength (f'_c), designate such concrete in affected area as defective.

3.04 ADJUSTING

- A. Provide repair of defective concrete at no additional cost to Owner and with no additional time added to the project schedule:
- B. Make repairs using approach and means acceptable to the Engineer.
 1. Provide repairs having strength equal to or greater than specified concrete for areas involved.
 2. Do not patch, repair, or cover defective work without inspection by the Engineer.
 3. Acceptable means may include, but are not limited to strengthening, repair, or removal and replacement.
- C. Strengthening of defective concrete:
 1. By addition of concrete.
 2. By addition of reinforcing.
 3. By addition of both concrete and reinforcing.

D. Repairs:

1. Methods of repair:

a. Dry pack method:

- 1) Use for holes having depth nearly equal to or greater than least surface dimension of hole, for cone-bolt holes, and for narrow slots cut for repair.
- 2) Smooth holes: Clean and roughen by heavy sandblasting before repair.

b. Mortar replacement method:

- 1) Use for holes too wide to dry pack and too shallow for concrete replacement.
- 2) Comparatively shallow depressions, large or small, which extend no deeper than nearest surface reinforcement.

c. Concrete replacement method:

- 1) Use when holes extend entirely through concrete section or when holes are more than 1 square foot in area and extend halfway or more through the section.

2. Preparation of concrete for repair:

- a. Chip out and key imperfections in the work and make them ready for repair.
- b. Obtain Engineer's acceptance of surface preparation methods and of prepared surfaces prior to repair.
- c. Surfaces of set concrete to be repaired: First coat with epoxy bonding agent as specified in Section 03071.

E. Remove and replace defective concrete.

END OF SECTION

SECTION 03366

TOOLED CONCRETE FINISHING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Tooled concrete finishes.

1.02 QUALITY ASSURANCE

- A. Mock-ups:
 - 1. Test panels for concrete finishes:
 - a. Prepare test panels for F4 and F5 finishes and tie-hole repairs for review by Engineer.
 - b. Accepted test panels serve as standard of quality and workmanship for project.
 - 2. Prepare test panel showing horizontal and vertical joints proposed for project for review by the Engineer. Refer to finishes specified in this Section.
 - 3. Test panels indicating methods for making concrete repairs: Prepare test panels for proposed repairs at beginning of project for review by Engineer:
 - a. Accepted test panels serve as standard for repairs during the project.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping:
 - 1. Deliver and store packaged materials in original containers until ready for use.

PART 2 PRODUCTS

2.01 MIXES

- A. Mortar mix for F4 finish: Consist of 1 part cement and 1-1/2 parts of fine sand passing Number 100 screen. Mix with enough water and emulsified bonding agent to have consistency of thick cream.
- B. Mortar mix for F5 finish: Consist of 1 part cement to 1-1/2 parts of sand which passes Number 16 screen.

PART 3 EXECUTION

3.01 CONCRETE FINISHES

- A. Cement for finishes:
 - 1. Addition of white cement may be required to produce finish which matches color of concrete to be finished.

- B. Finish vertical concrete surfaces with one of the following finishes as indicated in the Finish Schedule:
1. F1 finish: No special treatment other than repair defective work and fill depressions 1 inch or deeper and tie holes with mortar after removal of curing compound.
 2. F2 finish: No special treatment other than repair defective work, remove fins, fill depressions 1/2 inch or deeper and tie holes with mortar after removal of curing compound.
 3. F3 finish: Repair defective work, remove fins, offsets, and grind projections smooth. Fill depressions 1/4 inch or larger in depth or width and tie holes with mortar after removal of curing compound.
 4. F4 finish: Receive same finish as specified for F3 finish, and, in addition fill depressions and holes 1/16 inch or larger in width with mortar.
 - a. "Brush-Off" sandblast surfaces prior to filling holes to expose all holes near surface of the concrete.
 - b. Thoroughly wet surfaces and commence filling of pits, holes, and depressions while surfaces are still damp.
 - c. Perform filling by rubbing mortar over entire area with clean burlap, sponge rubber floats, or trowels.
 - d. Do not let any material remain on surfaces, except that within pits and depressions.
 - e. Wipe surfaces clean and moist cure.
 5. F5 finish: Receive same finish as specified for F3 finish, and, in addition, receive special stoned finish, in accordance with following requirements:
 - a. Remove forms and perform required repairs, patching, and pointing as specified in this Section.
 - b. Wet surfaces thoroughly with brush and rub with hard wood float dipped in water containing 2 pounds of portland cement per gallon.
 - c. Rub surfaces until form marks and projections have been removed.
 - d. Spread grindings from rubbing operations uniformly over surface with brush in such manner as to fill pits and small voids.
 - e. Moist cure brushed surfaces and allow to harden for 3 days:
 - 1) After curing, obtain final finish by rubbing with carborundum stone of approximately Number 50 grit until entire surfaces have smooth texture and are uniform in color.
 - 2) Continue curing for remainder of specified time.
 - f. If any concrete surface is allowed to become too hard to finish in above specified manner, sandblast and wash related surfaces exposed to view, whether finished or not.
 - 1) While still damp, rub over surface, plastic mortar, as specified for brushed surfaces and handstoned with Number 60 grit carborundum stone, using additional mortar for brushed surfaces until surface is evenly filled without an excess of mortar.
 - 2) Continue stoning until surface is hard.
 - 3) After moist curing for 3 days, make surface smooth in texture and uniform in color by use of Number 50 or Number 60 grit carborundum stone.
 - 4) After stoning, continue curing until 7 day curing period is completed.
- C. Finish horizontal concrete surfaces with one of the following finishes as indicated in the Finish Schedule after proper and adequate vibration and tamping:
1. S1 finish: Screeded to grade and leave without special finish.

2. S2 finish: Smooth steel trowel finish.
 3. S3 finish: Steel trowel finish free from trowel marks. Provide smooth finish free of all irregularities.
 4. S4 finish: Steel trowel finish, without local depressions or high points, followed by light hairbroom finish. Do not use stiff bristle brooms or brushes. Perform brooming parallel to slab-drainage. Provide resulting finish that is rough enough to provide nonskid finish. Finish is subject to review and acceptance by the Engineer.
 5. S5 finish: Nonslip abrasive: After concrete has been screeded level and hardened enough to support man standing on a board, sprinkle abrasive from shake screen into surface at uniform rate of 25 pounds for each 100 square feet of surface area, wood float into finish, then trowel abrasive into surface with steel trowel properly exposing abrasive in surface as required to provide nonslip surface.
 6. S6 finish: Roughened finish: After concrete has been screeded to grade, apply a roughened finish by use of a jitterbug roller or similar device.
- D. Finish concrete floor surfaces to which surfacing material is applied: Finish smooth with tolerance within 1/8 inch in 10 feet in any direction from lines indicated on the Drawings.

3.02 CONCRETE FINISH SCHEDULE

- A. Finish concrete surfaces as follows:
1. F4 finish for following vertical surfaces:
 - a. Concrete surfaces specified or indicated to be painted.
 - b. Concrete surfaces, interior or exterior, exposed to view.
 2. Surfaces in open channels, basins, and similar structures:
 - a. F3 finish for vertical surfaces which are normally below water surface.
 - b. F4 finish for vertical surfaces located above normal water surface and exposed to view.
 - c. Remove fins and fill tie holes from concrete surfaces located in closed boxes or channels where there is normally no access or passageway.
 3. S1 finish for following surfaces:
 - a. Projecting footings which are to be covered with dirt.
 - b. Slab surfaces which are to be covered with concrete fill.
 4. S2 finish for following surfaces:
 - a. Tops of corbels.
 - b. Tops of walls and beams not covered above in this Section.
 - c. Tops of slabs not covered above in this Section.
 - d. All other surfaces not specified to be finished otherwise.
 5. S3 finish for following surfaces:
 - a. Building and machine room floors which are not covered with surfacing material: Provide floors that are free from trowel marks.
 6. S4 finish for following surfaces:
 - a. Exterior walkways.
 - b. Tops of exterior walls or beams which are to serve as walkways.
 - c. Tops of exterior walls or beams which are to support gratings.
 - d. Top surface of slabs for basins, channels, digesters, and similar structures.

7. S6 finish for following surfaces:
 - a. Basin bottoms, or other similar slab surfaces, over which layer of basin bottom grout will be applied.
- B. **Finish concrete surfaces in accordance with Finish Schedule indicated on the Drawings.**

END OF SECTION

SECTION 03600

GROUTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Cement grout.
 - 2. Cement mortar.
 - 3. Dry-pack mortar.
 - 4. Epoxy grout.
 - 5. Grout.
 - 6. Non-shrink epoxy grout.
 - 7. Non-shrink grout.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 03071 - Epoxies.
 - b. Section 03300 - Cast-in-Place Concrete.
 - c. Section 15050 - Basic Mechanical Materials and Methods.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-inch or [50-millimeter] cube specimens).
 - 2. C 230 - Standard Specification for Flow Table for Use In Tests of Hydraulic Cement.
 - 3. C 531 - Standard Test Method for Liner Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - 4. C 579 - Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing and Polymer Concretes.
 - 5. C 939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
 - 6. C 942 - Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory.
 - 7. C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

8. C 1181 - Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.
- B. International Concrete Repair Institute (ICRI):
 1. 310.2R – Selecting and specifying Concrete Surface Preparations for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

1.03 SUBMITTALS

- A. Cement grout:
 1. Mix design.
 2. Material submittals.
- B. Cement mortar:
 1. Mix design.
 2. Material submittals.
- C. Non-shrink epoxy grout:
 1. Manufacturer's literature.
- D. Non-shrink grout:
 1. Manufacturer's literature.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to jobsite in their original, unopened packages or containers, clearly labeled with manufacturer's product identification and printed instructions.
- B. Store materials in cool dry place and in accordance with manufacturer's recommendations.
- C. Handle materials in accordance with the manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Non-shrink epoxy grout:
 1. Manufacturers: One of the following or equal:
 - a. Five Star Products, Inc., Five Star Epoxy Grout.
 - b. BASF Construction Chemicals, Masterflow 648 CP Plus.
 - c. L&M Construction Chemicals, Inc., EPOGROUT.
 2. Non-shrink epoxy grout shall be 100 percent solid, premeasured, prepackaged system containing 2-component thermosetting epoxy resin and inert aggregate.
 3. Maintain flowable consistency for at least 45 minutes at 70 degrees Fahrenheit.
 4. Shrinkage or expansion: Less than 0.0006 inches per inch when tested in accordance with ASTM C 531.
 5. Minimum compressive strength: 10,000 pounds per square inch at 24 hours and 14,000 pounds per square inch at 7 days when tested in accordance with ASTM C 579, Method B.

6. Compressive creep: Not exceed 0.0027 inches/per inch when tested under 400 pounds per square inch constant load at 140 degrees Fahrenheit in accordance with ASTM C 1181.
7. Coefficient of thermal expansion: Not exceed 0.000018 inches per inch per degree Fahrenheit when tested in accordance with ASTM C 531, Method B.

B. Non-shrink grout:

1. Manufacturers: One of the following or equal:
 - a. Five Star Products, Inc, Five Star Grout.
 - b. BASF Construction Chemicals, Masterflow 928.
 - c. L&M Construction Chemicals, Inc., CRYSTEX.
2. In accordance with ASTM C 1107.
3. Preportioned and prepackaged cement-based mixture.
4. Contain no metallic particles such as aluminum powder and no metallic aggregate such as iron filings.
5. Require only addition of potable water.
6. Water for pre-soaking, mixing, and curing: Potable water.
7. Free from emergence of mixing water from within or presence of water on its surface.
8. Remain at minimum flowable consistency for at least 45 minutes after mixing at 45 degrees Fahrenheit to 90 degrees Fahrenheit when tested in accordance with ASTM C 230.
 - a. If at fluid consistency, verify consistency in accordance with ASTM C 939.
9. Dimensional stability (height change):
 - a. In accordance with ASTM C 1107, volume-adjusting Grade B or C at 45 degrees Fahrenheit to 90 degrees Fahrenheit.
 - b. Have 90 percent or greater bearing area under bases.
10. Have minimum compressive strengths at 45 degrees Fahrenheit to 90 degrees Fahrenheit in accordance with ASTM C 1107 for various periods from time of placement, including 5,000 pounds per square inch at 28 days when tested in accordance with ASTM C 109 as modified by ASTM C 1107.

2.02 MIXES

A. Cement grout:

1. Use same sand-to-cementitious materials ratio for cement grout mix that is used for concrete mix.
2. Use same materials for cement grout that are used for concrete.
3. Use water-to-cementitious materials ratio that is no more than that specified for concrete.
4. For spreading over surfaces of construction or cold joints.

B. Cement mortar:

1. Use same sand-to-cementitious materials ratio for cement mortar mix that is used for concrete mix.
2. Use same materials for cement mortar that are used for concrete.
3. Use water-to-cementitious materials ratio that is no more than that specified for concrete being repaired.
4. At exposed concrete surfaces not to be painted or submerged in water: Use sufficient white cement to make color of finished patch match that of surrounding concrete.

- C. Dry-pack mortar:
 - 1. Proportions by weight: 1 part portland cement to 2 parts concrete sand.
 - a. Portland cement: As specified in Section 03300.
 - b. Concrete sand: As specified in Section 03300.
- D. Epoxy grout:
 - 1. Consist of mixture of epoxy or epoxy gel and sand.
 - a. Epoxy: As specified in Section 03071.
 - b. Epoxy gel: As specified in Section 03071.
 - c. Sand: Clean, bagged, graded, and kiln-dried silica sand.
 - 2. Proportioning:
 - a. For horizontal work: Consist of mixture of 1 part epoxy with not more than 2 parts sand.
 - b. For vertical or overhead work: Consist of 1 part epoxy gel with not more than 2 parts sand.
- E. Grout:
 - 1. Mix in proportions by weight: 1 part portland cement to 4 parts concrete sand.
 - a. Portland cement: As specified in Section 03300.
 - b. Concrete sand: As specified in Section 03300.
- F. Non-shrink epoxy grout:
 - 1. Mix in accordance with manufacturer's installation instructions.
- G. Non-shrink grout:
 - 1. Mix in accordance with manufacturer's installation instructions such that resulting mix has flowable consistency and is suitable for placing by pouring.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect concrete surfaces to receive grout or mortar and verify that they are free of ice, frost, dirt, grease, oil, curing compounds, paints, impregnations, and loose material or foreign matter likely to reduce bond or performance of grout or mortar.

3.02 PREPARATION

- A. Surface preparation for grouting other baseplates:
 - 1. Remove grease, oil, dirt, dust, curing compounds, laitance, and other deleterious materials that may affect bond to concrete and bottoms of baseplates.
 - 2. Roughen concrete surfaces in contact with grout to ICRI CSP-6 surface profile or rougher.
 - a. Remove loose or broken concrete.
 - 3. Metal surfaces in contact with grout: Grit blast to white metal surface.

3.03 INSTALLATION

- A. Mixing:
 - 1. Cement grout:
 - a. Use mortar mixer with moving paddles.

- b. Pre-wet mixer and empty out excess water before beginning mixing.
- 2. Cement mortar:
 - a. Use mortar mixer with moving paddles.
 - b. Pre-wet mixer and empty out excess water before beginning mixing.
- 3. Dry-patch mortar:
 - a. Use only enough water so that resulting mortar will crumble to touch after being formed into ball by hand.
- 4. Non-shrink epoxy grout:
 - a. Keep temperature of non-shrink epoxy grout from exceeding manufacturer's recommendations.
- 5. Non-shrink grout:
 - a. May be drypacked, flowed, or pumped into place. Do not overwork grout.
 - b. Do not retemper by adding more water after grout stiffens.

B. Placement:

- 1. Cement grout:
 - a. Exercise care in placing cement grout because it is required to furnish structural strength, impermeable water seal, or both.
 - b. Do not use cement grout that has not been placed within 30 minutes after mixing.
- 2. Cement mortar:
 - a. Use mortar mixer with moving paddles.
 - b. Pre-wet mixer and empty out excess water before beginning mixing.
- 3. Epoxy grouts:
 - a. Wet surfaces with epoxy for horizontal work or epoxy gel for vertical or overhead work prior to placing epoxy grout.
- 4. Non-shrink epoxy grout:
 - a. Mix in complete units. Do not vary ratio of components or add solvent to change consistency of mix.
 - b. Pour hardener into resin and mix for at least 1 minute and until mixture is uniform in color. Pour epoxy into mortar mixer wheelbarrow and add aggregate. Mix until aggregate is uniformly wetted. Over mixing will cause air entrapment in mix.
- 5. Non-shrink grout:
 - a. Add non-shrink cement grout to premeasured amount of water that does not exceed the manufacturer's maximum recommended water content.
 - b. Mix in accordance with manufacturer's instructions to uniform consistency.

C. Curing:

- 1. Cement based grouts and mortars:
 - a. Keep continuously wet for minimum of 7 days. Use wet burlap, soaker hose, sun shading, ponding, and in extreme conditions, combination of methods.
 - b. Maintain above 40 degrees Fahrenheit until it has attained compressive strength of 3,000 pounds per square inch, or above 70 degrees Fahrenheit for minimum of 24 hours to avoid damage from subsequent freezing.
- 2. Epoxy based grouts:
 - a. Cure grouts in accordance with manufacturers' recommendations.
 - 1) Do not water cure epoxy grouts.
 - b. Do not allow any surface in contact with epoxy grout to fall below 50 degrees Fahrenheit for minimum of 48 hours after placement.

- D. Grouting equipment bases, baseplates, soleplates, and skids: As specified in Section 15050.
- E. Grouting other baseplates:
 - 1. General:
 - a. Use non-shrink grout as specified in this Section.
 - b. Baseplate grouting shall take place from one side of baseplate to other in continuous flow of grout to avoid trapping air in grout.
 - c. Maintain hydrostatic head pressure by keeping level of grout in headbox above bottom of baseplate. Fill headbox to maximum level and work grout down.
 - d. Vibrate, rod, or chain non-shrink grout to facilitate grout flow, consolidate grout, and remove trapped air.
 - 2. Forms and headboxes:
 - a. Build forms using material with adequate strength to withstand placement of grouts.
 - b. Use forms that are rigid and liquidtight. Caulk cracks and joints with elastomeric sealant.
 - c. Line forms with polyethylene for easy grout release. Coating forms with 2 coats of heavy-duty paste wax is also acceptable.
 - d. Headbox shall be 4 to 6 inches higher than baseplate and shall be located on one side of baseplate.
 - e. After grout sets, remove forms and trim back grout at 45 degree angle from bottom edges of baseplate.

3.04 FIELD QUALITY CONTROL

- A. Non-shrink epoxy grout:
 - 1. Test for 24-hour compressive strength in accordance with ASTM C 579, Method B.
- B. Non-shrink grout:
 - 1. Test for 24-hour compressive strength in accordance with ASTM C 942.

END OF SECTION

SECTION 03920
CONCRETE RESURFACING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Resurfacing of interior concrete surfaces in preparation for finish materials.

1.02 SUBMITTALS

- A. Product data.
- B. Manufacturer's Mixing and Application Instructions.

1.03 SITE CONDITIONS

- A. Apply patching compound and leveling material between 40 and 95 degrees Fahrenheit.
- B. Turn off forced ventilation and radiant heating systems and protect work against drafts during installation and minimum 72 hours after completion.
 - 1. Use indirect auxiliary heaters to maintain temperature in area.
 - 2. Vent temporary heaters to exterior.

PART 2 PRODUCTS

2.01 PATCHING COMPOUND

- A. Patching compound powder: Fast-setting, cement based patching compound.
Manufacturers: One of the following or equal:
 - 1. Mapei Arizona Inc., Tempe, AZ, Plani/Patch.
 - 2. Ardex Inc., Coraopolis, PA, equivalent product.
 - 3. Sonneborn Building Products Division, Minneapolis, MN, equivalent product.
- B. Mixing:
 - 1. Mix patching compound in accordance with manufacturer's instructions.
 - 2. Using a clean mixing container, pour 4 quarts water per 25 pounds powder and 1.4 quarts per 10 pounds powder and gradually add patching compound powder while slowly mixing.
 - a. Mix to smooth lump-free consistency.
 - b. Avoid prolonged mixing.
 - 3. Mix no more material than can be finished within 8 to 10 minutes.
 - 4. Do not overwater or let material slake.

2.02 LEVELING MATERIAL FOR INTERIOR SURFACES

- A. Leveling powder: High compressive strength self-leveling underlayment. One of the following or equal:
 - 1. Mapei Arizona Inc., Tempe, AZ, Ultra/Plan.
 - 2. Ardex Inc., Coraopolis, PA, equivalent product.
 - 3. Sonneborn Building Products Division, Minneapolis MN, equivalent product.
- B. Mixing:
 - 1. Mix materials in accordance with manufacturer's instructions.
 - 2. Using clean mixing container, pour in 6-1/2 quarts water per 50 pounds of leveling powder.
 - 3. Gradually add powder.
 - 4. Mix with low speed mixer.
 - a. Avoid air entrapment and prolonged mixing.
 - b. Mix to homogeneous, almost soupy, lump-free consistency.
 - 5. Do not let mixture slake.

2.03 RELATED MATERIALS

- A. Water: Potable and free of deleterious materials.

PART 3 EXECUTION

3.01 INSPECTION

- A. Ensure concrete surfaces are clean and cured for minimum 28 days.

3.02 PATCHING COMPOUND APPLICATION

- A. Apply patching compound in accordance with manufacturer's instructions.
- B. Use flat edge steel trowel.
 - 1. Finish surface to smooth texture.
- C. Do not fill or cover existing expansion and control joints with patching compound.
- D. Protect from excessive heat or drafty conditions during curing.
- E. Protect from traffic, dirt, and dust until installation of floor covering.
- F. Do not allow application of adhesive or floor covering before patching compound is completely dry.

3.03 LEVELING MATERIAL APPLICATION

- A. Apply leveling material in accordance with manufacturer's instructions.
- B. Apply leveling material when concrete substrate fails to be flat within 1/8 inch in 8 feet or 1/16 inch in 3 feet, or fails to slope to drains.

- C. Mechanically scarify very smooth and moisten concrete before applying leveling material.
- D. Pour leveling material mixture as soon as possible after mixing.
 - 1. Spread mixture with steel straight edge, flat edge hand trowel or rubber squeegee.
 - 2. Do not overwork surface to avoid air entrainment.
- E. Do not fill or cover existing expansion and control joints with patching compound.
- F. Leave leveling material mixture to set. Protect surface from excessive heat or draughts during curing period. Do not walk over surface for at least 4 hours.
- G. Protect from excessive heat or drafty conditions during curing.
- H. Protect from traffic, dirt, and dust until installation of floor covering.
- I. Do not allow application of adhesive or floor covering before patching compound is completely dry.

END OF SECTION

SECTION 03925

CONCRETE REPAIR AND COATING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Field repair and coating of existing concrete.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 03072 – Epoxy Resin/Portland Cement Bonding Agent.
 - b. Section 03931 - Epoxy Injection System.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
 - 2. C 496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
 - 3. C 580 - Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - 4. C 666 - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
 - 5. C 882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
 - 6. C 884 - Standard Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay.
 - 7. D 16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
 - 8. D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - 9. D 638 - Standard Test Method for Tensile Properties for Plastic.
 - 10. D 1653 - Standard Test Methods for Water Vapor Transmission of Organic Coating Films.
 - 11. D 2240 - Standard Test Method for Rubber Property - Durometer Hardness.
 - 12. D 2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 - 13. D 4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

14. D 4264 - Test Method for Pressure Testing of Assemblies of Rubber-Lines Fire Hose and Rubber Booster Hose in Service on Interior Standpipes.
 15. D 4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
 16. F 1249 - Standard Test Method for Water Vapor Transmission Rate Through Plastic Film Sheeting Using a Modulated Infrared Sensor.
- B. International Concrete Repair Institute (ICRI):
1. Technical Guide No. 3732 - Selecting and Specifying Concrete Surface Preparation for Sealers, Coating and Polymer Overlays.
- C. NACE International (NACE):
1. SP0188 - Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
- D. The Society for Protective Coatings (SSPC):
1. SP-10 - Near-White Blast Cleaning.
 2. SP-13 – Surface Preparation of Concrete

1.03 DESCRIPTION OF WORK

- A. Furnish all labor, tools, equipment, materials, and other items required to:
1. Repair damaged/deteriorated concrete as determined necessary and as required by ENGINEER.
 2. Repair cracks in concrete by epoxy injection, as specified in Section 03931 as determined necessary and as required by ENGINEER.
 3. Apply 100 percent solids Elastomeric Polyurethane coating to all concrete surfaces as specified herein and indicated on the Drawings.
- B. Remove piping, fittings, and associated items where work is to be accomplished.

1.04 AREAS OF WORK

- A. Interior surfaces of existing dry well at the Highway Booster Pump Station, as indicated on the Drawings and described herein:
1. Prepare, repair, and coat all interior surfaces.
 2. For bidding purposes, assume the following quantities of concrete repair will be required:
 - a. Existing Dry well: 430 square feet.
 3. For bidding purposes, assume the following quantities of epoxy injection will be required:
 - a. Existing Dry well: 100 linear feet.

1.05 SEQUENCE OF WORK

- A. Individually prepare interior surface of dry well in preparation for viewing by ENGINEER, OWNER, CONTRACTOR, and coating manufacturer's technical representative:
1. Remove any items as required by ENGINEER, such as brackets, piping, etc., prior to abrasive blast cleaning of concrete surfaces.
 2. Seal existing dry well joints as indicated on drawings.
 3. Steam clean and degrease all interior surfaces.
 4. Remove all existing coatings.

5. Remove damaged and deteriorated concrete and blast clean all concrete surfaces to provide a sound substrate suitable for concrete repair material and coating.
 - a. Concrete substrate pH shall be 8.5 or greater. A spray on pH indicator or pH meter shall be used to prove compliance.
 6. Work shall be completed within 7 days after structure is taken out of service.
 7. Upon completion ENGINEER will view interior surfaces of each structure and determine concrete repair work to be completed prior to application of coating.
- B. Complete all concrete repair work, necessary epoxy injection work, additional abrasive blast cleaning, and coating application as specified and required by ENGINEER and in this Section.
 - C. Prepare coating field samples in preparation for viewing by ENGINEER, OWNER, CONTRACTOR, and Coating Manufacturer's Technical Representative.
 1. Upon completion ENGINEER will view field samples to confirm suitability of coating procedures.
 - D. Apply coating as specified and required by ENGINEER and in this Section.
 - E. Perform inspection and necessary repairs to coating as specified in this Section.
 - F. Complete all Modification Work as specified in Contract Documents:
 1. Replace all items previously removed with existing or new as required by contract documents.

1.06 SUBMITTALS

- A. Shop drawings: Submit prior to start of work.
- B. Product data (general): Submit prior to start of work.
- C. Product data for 100 percent solids polyurethane coating:
 1. Manufacturer's literature including installation procedure and warranty for coating system.
 2. Manufacturer's letter of declaration to maintain local permanent inventory and field technical services during coating application and Warranty period.
 3. Test results of product from approved material testing laboratory certifying that product meets or exceeds required physical properties.
 4. Certification of manufacturer's technical services representative.
- D. Testing procedure in accordance with ASTM F 1249.
- E. Dehumidification procedures.
- F. Coating repair procedures.
- G. Coating applicator licensing:
 1. Approval and licensing by manufacturer of 100 percent solids elastomeric polyurethane coating for coating applicator to apply this system.
 2. Certification from patent holder of Eco System expansion process for 100 percent solids elastomeric polyurethane coating that coating applicator is certified to utilize this process.

- H. Manufacturer's instructions: Submit in accordance with requirements for product data.
- I. Manufacturer's technical representative's field reports.

1.07 QUALITY ASSURANCE

- A. Qualifications of concrete repair contractor:
 - 1. Manufacturer of specified concrete repair products shall have in existence, for a minimum of 10 years, a program of training, certifying, and technically supporting a nationally organized approved contractor program with annual recertification of its participants.
 - 2. Provide list of at least 5 job references where contractor has successfully repaired spalled concrete surfaces.
- B. Qualifications of 100 percent solids polyurethane coating applicator:
 - 1. At least 5 years' experience applying type of coating under conditions similar to the Work specified in this Section:
 - 2. Submit list of 5 references for similar projects completed.
- C. Qualifications of 100 percent solids polyurethane coating manufacturer's technical services representative:
 - 1. Minimum 3 years' experience involving applications of 100 percent solids elastomeric polyurethane.
 - 2. Shall be available as required to support application of specified product.
- D. Regulatory requirements: Include requirements concerning the following:
 - 1. Abrasives and abrasive blast cleaning techniques and disposal.
- E. Pre-installation conference:
 - 1. Conduct prior to start of work at mutually agreed time by OWNER and CONTRACTOR.
 - 2. Coating manufacturer's technical services representative shall attend pre-installation conference.
- F. Certification: Certify that coatings to be applied are resistant to deterioration when exposed to hydrogen sulfide and other sewage gases.
- G. Field samples: Prepare and coat a minimum 100 square foot area between corners or limits such as control or construction joints of each system.
 - 1. Accepted field sample may be part of Work.
- H. Surface preparation and coating field sample inspection conferences:
 - 1. Conduct after completion of field sample preparation work and prior to start of surface preparation work at mutually agreed time by OWNER and CONTRACTOR.
 - 2. Coating Manufacturer's Technical Services Representative shall attend Field Sample Inspection Conferences.
- I. Compatibility of coatings: Use products by same manufacturer for prime coats, intermediate coats, and finish coats on same surface, unless specified otherwise.

- J. Services of coatings manufacturer's technical representative: Arrange for coating manufacturer's technical representative to attend pre-installation conferences and to make periodic visits to the project site to provide consultation and inspection services during surface preparation and application of coatings.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Remove unspecified and unapproved materials from Project site immediately.
- B. Deliver containers with labels identifying the manufacturer's name, brand name, product type, batch number, date of manufacturer, expiration date or shelf life, color, and mixing and reducing instructions.
- C. Store materials in a well-ventilated facility that provides protection from the sun, weather, and fire hazards.
 - 1. Maintain ambient storage temperature between 45 and 90 degrees Fahrenheit, unless otherwise recommended by the manufacturer.
- D. Take precautions to prevent fire and spontaneous combustion.

1.09 PROJECT CONDITIONS

- A. Surface moisture contents: Do not coat surfaces that exceed coating manufacturer specified moisture contents.
- B. Do not coat:
 - 1. Under dusty conditions.
 - 2. When light on surfaces measures less than 15 foot-candles.
 - 3. When ambient or surface temperature is less than 45 degrees Fahrenheit.
 - 4. When relative humidity is higher than 85 percent.
 - 5. When surface temperature is less than 5 degrees Fahrenheit above dewpoint.
 - 6. When surface temperature exceeds coating manufacturer's recommendation.
 - 7. When ambient temperature exceeds 90 degrees Fahrenheit, unless coating manufacturer allows a higher temperature.
- C. Provide fans, heating devices, dehumidification equipment, or other means recommended by manufacturer to prevent formation of condensate or dew on surface of substrate, coating between coats, and within curing time following application of last coat.

1.10 WARRANTY:

- A. Provide 3-year warranty for all concrete repair and coating work accomplished under this Contract stating that CONTRACTOR will provide all labor and materials to repair any defects that occur within 3 years from completion and acceptance date of work at no cost to OWNER.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Structural concrete repair mortar:
 - 1. Five Start Products, Inc., Structural Concrete V/O
- B. Epoxy mortar concrete repair materials:
 - 1. Epoxy: Global Eco-Technologies, Inc. 1200P, Pittsburg, CA.
 - 2. Filler: Global Eco-Technologies, Inc. 1200F, Pittsburg, CA.
- C. 100 percent solids polyurethane coating materials:
 - 1. Global Eco-Technologies, Inc. EnduraFlex EF-1988, Pittsburg, CA.
- D. Reinforcing steel coating:
 - 1. Armatec 110 Epo-Cem, Sika Corp., Lindhurst NJ.
- E. Epoxy resin/portland cement bonding agent:
 - 1. As specified in Section 03072.

2.02 MATERIALS

- A. Structural concrete repair mortar:
 - 1. Capable of being coated by moisture sensitive coatings within 24 hours.
 - 2. Compressive strength in accordance with ASTM C109:
 - a. 4000 psi at 7 days.
 - 3. Bond strength in accordance with ASTM C882:
 - a. 2200 psi at 7 days.
- B. Epoxy mortar concrete repair materials:
 - 1. Mortar consisting of mixture of Endura-flex 1200P epoxy and 1200F hollow ceramic sphere filler as follows.
 - a. Repair Mortar: 3 parts filler to one part epoxy.
 - 1) Repair of areas with heavy deterioration, large voids, and spalls.
 - b. Surfacer: 2 parts filler to one part epoxy.
 - 1) Resurfacing areas with surface roughness, exposed aggregate and bug holes.
 - 2) One quarter inch maximum thickness.
 - c. Parge coat: One part filler to one part epoxy.
 - 1) Smoothing areas with minor surface roughness
- C. Reinforcing steel coating:
 - 1. Solvent-free, moisture-tolerant, epoxy-modified, cementitious, corrosion inhibiting product.
- D. Elastomeric polyurethane coating:
 - 1. Two components, 100 percent solids, ASTM D 16 Type V, aromatic, MDI (Methylene Diisocyanate) elastomeric polyurethane which contains no sand or silica fillers.
 - 2. Certified by an approved material testing laboratory to be resistant to hydrogen sulfide and sodium hypochlorite and meet the following requirements:

Physical Properties	Test Method	Results
Durometer Hardness @ 75 Degrees Fahrenheit, Shore D	ASTM D 2240	50-70 Shore D
Tensile Strength	ASTM D 638	2800-3000 pounds per square inch
Percent Elongation	ASTM D 638	65 percent
Abrasion Resistance	ASTM D 4060	53 milligrams
Impact Resistance	ASTM D 2794	35 pounds per square inch
Tear Resistance	ASTM D 624	Greater than 200 pounds per square inch
Water Vapor Permeability	ASTM D 1653 Test Method A	At 75-8 mils grams 23 hours per 0.048 square feet per square

3. Systems:

a. Endura-Flex EF-1988:

- 1) For areas without concrete repair applied: Apply total dry film thickness (DFT) of 250 mils, or as required to be pin-hole free, consisting of a minimum 200 mils of expanded Endura-Flex EF 1988 with minimum 50 mils topcoat of solid Endura-Flex 1988.
- 2) For areas with concrete repair applied: Apply total of 200 mils, or as required to be pinhole free, consisting of a minimum of 150 mils of expanded Endura-Flex EF 1988 with a minimum 50 mils topcoat.

4. Primer:

a. Endura-Flex 1200P Epoxy Primer :

- 1) Primer to be used only as recommended by coating manufacturer's technical representative.

E. Epoxy resin/portland cement bonding agent:

1. As specified in Section 03072.

PART 3 EXECUTION

3.01 GENERAL PREPARATION

- A. As required, remove all existing gates, gate stems, brackets, piping, pipe hangers, concrete inserts, and other items as necessary from areas where repair and coating of concrete is required to facilitate repair and coating work, and acceptable to ENGINEER.
- B. Steam clean and degrease all surfaces prior to abrasive blasting.
- C. Utilize abrasive blast cleaning and mechanical means acceptable to the ENGINEER and described in ICRI 3732 to remove surface contaminants and loose material for preparation of concrete surfaces.
 1. Remove debris from structure and dispose of material off site:
 - a. Compressed air used for blasting or blow downs must be clean and free of oil particles.
 - b. Air compressors must be equipped with efficient oil and water traps.

- D. Utilize SSPC SP13 standards to remove damaged and deteriorated concrete for repair and coating and test surfaces for soundness and chemical contamination:
1. For areas with less than 1/2-inch concrete deterioration, provide the expanded polyurethane coating as specified in this Section.
 2. For areas of concrete deterioration between 1/2 inch and 3 inches, provide the structural concrete repair mortar or epoxy mortar concrete repair material with expanded polyurethane topcoat.
 3. For area with concrete deterioration beyond 3 inches, with exposed reinforcing bars, the concrete must be chipped back to 4-1/2 inches and reinforcing bars repaired.
- E. Remove loose and deteriorated concrete:
1. Remove loose and deteriorated concrete to sound substrate.
 - a. Sound substrate pH shall be 8.5 or greater.
 - b. Measure pH with spray-on indicator or pH meter.
 - c. Hammer sound concrete at 1 foot intervals to determine concrete soundness.
 2. In areas of reinforcing steel deterioration concrete removal shall extend along reinforcing steel to locations along the bar free of bond inhibiting corrosion, and where the bar is well bonded to surrounding concrete.
 3. In areas where concrete deterioration tapers to original concrete surface, make entire cavity to be repaired at least 1/2 inch deep from original concrete surface.
 4. Provide straight edges, sawcut 1/2 inch deep in sound concrete 2-inches away from deterioration.
 5. Prepare surface edges of cavity by grinding. Cavity edges shall flare inwards from the surface to key-in the repair material.
 6. Remove dust, dirt, and loosely bonded material resulting from cleaning.
 7. Ensure cavity surfaces are dry.
 8. Prepare cavity to provide for a minimum of 3/4 inch of concrete repair material at all locations.
- F. Use following procedures where reinforcing steel with corrosion is encountered:
1. Clean exposed reinforcing bars to SSPC SP10 standard.
 2. Determine reinforcing bar section loss, splice new reinforcing bars where there is more than 15 percent loss as determined by ENGINEER.
 - a. If more than half the diameter of reinforcing steel is exposed, chip out behind reinforcing steel a minimum of 1/2 inch.
 - b. Cut reinforcing bars, butt weld new reinforcing bars to undamaged existing reinforcing bars.
 3. Coat all exposed reinforcing steel with reinforcing steel coating before installation of final concrete repair material.
 4. Place structural concrete repair mortar to original surface profile.
- G. Restore damaged and deteriorated edges with concrete repair material and in accordance with manufacturer's recommendations.
1. Depths of 1/4 inch to 1 inch: Epoxy mortar concrete repair material.
 2. Depths greater than 1 inch: Structural concrete repair mortar.
- H. For all concrete repair areas:
1. Apply an epoxy resin/portland cement bonding agent to area to be repaired immediately prior to repairing concrete with structural concrete repair mortar.

2. Provide smooth steel trowel finish free from trowel marks and depressions greater than 1/4 inch followed by a light hair-broom finish to provide a surface similar to 60-grit sandpaper.
 3. Allow concrete repair areas to cure for minimum of 48 hours before application of elastomeric polyurethane coating, or as recommended by manufacturer of elastomeric polyurethane coating.
 4. Sweep blast all concrete repair areas, followed by air blow-down and vacuuming of all areas to remove all dust and debris before the application of coating.
 5. Provide heaters, fans, or dehumidification equipment as required to allow concrete surfaces to cure and be dry, as recommended by manufacturer of elastomeric polyurethane coating, prior to application of coating.
- I. Test surfaces to be coated for moisture as specified in ASTM F1249.
- J. Cleanliness:
1. At the direction of the coating manufacturer's technical representative or the OWNER, all surfaces shall be pressure cleaned with clean, potable water at a minimum pressure of 1,500 pounds per square inch to remove all dust, dirt, and other debris prior to the application of the elastomeric polyurethane coating.
- K. Expansion joints:
1. Seal expansion joints with bond breaker tape.
 - a. Polyethylene-backed adhesive tape is acceptable.
 2. Prior to installation of bond breaker tape, round-off sharp edges, remove debris/dust, and inspect to assure that joint compound is reasonably flush with top edge of expansion joint.
 3. Apply a tack coat of elastomeric polyurethane coating material to adjacent areas, followed immediately with installation of the tape.
 4. Install tape centered over the joint and be of sufficient width to extend a minimum of 1 inch onto the concrete on both sides of the joint.
 5. Tape thickness should be no more than 50 percent of the specified coating thickness.
 6. Topcoat bond breaker tape with elastomeric polyurethane coating material to the minimum specified thickness.
- L. Leading edges: Install a mechanical anchor for the leading edge of the applied coating material:
1. Leading edge mechanical anchor shall consist of a saw cut to a minimum depth of 1/4 inch and width of 1/8 inch.
 2. Sharp edges of the saw cut shall be rounded, dried, and cleaned of debris.
 3. After cleaning, solid base elastomeric polyurethane coating shall be applied into the saw cut, taking care to penetrate to full depth. The use of a trowel or putty knife might be required.
 4. After installation of the leading edge, topcoat the area with composite elastomeric polyurethane coating material.
 - a. Tape-off adjacent areas not scheduled for coating and protected from overspray.

- M. Inspection:
1. After completion of surface preparation OWNER, ENGINEER, and coating manufacturer's technical representative, will inspect all surfaces to be coated prior to coating.
 2. Specified cleanliness shall be verified through the use of accepted practice in accordance with SSPC or NACE standards.
 3. Utilize visual comparators to verify the specified level of cleanliness.
- N. Abrasive-blast and concrete debris:
1. Remove debris generated during preparation work from the structures.
 2. Haul and dispose of debris in accordance with all federal, State, and local regulations.

3.02 COATING APPLICATION

- A. Equipment requirements:
1. Utilize plural component proportioning equipment capable of pumping 2 separate streams of polyurethane components at the required ratio volumetrically.
 2. Have capability to heat the 2 different liquid components to a process temperature range from 100 to 125 degrees Fahrenheit depending on the set-up.
 - a. Do not use of band heaters.
 3. Have capability to maintain process temperature to spray through a gun or pour through the nozzle.
 - a. The use of insulated heat-trace fluid lines is mandatory.
 4. Have capability to pump at pressures ranging from 1,200 pounds per square inch to 3,000 pounds per square inch.
 5. Have capability to bring the 2 separately proportioned streams together as one stream and mix them together to provide a homogenous mixture for reacting into a solid polymer of known properties.
 6. Provide spray atomization tip sizes matched to the pumping equipment output which provides a fully atomized spray pattern, free of "fingers" without the addition of solvents of any kind.
 7. For applications requiring expanded films, CONTRACTOR must be licensed for the use of the expansion technology, including trained personnel, and have the equipment capabilities to apply the expanded 100 percent solids elastomeric polyurethane material using the manufacturer's specified technology.
- B. Before start of application and at such times when long breaks are involved or application of equipment malfunctions, perform the following 4 material quality tests:
1. A ratio check to verify required volumetric proportioning.
 2. A mixed material check to verify proper mixing of components.
 3. A pressure test to verify proper gas delivery for expansion process.
 4. Curing cycle test to verify the proper reaction is under way.
 - a. At least a pint sample is to be utilized.
 - b. First Durometer results should be determined within 15 minutes.
 5. A weight check (10 ounces. Container with solid material and a 10 ounces. Container with expanded material) to verify proper expansion and gas injection rate.

- C. All surfaces receiving the coating shall be visually dry and at least 5 degrees Fahrenheit (3 degrees Centigrade) above the dew point prior to starting the installation to prevent moisture entrapment:
 - 1. The relative humidity must be below 85 percent.
 - 2. Test surfaces to be coated in accordance with ASTM F 1249.
 - a. Test method for indicating moisture in concrete is by the plastic sheet method.
- D. Compressed air used for coating application shall be clean and free of oil and water.
- E. Use primer only at direction of, and as recommended by coating manufacturer's technical representative.
- F. Mix polyurethane base component thoroughly with a power mixer.
 - 1. Heat base and activator to 100 to 110 degrees Fahrenheit prior to use.
- G. Materials conditioning:
 - 1. Perform in accordance with manufacturer's latest published data.
 - 2. Control temperature in order to produce a repeatable finished product on each application.
- H. Deposition of materials: Apply coating to be monolithic and cohesive in nature and to minimize hand work repair.
- I. Curing:
 - 1. Protect finished coating from damage during curing.
 - 2. Cure coatings as recommended by coating manufacturer for a minimum of 3 days before coated areas are placed in service.
- J. Cleanup: Clean spillage and overspray from adjacent surfaces.

3.03 INSPECTION AND TESTING

- A. The following inspection equipment (or engineer accepted equal) shall be provided and utilized for performing quality control testing:
 - 1. Sling psychrometer.
 - 2. Surface temperature thermometer.
 - 3. Ambient temperature thermometer.
 - 4. Psychrometric charts for determining relative humidity and dew point.
 - 5. High range wet and dry film thickness gauges.
 - 6. Micrometer.
 - 7. Durometer: A scale.
 - 8. Sample cans.
 - 9. Inspection glass: 30 power minimum.
 - 10. High voltage holiday detector.
 - 11. Coating adhesion tester.
- B. The following quality control tests shall be performed, with results recorded and made available to ENGINEER:
 - 1. Compressed air quality in accordance with blotter test.
 - 2. Environmental conditions prior to coating application, including substrate temperature, ambient temperature, relative humidity, and dew point.

3. Observation of surface preparation, including anchor pattern prior to coating application.
 4. Results of ratio check of plural component proportioning equipment.
 5. Wet and dry film thickness measurements.
 6. Coating adhesion measurements.
- C. OWNER, ENGINEER, and coating manufacturer's technical representative shall be given sufficient notice so as to be present when the following hold points are reached:
1. Completion of surface preparation.
 2. Prior to coating application.
 3. During wet and dry film thickness measurements.
 4. During holiday detection testing.
 5. During coating repairs.
- D. Surface cleanliness, pH condition:
1. Use either spray on indicator or a pH meter to determine the pH of the concrete surface.
 2. A pH range of 8 to 9 is considered acceptable.
- E. Enlist the aid of various tests and implement those tests to verify the integrity of the applied repair mortar and coating.
1. Permit OWNER, ENGINEER, and coating manufacturer's technical representative full access at all times to observe and be satisfied that the specification is being followed.
- F. Wet film thickness shall be monitored throughout the coating installation by means of frequent measurements with a high-range wet film thickness gauge.
- G. All layers of material (expanded and solid) shall be applied the same day. This procedure is to ensure minimization of contamination of the coating:
1. If project is not completed, then at the end of the workday, a 3- to 12-inch "returning edge" of material will be left tapered to the substrate for the start of the next working day.
 2. The "returning edge" shall be cleaned with MEK before proceeding to spray on start up to the following workday.
- H. Coating shall be 100 percent electronically tested using high voltage in accordance with NACE procedure SP0188 inspected for discontinuities to include pinholes, voids, and mechanically damaged areas.
1. Any damaged areas, faulty areas, or discontinuities (pinholes) found during holiday detection within a 24-hour (within recoat window) period of application shall be corrected as follows:
 - a. Damaged or faulty areas (i.e., impact damage, off-ratio application):
 - 1) Clean area thoroughly, extending at least 6 inches beyond damaged area with MEK dampened cloth.
 - 2) Do not apply excessive MEK to repair area, the intent is to clean only.
 - 3) Allow MEK to thoroughly dry.
 - 4) When thoroughly dry to touch, spray area with coating to the specified thickness, feathering material into existing coating.

- 5) In the event that the damaged area exhibits a discolored substrate substandard to the specified requirements, these areas shall receive the same degree of surface preparation required by the original project specifications prior to application of the coating material.
- b. Discontinuity (pinhole) repair:
 - 1) Clean the immediate area around the detected discontinuity with MEK dampened cloth (do not apply excessive MEK to pinhole area, the intent is to clean only), allow MEK to thoroughly dry.
 - 2) Hand apply (putty knife, etc.) a small amount of mixed material directly to the pinhole.
 - 3) For pinhole repairs, hand mix and thoroughly blend a small amount (normally 2 or 3 ounces at a time, for each applicator) of Part A and Part B in correct ratios.
2. Any damaged areas, faulty areas, or discontinuities (pinholes) found during holiday detection inspection after 24 hours of coating installation (exceeding recoat window) shall be corrected as follows:
 - a. Damaged or faulty areas (i.e., impact damage, off-ratio application, etc.):
 - 1) Abrade the surface using a power grinder and/or power steel grinding brush down to and including exposed bare concrete to roughen the surface and to prepare the substrate to the original standard.
 - 2) Abraded areas shall extend at least 6 inches beyond damaged or faulty area.
 - 3) After abrading the surface, vacuum or blow down with clean, dry compressed air thoroughly to remove all loose particles.
 - 4) Clean the area thoroughly, extending at least 6 inches beyond the damaged area with MEK dampened cloth (do not apply excessive MEK to pinhole area, the intent is to clean only), allow MEK to thoroughly dry.
 - 5) When thoroughly dry to touch, spray area with coating to the specified thickness, feathering the material into the existing prepared coating.
 - b. Discontinuity (pinhole) repair:
 - 1) Abrade (hand sand or power tool clean) the immediate areas around the detected pinhole (1/2-inch radius from edge of discontinuity) to establish a roughed surface, and to prepare the substrate to the original standard, followed with vacuuming or blow down with clean, dry compressed air to remove loose particles.
 - 2) After dust removal, wipe abraded area with MEK dampened cloth.
 - 3) Do not apply excessive MEK to pinhole area.
 - 4) The intent is to clean only. Allow MEK to thoroughly dry.
 - 5) Hand apply (putty knife, etc.) a small amount of mixed material directly to the pinhole.
 - 6) For pinhole repairs, hand mix and thoroughly blend a small amount (normally to three ounces at a time for each applicator) of Part A and Part B in correct ratios.
- I. Confirm coating thickness and adhesion using ASTM D4541 pull-off testing.
 1. Conduct pull-off testing for every 200 square feet of applied coating at locations required by the Engineer. Conduct more frequently if recommended by the coating manufacturer.
 2. Repair locations of pull-off tests as specified for repair of damaged coating areas.

3. Areas with deficient coating thickness shall be recoated with solid coating material to obtain the specified minimum thickness.
 - a. Within a 24-hour (within recoat window) period of application shall be corrected as follows:
 - 1) Clean area thoroughly, extending at least 6 inches beyond damaged area with MEK dampened cloth.
 - 2) Do not apply excessive MEK, the intent is to clean only.
 - 3) Allow MEK to thoroughly dry.
 - 4) When thoroughly dry to touch, spray area with coating to the specified thickness, feathering material into existing coating.
 - b. After 24 hours of coating installation (exceeding recoat window) shall be corrected as follows:
 - 1) Abrade the surface using a power grinder and/or power steel grinding brush to roughen the coating surface.
 - 2) Abraded areas shall extend at least 6 inches beyond area to be recoated.
 - 3) After abrading the surface, vacuum or blow down with clean, dry compressed air thoroughly to remove all loose particles.
 - 4) Clean the area thoroughly, extending at least 6 inches beyond the damaged area with MEK dampened cloth
 - 5) Do not apply excessive MEK, the intent is to clean only.
 - 6) Allow MEK to thoroughly dry.
 - 7) When thoroughly dry to touch, spray area with coating to the specified thickness, feathering the material into existing coating.

3.04 REPLACEMENT OF REMOVED ITEMS

- A. Clean and recoat items removed from work areas prior to commencing work such as piping, pipe hangers, and associated equipment replace in like manner as removed.

3.05 FINAL INSPECTION AND ACCEPTANCE

- A. Final inspection:
 1. Following replacement of previously removed items, a final inspection of the repaired and coated structures shall be made by ENGINEER, OWNER, CONTRACTOR, and the coating manufacturer's technical representative.
 2. Any damage that has occurred to the coating shall be repaired in accordance with the coating manufacturer's instructions.
- B. Final acceptance:
 1. Written final acceptance of the concrete repair and coating work accomplished as specified in the Contract Documents, shall be prepared by the ENGINEER or OWNER and issued to the CONTRACTOR, with a copy to the coating manufacturer.

END OF SECTION

SECTION 03931

EPOXY INJECTION SYSTEM

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Epoxy injection system.

1.02 REFERENCES

- A. ASTM International (ASTM):
1. D 638 - Standard Test Method for Tensile Properties of Plastics.
 2. D 695 - Standard Test Method for Compressive Properties of Rigid Plastics.
 3. D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.03 SUBMITTALS

- A. Product data:
1. Submit manufacturer's data completely describing epoxy injection system materials.
- B. Quality control submittals:
1. Certificates of Compliance.
 2. Manufacturer's Instructions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Manufacturers: One of the following or equal:
1. BASF, Concessive Standard LVI.
 2. Sika Chemical Corp., Sikadur 35 Hi-Mod LV.
- B. Epoxy:
1. Use epoxy materials that are new and use them within shelf-life limitations set forth by manufacturer.
 2. Water-insensitive 2-part type low viscosity epoxy adhesive material containing 100 percent solids and meeting or exceeding following characteristics when tested in accordance with standards specified:

Physical Characteristic	Test Method	Required Results
Tensile Strength	ASTM D 638	8,000 pounds per square inch at 14 days.
Flexure Strength	ASTM D 790	11,000 pounds per square inch at 14 days.
Compressive Strength	ASTM D 695	11,000 pounds per square inch at 24 hours.
Bond Strength	--	Concrete shall fail before failure of epoxy.

Physical Characteristic	Test Method	Required Results
Gel Time for 5 Mil Film	--	4 hours maximum.
Elongation	ASTM D 638	1 percent minimum at 14 days.

2.02 EQUIPMENT

- A. Injection pump:
 1. Use positive displacement injection pump with interlock to provide in-line mixing and metering system for 2 component epoxy.
 2. Use pressure hoses and injection nozzle designed to properly mix of 2 components of epoxy.
 3. Standby injection unit may be required.

PART 3 EXECUTION

3.01 PREPARATION

- A. Surface preparation:
 1. Sweep or clean area in vicinity of cracks that will be injected with epoxy. Leave area in generally clean condition after epoxy injection is complete.
 2. Clean cracks so they are free from dirt, laitance, and other loose matter.

3.02 INSTALLATION

- A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.
- B. Mix epoxy in accordance with manufacturer's installation instructions.
- C. Do not use solvents to thin epoxy.
- D. Crack injection:
 1. Apply adequate surface seal to crack to prevent leakage of epoxy.
 2. Establish injection points at distance along crack not less than thickness of cracked member.
 3. Crack injection sequence:
 - a. Inject epoxy into crack at first port with sufficient pressure to advance epoxy to adjacent port.
 - b. Seal original port and shift injection to port where epoxy appears.
 - c. Continue port-to-port injection until crack has been injected for its entire length.
 - d. For small amounts of epoxy, or where excessive pressure developed by injection pump might further damage structure, premixed epoxy and use hand caulking gun to inject epoxy if acceptable to the Engineer.
 - e. Seal ports, including adjacent locations where epoxy seepage occurs, as necessary to prevent drips or run out.
 - f. After epoxy injection is complete, remove surface seal material and refinish concrete in area where epoxy was injected to match existing concrete.

END OF SECTION

SECTION 03933

HYDROPHILIC FOAM POLYURETHANE RESIN INJECTION SYSTEM

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Hydrophilic foam polyurethane resin injection system.

1.02 REFERENCES

- A. ASTM International (ASTM):
1. D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester.
 2. D2939 - Standard Test Methods for Emulsified Bitumens Used as Protective Coatings.
 3. D3574 - Standard Test Methods for Flexible Cellular Materials-Slab, Bonded, and Molded Urethane Foams.

1.03 SUBMITTALS

- A. Product data: Submit manufacturer's data completely describing polyurethane resin injection system materials.
- B. Quality control submittals:
1. Certificates of Compliance.
 2. Manufacturer's Instructions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Manufacturers: One of the following or equal:
1. Avanti International, AV-333 Injectaflex.
 2. BASF, MasterInject 1210 IUG.
- B. Resin: Provide polyurethane resin materials that are new and use them within shelf-life limitations set forth by manufacturer.
1. Water-insensitive 1-part type low-viscosity polyurethane resin adhesive material containing 100-percent solids and meeting or exceeding following characteristics when tested in accordance with standards specified:
 - a. Uncured:

Physical Characteristic	Test Method	Required Results
Solids Content	ASTM D2939	82-88 percent
Viscosity		300-600 CPS at 70 degrees Fahrenheit
Color	---	Amber (visual)

Physical Characteristic	Test Method	Required Results
Weight per Gallon		9.15 pounds
Flash Point	ASTM D93	25 degrees Fahrenheit
Corrosiveness	---	Non-corrosive

b. Cured foam (1:1):

Physical Characteristic	Test Method	Required Results
Tensile Strength	ASTM D3574	80 pounds per square inch with 1-day cure
		90 pounds per square inch with 7-day cure
Elongation	ASTM D3574	700 percent with 1-day cure
		800 percent with 7-day cure
Shrinkage	Procedure G	18 percent linear shrinkage

2.02 EQUIPMENT

- A. Pump unit:
 1. Furnish unit to be used for injection that is positive displacement type with interlock to provide in-line mixing and metering system for 1 component polyurethane resin.
 2. Furnish pressure hoses and injection nozzle of such design as to allow proper mixing of polyurethane resin.
 3. Standby injection unit may be required.
- B. Resin pump: Operating pressure in excess of 2,000 pounds per square inch with a variable pressure control trigger mechanism with attached pressure gauge, on the downstream end of the material supply hose.
- C. Water pump: High-pressure water blaster capable of 1,000 pounds per square inch or higher pressure.
- D. Incidentals: To be determined by site conditions and Contractor. See Installation Bulletin 6I12 - Urethane Injection, from BASF Construction Chemicals, LLC.

PART 3 EXECUTION

3.01 PREPARATION

- A. General: Before proceeding, sweep or clean area in vicinity of crack location to receive polyurethane resin and leave in generally clean condition.
- B. Joints to receive polyurethane resin: Clean joints free from dirt, laitance, and other loose matter.

3.02 INSTALLATION

- A. Install and cure polyurethane resin materials in accordance with manufacturer's installation instructions.
- B. Perform and conduct work of this Section in neat orderly manner.
- C. Polyurethane resin injection system:
 - 1. Apply adequate surface seal to crack to prevent escape of polyurethane resin.
 - 2. Establish entry points at distance along seal not less than thickness of cracked member.
 - 3. Force polyurethane resin into crack at first port with sufficient pressure to advance polyurethane resin to adjacent port.
 - 4. Seal original port and shift entry to port at which polyurethane resin appears.
 - 5. Continue in this manner of port-to-port injection until each crack has been injected for its entire length.
 - 6. For small amounts, or where excessive grout pressure developed by pump unit might further damage structure, premixed material and hand caulking gun may be used if acceptable to the Engineer.
 - 7. Seal ports, including adjacent locations where polyurethane resin seepage occurs, as necessary to prevent drips or run out.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Structural steel shapes and plate.
 - 2. Fasteners and structural hardware:
 - a. All thread rods.
 - 3. Welding.
 - 4. Bolting.
- B. Related sections:
 - 1. Section 03055 - Epoxy Bonding Reinforcing Bars and All Thread Rods.
 - 2. Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
 - 3. Section 09910 - Painting.
 - 4. Section 09960 - High-Performance Coatings.

1.02 REFERENCES

- A. American Institute of Steel Construction (AISC):
 - 1. 303 - Code of Standard Practice for Steel Buildings and Bridges.
 - 2. 360 - Specification for Structural Steel Buildings.
- B. American Iron and Steel Institute (AISI):
 - 1. Steel and stainless steel alloys ("types") as indicated.
- C. American Welding Society (AWS):
 - 1. A5.1 - Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
 - 2. A5.17 - Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
 - 3. A5.20 - Specification for Carbon Steel Electrodes for Flux Cored Arc Welding.
 - 4. D1.1 - Structural Welding Code - Steel.
 - 5. D1.6 - Structural Welding Code - Stainless Steel.
- D. ASTM International (ASTM):
 - 1. A6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 - 2. A36 - Standard Specification for Carbon Structural Steel.
 - 3. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless.
 - 4. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 5. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

6. A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 7. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 8. A276 - Standard Specification for Stainless Steel Bars and Shapes.
 9. A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 10. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 11. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 12. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 13. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
 14. A992 - Standard Specification for Structural Steel Shapes.
 15. F436 - Standard Specification for Hardened Steel Washers.
 16. F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
 17. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
- E. Research Council on Structural Connections (RCSC):
1. Specification for Structural Joints Using High-Strength Bolts (RCSC Specification).

1.03 DEFINITIONS

- A. Snug-tight: At bolted joints, the tightness attained with a few impacts of an impact wrench, or by the full effort of an ironworker using a spud wrench to bring the connected plies into firm contact.
- B. Stainless steel related terms:
1. Descaling: Removal of heavy, tightly adherent oxide films resulting from hot-forming, heat-treatment, welding, and other high-temperature operations.
 2. Pickling: Chemical descaling of stainless steel using aqueous solutions of nitric and hydrofluoric acid, or various proprietary formulations as specified.
 3. Passivation: Chemical treatment of stainless steel with a mild oxidant for the purpose of enhancing the spontaneous formation of the steel's protective passive film.

1.04 SUBMITTALS

- A. Quality control submittals:
1. Submit shop drawings of members to be fabricated before starting fabrication.
 2. Welder's certificates.
- B. Test reports:
1. Certified copies of mill tests and analyses made in accordance with applicable ASTM standards, or reports from a recognized commercial laboratory, including chemical and tensile properties of each shipment of structural steel or part thereof having common properties.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Perform welding of structural metals with welders who have current AWS certificate for the type of welding to be performed.
2. Steel fabricators shall be certified by the AISC or other certification as recognized and accepted by the local building official having jurisdiction.
3. Notify Engineer 24 hours minimum before starting shop or field welding.
4. Engineer may check materials, equipment, and qualifications of welders.
5. Remove welders performing unsatisfactory Work, or require to requalification.
6. Engineer may use gamma ray, magnetic particle, dye penetrant, trepanning, or other aids to visual inspection to examine any part of welds or all welds.
7. Contractor shall bear costs of retests on defective welds.
8. Contractor shall also bear costs in connection with qualifying welders.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping: Deliver structural steel free from mill scale, rust, and pitting.
- B. Storage and protection: Until erection and painting, protect from weather items not galvanized or protected by a shop coat of paint.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Unless otherwise specified or indicated on the Drawings, materials shall conform to the following:

Item	ASTM Standard	Class, Grade, Type, or Alloy Number
Steel		
Plate, bars, rolled shapes (except W and WT shapes), and miscellaneous items	A36	--
Rolled W and WT shapes	A992	Grade 50
Hollow structural sections (HSS): Round, square, or rectangular	A500	Grade B
Round HSS	A500	Grade B
Steel pipe	A53	Grade B
Stainless steel		
Plate, sheet, and strip	A240	Type 304* or 316**
Bars and shapes	A276	Type 304* or 316**
* Use Type 304L if material will be welded.		
** Use Type 316L if material will be welded.		

- B. Where stainless steel is welded, use low-carbon stainless steel.

2.02 FASTENERS AND STRUCTURAL HARDWARE

- A. General:
 - 1. Materials: Of domestic manufacture.
 - 2. Where fasteners and hardware are specified to be galvanized, galvanize in accordance with ASTM A153 or ASTM F2329.
- B. All thread rods:
 - 1. Uncoated
 - a. In accordance with ASTM A36 unless otherwise indicated on the Drawings.
 - b. Nuts: ASTM A194.
 - c. Washers: ASTM F436.
 - 2. Galvanized:
 - a. In accordance with ASTM A36 unless otherwise indicated on the Drawings, and hot dip galvanized in accordance with ASTM A153.
 - b. Nuts: ASTM A194, hot-dip galvanized in accordance with ASTM A153.
 - c. Washers: ASTM F436, hot-dip galvanized in accordance with ASTM A153.
 - 3. Stainless steel:
 - a. Units descaled, pickled, and passivated as specified in "Fabrication" in this Section.
 - b. Threaded rods and nuts to be the products of a single manufacturer/fabricator to ensure proper fit without galling. Ship all thread rods with properly fitting nuts attached.
 - c. Alloy Type 304 or Type 316 as indicated on the Drawings.
 - d. Type 304:
 - 1) Rod: ASTM F593, Group 1, Condition CW, coarse threads.
 - 2) Nuts: ASTM F594. Match alloy of rod (group and UNS designation).
 - 3) Washers: Type 304 stainless steel.
 - e. Type 316:
 - 1) Rod: ASTM F593, Group 2, Condition CW, coarse threads.
 - 2) Nuts: ASTM F594. Match alloy of rod (group and UNS designation).
 - 3) Washers: Type 316 stainless steel.
- C. Anchor bolts, anchor rods, and post-installed steel anchors: As indicated on the Drawings and as specified in Section 05190.

2.03 ISOLATING SLEEVES AND WASHERS

- A. As indicated on the Drawings and as specified in Section 05190.

2.04 GALVANIZED SURFACE REPAIR

- A. Manufacturers: One of the following or approved equal:
 - 1. Galvinox.
 - 2. Galvo-Weld.

2.05 THREAD COATING

- A. Manufacturers: One of the following or approved equal:
 - 1. Never Seez Compound Corporation, Never-Seez.
 - 2. Oil Research, Inc., WLR No. 111.

2.06 SUPPLEMENTARY PARTS

- A. Furnish as required for complete structural steel erection, whether or not such parts and Work are specified or indicated on the Drawings.

2.07 FABRICATION

- A. Shop assembly:
 - 1. Fabricate structural steel in accordance with AISC 360 and AISC 303 unless otherwise specified or modified by applicable regulatory requirements.
 - 2. Where anchors, connections, or other details of structural steel are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.
 - 3. Round off sharp and hazardous projections and grind smooth.
 - 4. Take measurements necessary to properly fit work in the field. Take responsibility for and be governed by the measurements and proper working out of all the details.
 - 5. Take responsibility for correct fitting of all metalwork.
- B. Stainless steel shapes and assemblies:
 - 1. For structural members such as W shapes, S shapes, channels, angles, and similar rolled shapes not available in quantity, size, and type of stainless steel specified or indicated on the Drawings:
 - a. Fabricate shapes using laser-fused, full penetration welds between pieces of plate to attain same or higher section modulus and moment of inertia as that of members indicated on the Drawings.
 - b. Fabricate shapes from dual grade stainless steel.
 - c. Fabricate beams and channels to ASTM A6 tolerances.
 - d. Manufacturers: The following, or equal:
 - 1) Stainless Structurals, LLC, Jacksonville, FL.
 - 2. Cleaning and passivation:
 - a. Following shop fabrication of stainless steel members and bolts, clean and passivate fabrications at point of manufacture.
 - b. Finish requirements: Remove free iron, heat tint oxides, weld scale and other impurities, and obtain a bright passive finished surface with no etching, pitting, frosting, or discoloration.
 - c. Provide quality control testing to verify effectiveness of cleaning agents and procedures and to confirm that finished surfaces are clean and passivated.
 - 1) Conduct sample runs using test specimens with proposed cleaning agents and procedures as required to avoid adverse effects on surface finishes and base materials.

- d. Pre-clean, chemically de-scale ("pickle"), passivate, and final-clean fabrications in accordance with the requirements of ASTM A380.
 - 1) If degreasing is required before cleaning (pickling) to remove scale or iron oxide, cleaning with citric acid treatments is permissible; however, such treatments shall be followed inorganic cleaners.
 - 2) Pickle and passivate stainless steel using a nitric acid solution in accordance with ASTM A380, Annex A2, Table A2.1, Part II.
 - 3) Pickling by citric acid treatment or sulfuric acid treatment is not considered to satisfy the requirements of this Section.
 - e. Inspect after cleaning using methods specified for "gross inspection" in ASTM A380.
 - f. Improperly or poorly cleaned and passivated materials shall not be shipped and will not be accepted at the site.
- C. Galvanized steel:
- 1. Where galvanizing is required, hot-dip structural steel after fabrication in accordance with ASTM A123:
 - 2. Do not electro-galvanize or mechanically-galvanize unless specified or accepted by Engineer.
 - 3. Re-straighten galvanized items that bend or twist during galvanizing.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions: Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 ERECTION

- A. General:
- 1. Fabricate structural and foundry items to true dimensions without warp or twist.
 - 2. Form welded closures neatly, and grind off smooth where weld material interferes with fit or is unsightly.
 - 3. Install structural items accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting structure or equipment for which intended.
 - 4. Do not cock out of alignment, re-drill, re-shape, or force fit fabricated items.
 - 5. Place anchor bolts or other anchoring devices accurately and make surfaces that bear against structural items smooth and level.
 - 6. Rigidly support and brace structural items needing special alignment to preserve straight, level, even, and smooth lines. Keep structural items braced until concrete, grout, or dry pack mortar has hardened for 48 hours minimum.
 - 7. Erect structural steel in accordance with AISC 360 unless otherwise specified or modified by applicable regulatory requirements.
 - 8. Where anchors, connections, and other details of structural steel erection are not specifically indicated on the Drawings or specified, form, locate, and attach with equivalent in quality and workmanship to items specified.
 - 9. Round off sharp or hazardous projections and grind smooth.
 - 10. Paint or coat steel items as specified in Sections 09910 and 09960.

- B. Stainless steel. Take all necessary precautions to avoid iron contamination of stainless steel during delivery, storage, and handling.
 - 1. Segregate stainless steel from iron.
 - 2. Tools and handling devices.
 - a. Do not use iron tools clamps, chokes, working surfaces, or brushes when fabricating, handling, and erecting stainless steel.
 - b. Do not use tools that have been contaminated by contact with iron.
 - c. Use stainless steel, polymer coated, or wood tools and handling equipment. Do not use tools that have been contaminated by contact with iron or steel.
- C. Welding: General:
 - 1. Make welds full penetration type, unless otherwise indicated on the Drawings.
 - 2. Remove backing bars and weld tabs after completion of weld. Repair defective welds observed after removal of backing bars and weld tabs.
- D. Welding carbon steel:
 - 1. General: In accordance with AWS D1.1:
 - a. Weld ASTM A36 and A992 structural steel, ASTM A500 and A501 structural tubing, and ASTM A53 pipe with electrodes in accordance with AWS A5.1, using E70XX electrodes; AWS A5.17, using F7X-EXXX electrodes; or AWS A5.20, using E7XT-X electrodes:
 - b. Field repair cut or otherwise damaged galvanized surfaces to equivalent original condition using a galvanized surface repair.
- E. Interface with other products:
 - 1. Where steel members and fasteners come in contact with dissimilar metals (aluminum, stainless steel, etc.), separate or isolate the dissimilar metals with isolating sleeves and washers as specified in Section 05190.
- F. Fasteners: General:
 - 1. Install bolts to project 2 threads minimum, but 1/2 inch maximum beyond nut.
 - 2. Anchor bolts and anchor rods: Install as specified in Section 05190.
 - a. Unless otherwise specified, tighten nuts on anchor bolts and anchor rods specified in Section 05190 to the "snug-tight" condition.
 - 3. All thread rods in drilled holes and bonded to concrete with epoxy: Install as specified in Section 03055.

END OF SECTION

SECTION 05190

MECHANICAL ANCHORING AND FASTENING TO CONCRETE AND MASONRY

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Cast-in anchors and fasteners:
 - a. Anchor bolts.
 - b. Anchor rods.
 - c. Deformed bar anchors.
 - 2. Post-installed steel anchors and fasteners:
 - a. Concrete anchors.
 - 3. Appurtenances for anchoring and fastening:
 - a. Thread coating for threaded stainless steel fasteners.
- B. Related sections:
 - 1. Section 01300 - Submittals.
 - 2. Section 01410 - Regulatory Requirements.
 - 3. Section 01400 - Quality Control.
 - 4. Section 01455 - Special Tests and Inspections.
 - 5. Section 01610 - Project Design Criteria.
 - 6. Section 03055 - Adhesive-Bonded Reinforcing Bars and All Thread Rods.
 - 7. Section 05500 - Metal Fabrications.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 355.2 - Qualification of Post-Installed Mechanical Anchors in Concrete & Commentary.
- B. American National Standards Institute (ANSI):
 - 1. B212.15 - Cutting Tools - Carbide-tipped Masonry Drills and Blanks for Carbide-tipped Masonry Drills.
- C. American Welding Society (AWS):
 - 1. D1.1 - Structural Welding Code - Steel.
 - 2. D1.6 - Structural Welding Code - Stainless Steel.
- D. ASTM International (ASTM):
 - 1. A29 - Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for.
 - 2. A36 - Standard Specification for Carbon Structural Steel.
 - 3. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 4. A108 - Standard Specification for Steel Bars, Carbon and Alloy, Cold Finished.
 - 5. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 6. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

7. A240 - Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 8. A308 - Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot-Dip Process.
 9. A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
 10. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
 11. B633 - Standard Specification for *Electrodeposited* Coatings of Zinc on Iron and Steel.
 12. B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
 13. E488 - Standard Test Methods for Strength of Anchors in Concrete Elements.
 14. F436 - Standard Specification for Hardened Steel Washers.
 15. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
 16. F594 - Standard Specification for Stainless Steel Nuts.
 17. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
 18. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
- E. International Code Council Evaluation Service, Inc. (ICC-ES):
1. AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.

1.03 DEFINITIONS

- A. Built-in anchor: Headed bolt or assembly installed in position before filling surrounding masonry units with grout.
- B. Cast-in anchor: Headed bolt or assembly installed in position before placing plastic concrete around.
- C. Overhead installations: Fasteners installed on overhead surfaces where the longitudinal axis of the fastener is more than 60-degrees above a horizontal line so that the fastener resists sustained tension loads.
- D. Passivation: Chemical treatment of stainless steel with a mild oxidant for the purpose of enhancing the spontaneous formation of the steel's protective passive film.
- E. Post-installed anchor: Fastener or assembly installed in hardened concrete or finished masonry construction, typically by drilling into the structure and inserting a steel anchor assembly.
- F. Terms relating to structures or building environments as used with reference to anchors and fasteners:
 1. Corrosive locations: Describes interior and exterior locations as follows:
 - a. Locations used for delivery, storage, transfer, or containment (including spill containment) of chemicals used for plant treatment processes.
 - b. Exterior and interior locations at the following treatment structures.
 - 1) Wastewater treatment facilities: Liquids stream:

- a) Raw wastewater delivery and holding structures.
- 2. Wet and moist locations: Describes locations, other than "corrosive locations," that are submerged, are immediately above liquid containment structures, or are subject to frequent wetting, splashing, or wash down. Includes:
 - a. Exterior portions of buildings and structures.
 - b. Liquid-containing structures:
 - 1) Locations at and below the maximum operating liquid surface elevation.
 - 2) Locations above the maximum operating liquid surface elevation and:
 - a) Below the top of the walls containing the liquid.
 - b) At the inside faces and underside surfaces of a structure enclosing or spanning over the liquid (including walls, roofs, slabs, beams or walkways enclosing the open top of the structure).
 - c. Liquid handling equipment:
 - 1) Bases of pumps and other equipment that handles liquids.
 - d. Indoor locations exposed to moisture, splashing or routine wash down during normal operations, including floors with slopes toward drains or gutters.
 - e. Other locations indicated on the Drawings.
- 3. Other locations:
 - a. Interior dry areas where the surfaces are not exposed to moisture or humidity in excess of typical local environmental conditions.

1.04 SUBMITTALS

- A. General:
 - 1. Submit as specified in Section 01300.
 - 2. Submit information listed for each type of anchor or fastener to be used.
- B. Action submittals:
 - 1. Product data:
 - a. Cast-in anchors.
 - 1) Manufacturer's data including catalog cuts showing anchor sizes and configuration, materials, and finishes.
 - b. Post-installed anchors:
 - 1) For each anchor type, manufacturer's data including catalog cuts showing anchor sizes and construction, materials and finishes, and load ratings.
 - 2. Samples:
 - a. Samples of each type of anchor, including representative diameters and lengths, if requested by the Engineer.
 - 3. Certificates:
 - a. Cast-in anchors:
 - 1) Mill certificates for steel anchors that will be supplied to the site.
 - b. Post-installed anchors:
 - 1) Manufacturer's statement or certified test reports demonstrating that anchors that will be supplied to the site comply with the materials properties specified.
 - 4. Test reports:
 - a. Post-installed anchors: For each anchor type used for the Work:
 - 1) Current ICC-ES Report (ESR) demonstrating:

- a) Acceptance of that anchor for use under the building code specified in Section 01410.
- 5. Manufacturer's instructions.
 - a. Requirements for storage and handling.
 - b. Recommended installation procedures including details on drilling, hole size (diameter and depth), hole cleaning and preparation procedures, anchor insertion, and anchor tightening.
 - c. Requirements for inspection or observation during installation.
- 6. Qualification statements.
 - a. Post-installed anchors: Installer qualifications:
 - 1) Submit list of personnel performing installations and include date of manufacturer's training for each.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Post installed anchors shall be in accordance with building code specified in Section 01410.
- B. Special inspection:
 - 1. Provide special inspection of post-installed anchors as specified in Section 01455 and this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver post-installed anchors in manufacturer's standard packaging with labels visible and intact. Include manufacturer's installation instructions.
- B. Handle and store anchors and fasteners in accordance with manufacturer's recommendations and as required to prevent damage.
- C. Protect anchors from weather and moisture until installation.

1.07 PROJECT CONDITIONS

- A. As specified in Section 01610.
- B. Seismic Design Category (SDC) for structures is indicated on the Drawings.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. General:
 - 1. Furnish threaded fasteners with flat washers and hex nuts fabricated from materials corresponding to the material used for threaded portion of the anchor.
 - a. Cast-in anchors: Provide flat washers and nuts as listed in the ASTM standard for the anchor materials specified.
 - b. Post-installed anchors: Provide flat washers and nuts supplied for that product by the manufacturer of each anchor.

2. Size of anchors and fasteners, including diameter and length or minimum effective embedment depth: As indicated on the Drawings or as specified in this Section. In the event of conflicts, contact Engineer for clarification.
3. Where anchors and connections are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.

B. Materials:

1. Provide and install anchors of materials as in this Section.

C. Anchor rods:

1. Description: Straight steel rod having threads on each end[or continuously threaded from end to end]. One threaded end is fitted with nuts or plates and embedded in concrete to the effective depth indicated on the Drawings, leaving the opposite threaded end to project clear of the concrete face as required for the connection to be made at that location.
2. Materials:
 - a. Stainless steel: Type 316:
 - 1) [Surfaces descaled, pickled, and passivated in accordance with ASTM A308.]
 - 2) Rod: ASTM F593, Group 2, Condition CW, coarse threads.
 - 3) Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of rods.
 - 4) Washers: Type 316 stainless steel.
 - 5) Plates (embedded): ASTM A240.

2.02 POST-INSTALLED ANCHORS AND FASTENERS – ADHESIVE

- A. Epoxy bonding of reinforcing bars, all thread rods, and threaded inserts in concrete: As specified in Section 03055.

2.03 POST-INSTALLED ANCHORS AND FASTENERS – MECHANICAL

A. General:

1. Post-installed anchors used for the Work shall hold a current ICC Evaluation Service Report demonstrating acceptance for use under the building code specified in Section 01410
 - a. Conditions of use: The acceptance report shall indicate acceptance of the product for use under the following conditions:
 - 1) In regions of concrete where cracking has occurred or may occur.
 - 2) To resist short-term loads due to wind forces.
 - 3) To resist short-term loading due to seismic forces for the Seismic Design Category of the structure where the product will be used.
2. Substitutions: When requesting product substitutions, submit calculations, indicating the diameter, effective embedment depth and spacing of the proposed anchors, and demonstrating that the substituted product will provide load resistance that is equal to or greater than that provided by the anchors listed in this Section.
 - a. Calculations shall be prepared by and shall bear the signature and sealed of a Professional Engineer licensed in the State of California.
 - b. Decisions regarding the acceptability of proposed substitutions shall be at the discretion of the Engineer.

- B. Concrete anchors:
1. Description. Post-installed anchor assembly consisting of a threaded stud and a surrounding wedge expansion sleeve that is forced outward by torquing the center stud to transfer loads from the stud to the concrete through bearing, friction, or both. (Sometimes referred to as "expansion anchors" or "wedge anchors.")
 - a. Do not use slug-in, lead cinch, and similar systems relying on deformation of lead alloy or similar materials to develop holding power.
 2. Concrete anchors for anchorage to concrete:
 - a. Acceptance criteria:
 - 1) Concrete anchors shall have a current ICC-ES Report demonstrating that the anchors have been tested and qualified for performance in both cracked and un-cracked concrete, and for short term loading due to wind and seismic forces for Seismic Design Categories A through F in accordance with ACI 355.2 and with ICC-ES AC193 (including all mandatory tests and optional tests for seismic tension and shear in cracked concrete).
 - 2) Concrete anchor performance in the current ICC-ES Report shall be "Category 1" as defined in ACI 355.2.
 - b. Manufacturers: One of the following or equal:
 - 1) Hilti: Kwik Bolt TZ Expansion Anchor.
 - 2) Powers fasteners: PowerStud+ SD2.
 - 3) Simpson Strong-Tie®: Strong Bolt 2 Wedge Anchor.
 - c. Materials. Integrally threaded stud, wedge, washer and nut:
 - 1) Stainless steel: Type 316.
 - a) Type 304 stainless steel acceptable for use at wet and moist locations when accepted in writing by the Engineer.

2.04 APPURTENANCES FOR ANCHORING AND FASTENING

- A. Thread coating: For use with threaded stainless steel fasteners:
1. Manufacturers: One of the following or equal:
 - a. Never Seez Compound Corporation, Never-Seez.
 - b. Oil Research, Inc., WLR No. 111.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 INSTALLATION: GENERAL

- A. Where anchors and fasteners are not specifically indicated on the Drawings or specified, make attachments with materials specified in this Section.
- B. Substitution of anchor types:
1. Post-installed anchors may not be used as an alternative to cast-in / built-in anchors at locations where the latter are indicated on the Drawings.

2. Cast-in/built-in anchors may be used as an alternative to post-installed mechanical anchors at locations where the latter are indicated on the Drawings.
- C. Protect products from damage during installation. Take special care to protect threads and threaded ends.
- D. Accurately locate and position anchors and fasteners:
 1. Unless otherwise indicated on the Drawings, install anchors perpendicular to the surfaces from which they project.
 2. Install anchors so that at least 2 threads, but not more than 1/2 inch of threaded rod, projects past the top nut.
- E. Interface with other products:
 1. Where steel anchors come in contact with dissimilar metals (aluminum, stainless steel, etc.), use stainless steel anchors and separate or isolate dissimilar metals using isolating sleeves and washers.
 2. Prior to installing nuts, coat threads of stainless steel fasteners with thread coating to prevent galling of threads.

3.03 INSTALLATION: CAST-IN ANCHORS

- A. General:
 1. Accurately locate cast-in and built-in anchors.
 - a. Provide anchor setting templates to locate anchor bolts and anchor rods. Secure templates to formwork.
 - b. Brace or tie off embedments as necessary to prevent displacement during placement of plastic concrete or of surrounding masonry construction.
 - c. Position and tie cast-in and built-in anchors in place before beginning placement of concrete or grout. Do not "stab" anchors into plastic concrete, mortar, or grout.
 - d. Do not allow cast-in anchors to touch reinforcing steel. Where cast-in anchors are within 1/4 inch of reinforcing steel, isolate the metals by wrapping the anchors with a minimum of 4 wraps of 10-mil polyvinyl chloride tape in area adjacent to reinforcing steel.
 2. For anchoring at machinery bases subject to vibration, use 2 nuts, with 1 serving as a locknut.
 3. Where anchor bolts or anchor rods are indicated on the Drawings as being for future use, thoroughly coat exposed surfaces that project from concrete or masonry with non-oxidizing wax. Turn nuts down full length of the threads, and neatly wrap the exposed thread and nut with a minimum of 4 wraps of 10-mil waterproof polyvinyl tape.
- B. Anchor bolts:
 1. Minimum effective embedment: 10-bolt diameters, unless a longer embedment is indicated on the Drawings.
- C. **Anchor rods:**
 1. Install as specified for anchor bolts.

3.04 INSTALLATION: POST-INSTALLED ADHESIVE ANCHORS

- A. Epoxy and acrylic adhesive bonding of reinforcing bars, all thread rods, and internally threaded inserts in concrete: As specified in Section 03055.

3.05 INSTALLATION: POST-INSTALLED MECHANICAL ANCHORS

- A. General:
 - 1. Install anchors in accordance with the manufacturer's instructions, ACI 355.2, the anchor's ICC-ES Report. Where conflict exists between the ICC-ES Report and the requirements in this Section, the requirements of the ICC-ES Report shall control.
 - 2. Where anchor manufacturer recommends the use of special tools and/or specific drill bits for installation, provide and use such tools.
 - 3. After anchors have been positioned and inserted into concrete or masonry, do not:
 - a. Remove and reuse/reinstall anchors.
 - b. Loosen or remove bolts or studs.
- B. Holes drilled into concrete and masonry:
 - 1. Do not drill holes in concrete or masonry until the material has achieved its minimum specified compression strength (f'_c or f'_m).
 - 2. Accurately locate holes:
 - a. Before drilling holes, use a reinforcing bar locator to identify the position of all reinforcing steel, conduit, and other embedded items within a 6-inch radius of each proposed hole.
 - b. If the hole depth exceeds the range of detection for the rebar locator, the Engineer may require radiographs of the area designated for investigation before drilling commences.
 - 3. Exercise care to avoid damaging existing reinforcement and other items embedded in concrete and masonry.
 - a. If embedments are encountered during drilling, immediately stop work and notify the Engineer. Await Engineer's instructions before proceeding.
 - 4. Unless otherwise indicated on the Drawings, drill holes perpendicular to the concrete surface into which they are placed.
 - 5. Drill using anchor manufacturer's recommended equipment and procedures.
 - a. Unless otherwise recommended by the manufacturer, drill in accordance with the following:
 - 1) Drilling equipment: Electric or pneumatic rotary type with light or medium impact. Where edge distances are less than 2 inches, use lighter impact equipment to prevent micro-cracking and concrete spalling during drilling process.
 - 2) Drill bits: Carbide-tipped in accordance with ANSI B212-15. Hollow drills with flushing air systems are preferred.
 - 6. Drill holes at manufacture's recommended diameter and to depth required to provide the effective embedment indicated.
 - 7. Clean and prepare holes as recommended by the manufacturer and as required by the ICC-ES Report for that anchor.
 - a. Unless otherwise recommended by anchor manufacturer, remove dust and debris using brushes and clean compressed air.
 - b. Repeat cleaning process as required by the manufacturer's installation instructions.

- c. When cleaning holes for stainless steel anchors, use only stainless steel or non-metallic brushes.
- C. Insert and tighten (or torque) anchors in full compliance with the manufacturer's installation instructions.
 - 1. Once anchor is tightened (torque), do not attempt to loosen or remove its bolt or stud.
- D. Concrete anchors: Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Concrete Anchors			
Nominal Diameter	Minimum Effective Embedment Length		Minimum required member thickness
	In concrete	In grouted masonry	
3/8 inch	2 1/2 inch	2 5/8 inch	8 inch
1/2 inch	3 1/2 inch	3 1/2 inch	8 inch
5/8 inch	4 1/2 inch	4 1/2 inch	10 inch
3/4 inch	5 inch	5 1/4 inch	12 inch

3.06 FIELD QUALITY CONTROL

- A. Contractor shall provide quality control over the Work of this Section as specified in Section 01450.
 - 1. Expenses associated with work described by the following paragraphs shall be paid by the Contractor.
- B. Post-installed anchors:
 - 1. Review anchor manufacturer's installation instructions and requirements of the Evaluation Service Report (hereafter referred to as "installation documents") for each anchor type and material.
 - 2. Observe hole-drilling and cleaning operations for conformance with the installation documents.
 - 3. Certify in writing to the Engineer that the depth and location of anchor holes, and the torque applied for setting the anchors conforms to the requirements of the installation documents.

3.07 FIELD QUALITY ASSURANCE

- A. Owner will provide on-site observation and field quality assurance for the Work of this Section.
 - 1. Expenses associated with work described by the following paragraphs shall be paid by the Owner.
- B. Field inspections and special inspections:
 - 1. Required inspections: Observe construction for conformance to the approved Contract Documents, the accepted submittals, and manufacturer's installation instructions for the products used.
 - 2. Record of inspections:
 - a. Maintain record of each inspection.
 - b. Submit copies to Engineer upon request.

3. Statement of special inspections: At the end of the project, prepare and submit to the Engineer and the authority having jurisdiction inspector's statement that the Work was constructed in general conformance with the approved Contract Documents, and that deficiencies observed during construction were resolved.
- C. Special inspections: Anchors cast into concrete and built into masonry.
1. Provide special inspection during positioning of anchors and placement of concrete or masonry (including mortar and grout) around the following anchors:
 - a. Anchor bolts.
 - b. Anchor rods.
 2. During placement, provide continuous special inspection at each anchor location to verify that the following elements of the installation conform to the requirements of the Contract Documents.
 - a. Anchor:
 - 1) Type and dimensions.
 - 2) Material: Galvanized steel, Type 304 stainless steel, or Type 316 stainless steel as specified in this Section or indicated on the Drawings.
 - 3) Positioning: Spacing, edge distances, effective embedment, and projection beyond the surface of the construction.
 - 4) Reinforcement at anchor: Presence, positioning, and size of additional reinforcement at anchors indicated on the Drawings.
 3. Following hardening and curing of the concrete or masonry surrounding the anchors, provide periodic special inspection to observe and confirm the following:
 - a. Base material (concrete or grouted masonry):
 - 1) Solid and dense concrete or grouted masonry material within required distances surrounding anchor.
 - 2) Material encapsulating embedment is dense and well-consolidated.
- D. Special Inspections: Post-installed mechanical anchors placed in hardened concrete and in grouted masonry.
1. Provide special inspection during installation of the following anchors:
 - a. Concrete anchors.
 2. Unless otherwise noted, provide periodic special inspection during positioning, drilling, placing, and torquing of anchors.
 - a. Provide continuous special inspection for post-installed anchors in "overhead installations" as defined in this Section.
 3. Requirements for periodic special inspection:
 - a. Verify items listed in the following paragraphs for conformance to the requirements of the Contract Documents and the Evaluation Report for the anchor being used. Observe the initial installation of each type and size of anchor, and subsequent installation of the same anchor at intervals of not more than 4 hours.
 - 1) Any change in the anchors used, in the personnel performing the installation, or in procedures used to install a given type of anchor, shall require a new "initial inspection."
 - b. Substrate: Concrete or masonry surfaces receiving the anchor are sound and of a condition that will develop the anchor's rated strength.
 - c. Anchor:
 - 1) Manufacturer, type, and dimensions (diameter and length).

- 2) Material (galvanized, Type 304 stainless steel, or Type 316 stainless steel).
 - d. Hole:
 - 1) Positioning: Spacing and edge distances.
 - 2) Drill bit type and diameter.
 - 3) Diameter, and depth.
 - 4) Hole cleaned in accordance with manufacturer's required procedures. Confirm multiple repetitions of cleaning when recommended by the manufacturer.
 - 5) Anchor's minimum effective embedment.
 - 6) Anchor tightening/installation torque.
 4. Requirements for continuous special inspection:
 - a. The special inspector shall observe all aspects of anchor installation, except that holes may be drilled in his/her absence provided that he/she confirms the use of acceptable drill bits before drilling, and later confirms the diameter, depth, and cleaning of drilled holes.
- E. Field tests:
 1. Owner may, at any time, request testing to confirm that materials being delivered and installed conform to the requirements of the Specifications.
 - a. If such additional testing shows that the materials do not conform to the specified requirements, the Contractor shall pay the costs of these tests.
 - b. If such additional testing shows that the materials do conform to the specified requirements, the Owner shall pay the costs of these tests.

3.08 NON-CONFORMING WORK.

- A. Remove misaligned or non-performing anchors.
- B. If more than 10 percent of all tested anchors of a given diameter and type fail to achieve their specified torque or proof load, the Engineer will provide directions for required modifications. Make such modifications, up to and including replacement of all anchors, at no additional cost to the Owner.

3.09 SCHEDULES

- A. Stainless steel. Provide and install stainless steel anchors at the following locations:
 1. "Corrosive locations" as defined in this Section: Type 316 stainless steel
 2. "Wet and moist locations" as defined in this Section: Type 316 stainless steel.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Manhole frames and covers.
 - 2. Miscellaneous metals.
 - 3. Associated accessories to the above items.
- B. Related sections:
 - 1. Section 02084 - Precast Manholes.
 - 2. Section 09960 - High Performance Coatings.
 - 3. Section 15061 - Pipe Supports.

1.02 REFERENCES

- A. Aluminum Association (AA):
 - 1. DAF-45: Designations from Start to Finish.
 - a. M12-C22-A41.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. Standard Specifications for Highway Bridges.
- C. ASTM International (ASTM):
 - 1. A 36 - Standard Specification for Carbon Structural Steel.
 - 2. A 48 - Standard Specification for Gray Iron Castings.
 - 3. A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless.
 - 4. A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 5. A 240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels for General Applications.
 - 6. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
 - 7. A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - 8. A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 9. A 380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - 10. A 489 - Standard Specification for Carbon Steel Lifting Eyes.
 - 11. A 490 - Standard Specification for Structural Bolts, Alloy Steel, Heat-Treated , 150 ksi Minimum Tensile Strength.
 - 12. A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 13. A 501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

14. A 635 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
 15. A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 16. A 992 - Standard Specification for Structural Steel Shapes.
 17. B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 18. B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 19. B 308 - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
 20. B 429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 21. F 593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
- D. American Welding Society (AWS):
1. A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- E. Occupational Safety and Health Administration (OSHA).

1.03 DEFINITIONS

- A. Passivation: Removal of exogenous iron or iron compounds from the surface of a stainless steel by means of chemical dissolution resulting from treatment with an acid solution that removes the surface contamination but does not significantly affect the stainless steel itself.

1.04 SUBMITTALS

- A. Product Data:
1. Manhole frames and covers.
- B. Shop drawings:
1. Miscellaneous metals.
- C. Quality control submittals:
1. Design data.
 2. Test reports:
 - a. Guardrails: 3 copies of certified tests performed by an independent testing laboratory certifying that guardrails meet current State and OSHA strength requirements.
 - b. Gratings:
 - 1) Grating manufacturers' calculations showing that gratings will meet specified design load, stress, and deflection requirements for each size grating for each span.
 - 2) Reports of tests performed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General: Unless otherwise specified or indicated on the Drawings, structural and miscellaneous metals in accordance with the standards of the ASTM, including the following:

Item	ASTM Standard No.	Class, Grade Type or Alloy No.
Cast Iron		
Cast Iron	A 48	Class 40B
Steel		
Galvanized sheet iron or steel	A 653	Coating G90
Coil (plate)	A 635	--
Structural plate, bars, rolled shapes, and miscellaneous items (except W shapes).	A 36	--
Rolled W shapes	A 992	Grade 50
Standard bolts, nuts, and washers	A 307	--
High strength bolts, nuts, and hardened flat washers	A 325 A 490	--
Eyebolts	A 489	Type 1
Tubing, cold-formed	A 500	--
Tubing, hot-formed	A 501	--
Steel pipe	A 53	Grade B
Stainless Steel		
Plate, sheet, and strip	A 240	Type 304* or 316**
Bars and shapes	A 276	Type 304* or 316**
Bolts (Type 304)	F593	Group 1 Condition CW

Item	ASTM Standard No.	Class, Grade Type or Alloy No.
Bolts (Type 316)	F593	Group 2 Condition CW
Aluminum		
Flashing sheet aluminum	B 209	Alloy 5005-H14, 0.032 inches minimum thickness
Structural sheet aluminum-	B 209	Alloy 6061-T6
Structural aluminum	B 209 B 308	Alloy 6061-T6
Extruded aluminum	B 221	Alloy 6063-T42
* Use Type 304L if material will be welded. ** Use Type 316L if material will be welded.		

1. Stainless steels are designated by type or series defined by ASTM.
2. Where stainless steel is welded, use low-carbon stainless steel.

2.02 MANUFACTURED UNITS

- A. Manhole frames and covers:
 1. Material: Gray iron castings, in accordance with ASTM A 48, Class 30-B.
 2. Type: Heavy-duty traffic type, with combined minimum set weight of 265 pounds.
 3. Machine horizontal and vertical bearing surfaces to fit neatly, with easily removable cover bearing firmly in frame without rocking.
 4. Frame:
 - a. Bottom flange type.
 - b. Approximately 4-1/2 inches frame height.
 - c. Dimensions as indicated on the Drawings.
 - 1) Minimum inside clear dimension may not be smaller than nominal diameter minus 2 inches.
 5. Cover:
 - a. Skid-resistant grid pattern design stamped with name of utility service provided by manhole, such as "ELECTRICAL," "SEWER," "TELEPHONE," or "WATER."
 - b. Solid type without ventilation holes.
 6. Finish: Unpainted.
- B. Metal tread plate:
 1. Plate having a raised figured pattern on 1 surface to provide improved traction.

- C. Miscellaneous stainless steel:
 - 1. Provide miscellaneous stainless steel items not specified in this Section as indicated on the Drawings or specified elsewhere.
 - a. Fabricate and install in accordance with the best practices of the trade.
 - 2. Cleaning and passivation:
 - a. Following shop fabrication of stainless steel members, clean and passivate fabrications.
 - b. Finish requirements: Remove free iron, heat tint oxides, weld scale and other impurities, and obtain a passive finished surface.
 - c. Provide quality control testing to verify effectiveness of cleaning agents and procedures and to confirm that finished surfaces are clean and passivated.
 - 1) Conduct sample runs using test specimens with proposed cleaning agents and procedures as required to avoid adverse effects on surface finishes and base materials.
 - d. Pre-clean, chemically descale (pickle), and final clean fabrications in accordance with the requirements of ASTM A 380 to remove deposited contaminants before shipping.
 - 1) Passivation by citric acid treatment is not allowed.
 - a) If degreasing is required before cleaning to remove scale or iron oxide, cleaning (pickling) treatments with citric acid are permissible; however, these treatments shall be followed by inorganic cleaners such as nitric-hydrofluoric acid.
 - 2) Provide acid descaling (pickling) in accordance with Table A1.1 of Annex A1 of ASTM A 380.
 - 3) After pickling, final cleaning of stainless steel shall conform to Part II of Table A2.1 of Annex A2 of ASTM A 380.
 - e. After cleaning, inspect using methods specified for "gross inspection" in ASTM A 380.
 - f. Improperly or poorly cleaned and passivated materials shall not be shipped and will not be accepted at the job site.
- D. Miscellaneous structural steel:
 - 1. Provide miscellaneous steel items not specified in this Section as indicated on the Drawings or specified elsewhere.
 - a. Fabricate and install in accordance with the best practices of the trade.
- E. Isolating sleeves and washers:
 - 1. As indicated on the Drawings and as specified in Section 05190.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions:
 - 1. Examine work in place to verify that it is satisfactory to receive the work of this Section.
 - 2. If unsatisfactory conditions exist, do not begin this work until such conditions have been corrected.

3.02 INSTALLATION

A. General:

1. Install products as indicated on the Drawings, and in accordance with shop drawings and manufacturer's printed instructions, as applicable except where specified otherwise.
2. Interface between materials:
 - a. Dissimilar metals: Where steel comes in contact with dissimilar metals (aluminum, stainless steel, etc.), separate or isolate the dissimilar metals.
 - 1) Make application so that the isolating or protective barrier is not visible in the completed construction.
 - 2) Isolating sleeves and washers: As specified in Section 05190.
 - b. Aluminum in contact with concrete or masonry: Coat aluminum surfaces as specified in Section 09960.
 - c. Aluminum in contact with concrete or masonry.

END OF SECTION

SECTION 07900

JOINT SEALANTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Precast concrete joint sealant.
 - 2. Related materials.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. M 198 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
- B. ASTM International (ASTM):
 - 1. C 920 - Standard Specification for Elastomeric Joint Sealants.
 - 2. C 990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
 - 3. D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
 - 4. D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.

1.03 SUBMITTALS

- A. Product data.
- B. Manufacturer's Installation Instructions.
- C. Warranty.

1.04 QUALITY ASSURANCE

- A. Manufacturer qualifications: Manufacturer of proposed product for minimum 5 years with satisfactory performance record.
- B. Installer qualifications: Manufacturer approved installer of products similar to specified products on minimum 5 projects of similar scope as Project with satisfactory performance record.

1.05 PROJECT/SITE CONDITIONS

- A. Environmental requirements: Do not apply sealant on wet or frosty surfaces or when surface temperature is higher than 100 degrees Fahrenheit or lower than recommended by the manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products in accordance with manufacturer's recommendations.
- B. Code date packages. Do not use material older than manufacturer's published shelf life. Store materials at temperatures lower than 80 degrees Fahrenheit. Condition materials in accordance with manufacturer's instructions prior to installation.

1.07 WARRANTY

- A. Warrant to correct defective products for minimum 1 year in accordance with manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 PRECAST CONCRETE JOINT SEALANT

- A. Between Joints: Preformed, cold-applied, ready-to-use, flexible joint sealant in accordance with ASTM C 990 and AASHTO M 198. Manufacturers: One of the following or equal:
 - 1. Henry Corporation, Ram-Nek.
 - 2. Concrete Sealants Division, ConSeal.

2.02 RELATED MATERIALS

- A. Primer: Nonstaining type, recommended by sealant manufacturer to suit application.
- B. Joint cleaner: Noncorrosive, nonstaining, compatible with joint forming materials and as recommended by sealant manufacturer.
- C. Bond breaker tape: Pressure-sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify acceptability of joint dimensions, physical, and environmental conditions.
- B. Verify that surfaces are dry, clean, and free of dirt, grease, curing compound, and other residue which might interfere with adhesion of sealants.

3.02 PREPARATION

- A. Allow concrete to cure thoroughly before caulking.
- B. Synthetic sponge rubber filler:
 - 1. Prepare surfaces designated to receive filler in accordance with manufacturer's installation instructions.
 - 2. Do not stretch filler beyond its normal length during installation.
- C. Caulking:
 - 1. Verify that surfaces are dry, clean, and free of dirt, grease, curing compounds, and other residue that might interfere with adhesion of sealant.
 - 2. Concrete, masonry, wood, and steel surfaces: Clean and prime in accordance with manufacturer's instructions prior to caulking.
- D. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but neither more than 5/8 inches deep nor less than 3/8 inches deep.
- E. For normal moving building joints sealed with elastomeric sealants not subject to traffic, fill joints to depth equal to 50 percent of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.
- F. For joints sealed with acrylic-latex sealants, fill joints to depth in range of 75 percent to 125 percent of joint width.
- G. Use joint filler to achieve required joint depths, to allow sealants to perform properly.
- H. Prepare surfaces and install synthetic sponge rubber filler in accordance with manufacturer's recommendations.
- I. Do not stretch filler beyond normal length during installation.
- J. Apply bond breaker when recommended by joint sealer manufacturer.

3.03 INSTALLATION

- A. Synthetic sponge rubber filler: Install filler in accordance with manufacturer's installation instructions.
- B. Caulking, joints, and sealing:
 - 1. Construct expansion, contraction, and construction joints as indicated on the Drawings.
 - 2. Pipe and conduit installed in structures.
 - 3. Verify that concrete is thoroughly cured prior to caulking.
 - 4. When filler compressible material is used, use untreated type.
 - 5. Apply caulking with pneumatic caulking gun.
 - 6. Use nozzles of proper shape and size for application intended.

7. Maintain continuous bond between caulking and sides of joint to eliminate gaps, bubbles, or voids and fill joint in continuous operation without layering of compound.
8. Employ experienced applicators to caulk joints and seams in neat workmanlike manner.
9. To hasten curing of compound when used on wide joints subject to movement, apply heat with infrared lamps or other convenient means.

3.04 CLEANING

- A. Clean surfaces adjacent to sealant as work progresses.
- B. Remove excess uncured sealant by soaking and scrubbing with sealant cleaning solvent.
- C. Remove excess cured sealant by sanding with Number 80 grit sandpaper.
- D. Leave finished work in neat, clean condition.

END OF SECTION

SECTION 08110

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Steel Fire Resistive Rated :
 - 1. Doors.
 - 2. Door frames.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 01410 - Regulatory Requirements.
 - b. Section 08710 - Door Hardware.
 - c. Section 09960 - High-Performance Coatings.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. A250.6 - Hardware on Steel Doors (Reinforcement Application).
 - 2. A250.8 - Recommended Specification for Standard Steel Doors and Frames.
- B. ASTM International (ASTM):
 - 1. A 653/A653M - Standard Specification for Sheet Steel, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. A 924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic- Coated by the Hot-Dip Process.
 - 3. A 1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - 4. A 1011 – Standard Specification for Steel, Sheet and Strip, Hot Rolled, Carbon, Structural, High Strength Low Alloy, High Strength Low Alloy with Improved Formability, and Ultra High Strength.
 - 5. E 152 - Standard Methods of Fire Tests of Door Assemblies.
 - 6. E 413 - Classification for Rating Sound Insulation.
 - 7. E 1408 - Standard Test Method for Laboratory Measurement of the Sound Transmission Loss of Door Panels and Door Systems.
 - 8. E 2074 - Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies.

- C. National Association of Architectural Metal Manufacturers (NAAMM)/Hollow Metal Manufacturers Association (HMMA):
 - 1. HMMA 861 - Guide Specifications For Commercial Hollow Metal Doors and Frames.
- D. National Fire Protection Association (NFPA):
 - 1. 80 - Standard for Fire Doors and Other Opening Protectives.
- E. Steel Door Institute (SDI):
 - 1. SDI-111 - A Steel Doors and Frame Details.
 - 2. SDI-117 - Manufacturing Tolerances Standard Steel Doors and Frames.
- F. Underwriters' Laboratories, Inc., (UL):
 - 1. UL 10C - Positive Pressure Fire Tests of Door Assemblies.

1.03 SUBMITTALS

- A. Product data.
- B. Shop drawings: Show the following with references to the Engineer's door marks and hardware groups:
 - 1. Location of door and frame types.
 - 2. Details of fabrication, including core construction, weather stripping, and factory finish for each door.
 - 3. Cutouts and reinforcements for hardware.
 - 4. Methods of installation and anchorage to adjacent construction.
- C. Manufacturer's instructions: Submit manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. Testing agency qualifications: Approved by ultimate enforcing authority for the Project; regularly engaged in inspection of materials and workmanship at factory.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Before delivery, identify type and size of each door and frame in such a way that markings will not damage finish.
- B. Preassemble doorframes in shop and deliver to Project site with spreader bar at sill or tie them in pairs to form box.
- C. Protect doors and frames with resilient packaging sealed with heat shrunk plastic. Break seal on-site to permit ventilation.
- D. Protect doors and frames during shipment and storage to prevent warping, bending, and corrosion.

1.06 SEQUENCING AND SCHEDULING

- A. Ensure timely delivery of reviewed hardware schedule and hardware templates such that no delay occurs in the work of the Contract.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Sheet steel: ASTM A 1008, commercial quality, level, cold rolled steel, or ASTM A 1011, hot rolled, pickled and oil rolled steel. Galvanize by hot-dip process with zinc-coating conforming to ASTM A 653 and A 924, with a coating weight of not less than 0.60 ounces per square foot (0.30 ounces per square foot per side). Clips, bolts, screws, and rivets: sized as recommended by manufacturer.
- B. Primer: Rust- inhibitive metal primer capable of being baked and compatible with finish painting system specified in Section 09960.
- C. Touch-up materials: Primer as recommended by manufacturer.
- D. Door hardware: As specified in Section 08710.

2.02 DOOR AND FRAME TYPES

- A. Exterior doors: ANSI 250.8, Grade III, Model 3, or NAAMM HMMA 810 Type A and NAAMM HMMA 861, flush steel rib-stiffened, minimum 16 gauge face sheets.
- B. Exterior frames: ANSI 250.8 or NAAMM HMMA 861, fully welded frames HMMA 861, except minimum 14 gauge sizes and shapes.

2.03 COMPONENTS

- A. Door cores:
 - 1. Stiffeners: Vertical steel ribs formed from minimum 22-gauge plain sheet steel, spaced at maximum 6 inches apart and securely attached to face sheets by spot welds at maximum 5 inches on center.
 - 2. Core fillers: Insulation, minimum 0.60 pound density noncombustible type, installed in spaces between stiffeners for full height of door; labeled door core material shall conform to requirements of labeling authority.
- B. Glazing stops: Minimum 18 gauge sheet steel, mitered, square, or rectangular:
 - 1. Outside of exterior doors: Fixed, integral to doors and frames.
 - 2. Secure side of interior doors: Removable.
- C. Removable stop fasteners: Flat head, countersunk, tamperproof, self-tapping sheet metal screws.

2.04 FABRICATION OF FRAMES

- A. Galvanize all frames installed in exterior openings.
- B. Frames: Sheet steel, integral type, welded continuous to full depth of frames with minimum 5/8-inch deep stops.
- C. Hardware reinforcement: Minimum 7 gauge at hinges; 12 gauge at strikes, bolts, closers, and other applied hardware.
- D. Jamb Anchors: As required for adjacent wall construction, minimum 3 per jamb;

- E. Floor anchors: Fixed type, except where adjustable anchors are indicated on the Drawings, 1 per jamb, with minimum 2 holes for anchorage. Where floor fill occurs, terminate bottom of frames at indicated finished floor level and support by adjustable extension clips resting on and anchored to structural slabs.
- F. Anchors at masonry: Adjustable strap and stirrup, minimum 16 gauge corrugated or perforated steel at maximum of 30 inches on center and extending minimum 8 inches into masonry.
- G. Anchors at previously placed concrete: Countersink machine screws through the frame into expansion devices spaced at maximum 30 inches on center.
- H. Anchors at structural steel framing: Welded or otherwise securely fastened with stainless steel screws.
- I. Anchors for fire resistive frames: Conform to requirements of labeling authority having jurisdiction.
- J. Masonry angle stiffeners: Factory welded into heads of frames for installation in openings more than 48 inches wide.
- K. Mullions, muntins, and transom bars: Minimum 18 gauge, tubular sheet steel matching, and butt-welded to head and jamb members.
- L. Removable stops: Fasten at approximately 12 to 16 inches on center.

2.05 FABRICATION OF DOORS

- A. Galvanize all doors installed in exterior openings.
- B. Reinforce face sheets with steel rib stiffeners, spaced at maximum 6 inches apart, and securely attached to face sheets by spot welds at maximum 5 inches on center.
- C. Fill voids between face sheets and stiffeners with fiberglass insulation having a minimum density of 0.8 pounds per cubic foot.
- D. Edges: Full weld without visible joints. Bevel striking edge 1/8 inch in 2 inches.
- E. Tops and bottoms of doors: Close with continuous recess steel channel of minimum 16 gauge, extending full width of door and spot welded to both faces.
- F. Tops and bottoms of exterior doors: Flush closing channels welded to make tops and bottoms waterproof with weep holes for escape of moisture.
- G. Hinge reinforcement: 7 gauge.
- H. Lock, closer, and flush bolt reinforcement: 12 gauge.
- I. Astragals:
 - 1. Do not provide astragal cutouts for hardware operations.
- J. Astragal clearances for fire resistive rated doors:

1. Door bottoms at doors designated to receive non-combustible threshold: Not to exceed 3/8 inch between threshold and door bottom.
2. Door bottoms where there is no threshold: Maximum clearance between door and floor not to exceed 1/2 inch.
3. Door bottoms at doors designated to receive combustible floor coverings: Not to exceed 1/2 inch between floor covering and door bottom.
4. Clearance between door and frame and between meeting edges of pairs of doors: Not to exceed 1/8 inch.

K. Glazing: In accordance with fire labeling.

2.06 HARDWARE PREPARATION

- A. Cutout, drill, and reinforce frames and doors for hardware in accordance with hardware templates.
- B. Install plaster guards or mortar boxes in back of hardware cutouts in and welded to frames.
- C. Prepare fire resistive rated doors for hardware in accordance with requirements of labeling authority.
- D. Do not weld hinges to doorframes.
- E. Silencers:
 1. Drill single leaf doorframe jamb stops for minimum 3 silencers.
 2. Do not drill doorframes for silencers when weatherstripping is to be installed.

2.07 FINISHING

- A. Thoroughly clean surfaces of oil, grease, and other impurities; touch-up abraded galvanizing; and chemically etch.
- B. Fill irregularities and sand smooth finish surface. Apply 1 coat of manufacturer's standard rust inhibitive baked-on primer.
- C. Finish painting: As specified in Section 09960.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine reviewed hardware schedules and verify proper coordination of hardware and doors and frames.
- B. Examine opening locations and verify the following:
 1. Correctness of dimensions, backing, or support conditions.
 2. Absence of defects that would adversely affect frame or door installation.

3.02 INSTALLATION

- A. Install doors and frames in accordance with approved shop drawings and manufacturer's instructions.
- B. Frames:
 - 1. Set accurately in position, plumb, align, and attach securely to structure.
 - 2. Set in place before construction of adjacent masonry or framed walls.
 - 3. Anchor frames to previously placed concrete.
 - 4. Set frames before removing spreader bars.
 - 5. Fully grout frames in masonry as the Work progresses.
 - 6. Grout frames at concrete through keyways provided at head and jambs.
- C. Doors: Install at correct openings, ensure smooth swing and proper closure with frame.
- D. Fire resistive frames and doors: Install to conform to NFPA 80 for fire resistive rated class as indicated on the Drawings.
- E. Door hardware: Install in accordance with Section 08710.
- F. Separate or isolate dissimilar metals with neoprene gaskets, sleeves, and washers, or with coatings acceptable to the Engineer.

3.03 TOLERANCES

- A. Manufacturing and installation tolerances: As indicated on the Drawings or in conformance to SDI 117 as minimum.

3.04 ADJUSTING AND CLEANING

- A. Prime coat touch-up: Immediately after installation, sand smooth and touch-up rust areas, and other areas where primer has been damaged, with prime touch-up paint.
- B. Make adjustments as required for correct, proper, and free function and smooth operation without binding of hardware or doors and frames.
- C. Protect doors and frames from damage to surface or profile.

END OF SECTION

SECTION 08320
FLOOR ACCESS DOORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Non-fire-rated floor access doors.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 05500 - Metal Fabrications.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO).

1.03 SUBMITTALS

- A. Product data.
- B. Shop drawings: Show the following:
 - 1. Floor access door installation recommendations.
 - 2. Locations of floor access doors.
 - 3. Door size and configuration.
 - 4. Live load capacity.
 - 5. Materials of construction and finishes provided.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Identify type and size of each floor access door in way not to damage finish prior to delivery.
- B. Deliver products only after proper facilities are available.
- C. Deliver and store packaged products in original containers with seals unbroken and labels intact until time of use.
- D. Handle carefully to prevent damage and store on clean concrete surface or raised platform in safe, dry area.
 - 1. Do not dump onto ground.

- E. Protect floor access doors during shipment and storage to prevent warping, bending, and corrosion.

1.05 WARRANTY

- A. Provide manufacturer's warranty against defects in material and workmanship for a period of 5 years.

1.06 MAINTENANCE

- A. Deliver 2 keys for each cylinder lock to Owner.

PART 2 PRODUCTS

2.01 HEAVY-DUTY OFF-STREET FLOOR ACCESS DOORS

- A. Manufacturers: One of the following or equal:
 - 1. The Bilco Co., Model JH-20 or JDH-20 (double leaf).
 - 2. Babcock Davis Associates, Inc., Model BFDDH-SAL or BFDDH-DAL (double leaf).
- B. Style: Assisted lift, single leaf or double leaf as indicated on the Drawings, aluminum, capable of withstanding minimum AASHTO H-20 wheel load with a maximum deflection of 1/150 of the span, live load channel frame, with drainage couplings, and recessed padlock.
- C. Door leaf: Minimum 1/4 inch, diamond-pattern plate reinforced with stiffeners as required to meet specified live load.
- D. Frame: 1/4-inch channel with anchor flange around perimeter.
- E. Hardware:
 - 1. Hinges: Each leaf equipped with a minimum of 2 heavy forged-brass hinges with stainless steel pins.
 - 2. Lock: Snap lock with removable handle mounted on door leaf.
 - 3. Grip handle: Provide vinyl grip handle designed to release cover for closing.
 - 4. Operating mechanism: Spring operators designed for ease of operation and automatic hold-open arm with release handle.
 - 5. Drainage assembly: Provide 1-1/2-inch drainage coupling located in corner of the channel frame.

2.02 SAFETY ACCESSORIES

- A. Fall Prevention Grating:
 - 1. General: Provide fall prevention grating at all floor access doors. Grating shall be located below hatch, within opening. Grating shall be a hinged, spring assisted, lockable assembly, and shall operate independently of hatch cover.
 - 2. Design Criteria: 300 pounds per square foot load rating.
 - 3. Hardware: 316 stainless steel.
 - 4. Color: Safety orange.
 - 5. Material: Aluminum or FRP.

6. Model:
 - a. Fall Protection Grating by Bilco.
 - b. SG-Series Safety Grating by Babcock-Davis.

2.03 FINISHES

- A. Floor access door finishes:
 1. Aluminum: Provide with grey colored non-slip coating on top surfaces. Coordinate color selection with OWNER.
 2. Aluminum in contact with dissimilar metals and concrete: Manufacturer's standard bituminous coating.
 3. Steel: Provide with grey colored non-slip coating on top surfaces. Coordinate color selection with OWNER.
- B. Hardware finishes:
 1. Provide optional Type 316 stainless steel hardware throughout, including parts of the latch and lifting mechanism assemblies, hold-open arms, and all brackets, hinges, pins, and fasteners.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine construction to receive floor access door and verify correctness of dimensions and other supporting or adjoining conditions.

3.02 PREPARATION

- A. Coordinate details with other work supporting, adjoining, or requiring floor access doors.
- B. Verify dimensions and profiles for each opening.
- C. Verify that location will serve portion of work to which access is required.
 1. Where proposed functional location conflicts with other work, notify the Engineer before installation.
- D. Apply coating to aluminum surfaces that will be in contact with dissimilar metals or concrete when there is none.

3.03 INSTALLATION

- A. Install floor access doors in accordance with manufacturer's instructions.
- B. Ensure correct types and adequate sizes at proper locations.
- C. Securely attach frames to supporting work and ensure doors, frames, and hardware operate smoothly and are free from warp, twist, and distortion.
- D. Attach drain pipe to coupling provided.
 1. Drainage shall be routed to drain into structure covered by the access door.

3.04 ADJUSTING

- A. Adjust doors, frames, and hardware to operate smoothly, freely, and properly without binding.

3.05 CLEANING

- A. Thoroughly clean surfaces of grease, oil, or other impurities; touch up abraded prime coat where applicable.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Door hardware .Door lock shall be keyed to District's master key (Schlage SC1 type).
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 08110 - Hollow Metal Doors and Frames.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 2. E 283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- B. Builders Hardware Manufacturers Association (BHMA):
 - 1. A156.7 - Template Hinge Dimensions.
 - 2. A156.18 - Materials and Finishes.
- C. Underwriters Laboratories, Inc.

1.03 SUBMITTALS

- A. Product Data.
- B. Samples: Include for each different type and manufacturer for review of finish.
- C. Construction key distribution list: Submit upon Owner's request.
- D. Templates:
 - 1. Furnish hardware templates to fabricators of doors, frames, and other work to be factory-prepared for hardware.
 - 2. Check shop drawings of other work to confirm that adequate hardware backing is available.

1.04 REGULATORY REQUIREMENTS

- A. Provide hardware for fire-resistive rated openings that complies with UL and listed by UL.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hardware where directed in unopened packages with items packed separately, complete and ready for installation with necessary fittings, trim, fasteners, and accessories.

1.06 SCHEDULING AND SEQUENCING

- A. Upon receipt of accepted hardware, coordinate accepted hardware schedule, templates, reinforcing units, and template instructions to door and frame sections.
- B. Restrict distribution of construction keys to superintendents and foremen. Maintain record of persons who have received keys on construction distribution list.

PART 2 PRODUCTS

2.01 FASTENERS

- A. Types:
 - 1. To concrete, marble, or masonry: Machine screws and flush shells.
 - 2. To wood: Wood screws.
 - 3. Of exit devices to doors: Thru-bolts, unless otherwise specified.
- B. Screws, exposed: Phillips-head type, full-threaded screws, not combination type.
- C. Sizes: Suitable for heavy use.
- D. Finish: Stainless steel, unless otherwise required to match material and hardware finish.

2.02 HINGES

- A. Manufacturers: One of the following or equal:
 - 1. Stanley.
 - 2. Hager.
 - 3. McKinney.
 - 4. Ives 5BB1 - Stainless steel, satin finish (630).
- B. Material:
 - 1. Exterior doors: Stainless steel.
- C. Knuckles, number of: Minimum 5.
- D. Ball bearings: Concealed with interior self-lubricating bushings.
- E. Type for doors with closers: Ball bearing.

- F. Material for fire-resistive rated doors: Steel.
- G. Pins for exterior doors: Non-removable.
- H. Template hinges: BHMA A156.7.
- I. Tips: Flat button.
- J. Height: As follows, unless otherwise specified:
 - 1. Doors 1-3/8-inch thick: 3-1/2 inches.
 - 2. Doors 1-3/4-inch thick and up to 41 inches wide: 4-1/2 inches.
 - 3. Doors 1-3/4-inch thick and from 41 to 48 inches wide: 4-1/2 inches, extra heavy.
 - 4. Doors 2 inches thick or over 48 inches wide: 5 inches, extra heavy.
- K. Widths: Sufficient to clear trim projection when door swings 180 degrees, unless otherwise specified.
- L. Number per door leaf: As follows, unless otherwise specified:
 - 1. 3 hinges on door to 7 feet, 6 inches in height.
 - 2. 1 additional hinge for each additional 2 feet, 6 inches of height or fraction thereof.

2.03 LOCKSETS

- A. Manufacturer for corrosive environments: Suitable for marine use or other severe climate conditions, having only stainless steel parts. Ensure lock is compatible with Owner's Master key prior to purchase. One of the following or equal:
 - 1. Schlage L Series with removable core cylinders and 06A lever and rose.
 - 2. Sargent, Division of Essex Industries, Inc., Model 8200 with removable core cylinders, and Model L levers, and Model LN roses.
- B. Cylinders:
 - 1. Number of pins: Minimum 6.
 - 2. Cases: Steel, cylindrical.
 - 3. Interior parts: Non-corrosive with non-plastic, non-die-cast, non-aluminum mechanisms.
 - 4. Accessibility to key-in-knob type cylinders: Not requiring removal of lockset from door.
 - 5. Plugs: Extruded brass bar material fully round without flattened areas.
 - 6. Cores: Removable.
- C. Strikes:
 - 1. Material: Same as lock trim.
 - 2. Lock and latch boxes: Wrought.
 - 3. Lips: Extended, able to protect trim from marring by latch bolt.
 - 4. Cutouts at metal frames: In accordance with ANSI, unless otherwise specified.
- D. Levers: Type that returns to within 1/2 inch of door.
- E. Backset: 2-3/4 inches.
- F. Trim materials: Stainless steel.

2.04 CONSTRUCTION KEYING

- A. Type: Removable core system.

2.05 PERMANENT KEYING AND KEYS

- A. Key door locks to match existing system. District shall provide master key.

2.06 PUSH/PULL PLATES

- A. Manufacturers: One of the following or equal:
 - 1. Ives.
 - 2. Trimco.
 - 3. Rockwood.
- B. Pulls:
 - 1. Material: Stainless steel.
 - 2. Size: Minimum 8 inches center to center, minimum grip diameter of 3/4 inch, minimum projection of 2-1/4 inch.
- C. Pull plates:
 - 1. Material: Stainless steel.
 - 2. Plate size: Minimum 3 by 12 inches by 0.050-inch thick, with beveled edges on 4 sides with pull.
 - 3. Pull size: Minimum 8 inches center to center, minimum grip diameter of 3/4 inch, minimum projection of 2-1/4 inch.
- D. Push plates:
 - 1. Material: Stainless steel.
 - 2. Size: Minimum 3 by 12 inches by 0.050-inch thick, with beveled edges on 4 sides.

2.07 CLOSERS

- A. Manufacturers:
 - 1. Features:
 - a. Heavy-duty.
 - b. Non-handed and non-sized.
 - c. Adjustable spring power from size 1 through 4.
 - 2. One of the following or equal:
 - a. Sargent, 351 Series.
 - b. LCN, Super Smoothee Model 4041 Series.
 - c. Norton Door Controls, Multi-Size Door Closers Model 7500BF Series.
- B. Type: Full rack and pinion type with steel spring and non-gumming, non-freezing hydraulic fluid.
- C. Controls: Separate set for regulating sweep speed, latch speed, backcheck and backcheck positioning.
- D. Sizes: As recommended by accepted manufacturer.

- E. Covers: Metal, capable of receiving finishes to match adjacent hardware finishes, unless otherwise specified.
- F. Narrow frame provisions: Drop plates.
- G. Effort to operate: As follows:
 - 1. Exterior: Maximum 8-1/2 pounds.
 - 2. Fire-resistive rated doors: Maximum 15 pounds.
- H. Adjust closers in accordance with manufacturer's directions for size of door.

2.08 EXIT DEVICES

- A. Lever design:
 - 1. Manufacturers: The following or equal:
 - a. Von Duprin, Lever Model 06.
- B. Rim device, fire-resistive rated:
 - 1. Manufacturers: One of the following or equal:
 - a. Von Duprin Inc., Model Series 98-F.
 - b. Sargent Essex Industries, Model Series 12-8800.
- C. Mortise lock device, fire-resistive rated:
 - 1. Manufacturers: The following or equal:
 - a. Von Duprin Inc., Model Series 9875L-F.
- D. Material: Stainless steel.
- E. Corrosive environment provisions: Zinc dichromate coated internal parts.

2.09 MISCELLANEOUS DOOR HARDWARE

- A. Wall stops.
 - 1. Manufacturers: One of the following or equal:
 - a. Ives.
 - b. Trimco.
 - c. Rockwood.
- B. Gasketing systems: self-adhesive silicone seal, continuous at head and jambs, rated for fire and smoke in accordance with ASTM E 283, sound rated in accordance with ASTM E 90.
 - 1. Manufacturers: One of the following or equal:
 - a. Pemko Mfg. Co. 303 AS.
 - b. National Guard Products Inc.
 - c. Reese.
- C. Weather stripping for exterior doors.
- D. Thresholds: extruded aluminum, maximum 1/2-inch high, maximum slope of 1 foot in 2 feet.
 - 1. Manufacturers: One of the following or equal:
 - a. National Guard Products Inc.
 - b. Pemko Mfg. Co. 1720E.

- E. Coordinator with filler bar: non-handed, series type length as required for door, complete with filler lengths as required, with mounting brackets and carry bars when required for proper operation; steel with manufacturer's standard prime finish capable of receiving painted finish.
 - 1. Manufacturers: One of the following or equal:
 - a. Glynn-Johnson Coordinators, Model COR Series.
 - b. Ives, Door Co-Ordinator, Model 900 Series.
- F. Door bottoms: extruded aluminum with vinyl insert, surface mounted, length equal to door width minus 2 inches, automatic, recessed in bottom of door.
 - 1. Manufacturers: One of the following or equal:
 - a. Pemko.
 - b. Reese.
- G. Astragals: As specified in Sections 08110.

2.10 FINISHES

- A. Stainless steel: BHMA A156.18 630 (US32D), satin stainless steel.
- B. Metal closer covers: Plate covers to match typical door hardware finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect doors and door frames for damage or defects and examine hardware for compatibility with receiving conditions and suitable to intended use.
- B. Verify that required wall backing has been installed.

3.02 INSTALLATION

- A. Install finish hardware in accordance with manufacturer's templates and instructions.
- B. Accurately and properly fit hardware.
- C. Securely fasten fixed parts for smooth, trouble-free, non-binding operation.
- D. Fit faces of mortise parts snug and flush.
- E. Ensure that operating parts move freely and smoothly without binding, sticking, or excessive clearance.
- F. Protection:
 - 1. Protect door hardware from damage or marring of finish during construction, use strippable coatings, removable tapes, or other acceptable means.
 - 2. Ensure door hardware displays no evidence of finish paint after final building cleanup.

- G. Latch guard and dead bolts: Install so that bolts automatically engage in keeper, whether activated by closer or by manual pressure.
- H. Closers:
 - 1. Mount on opposite sides of corridors or vestibules, except at exterior doors.
 - 2. Mount for 180-degree swing wherever possible.
 - 3. Mount with drop plates at narrow top rail doors.
 - 4. Adjust to operate noiselessly and evenly.
 - 5. Have closer manufacturer regulate closers prior to final acceptance of project.
- I. Kick plates: Screw on push side of doors, unless otherwise indicated on the Drawings.
- J. Gasketing: Mount to provide complete contact between door and frame, finished floor, or both; and weathertight enclosure.
- K. Thresholds:
 - 1. Install immediately before inspection for Substantial Completion.
 - 2. Cope to fit door frame profile and drill to suit required flush bolts and panic bolts.
 - 3. Unless indicated on the Drawings to be set in grout, set in double bead of sealant, tightly fit at jambs, and make waterproof.
 - 4. Fasten to concrete slab with 5/16-inch stainless steel flat head countersunk machine screws and concrete anchors at 8-inch centers.

3.03 CONSTRUCTION KEYING

- A. Insert construction inserts in cylinder cores of exterior doors, and doors requiring security and access for workman, unless otherwise directed by the Engineer.

3.04 ADJUSTING

- A. Examine hardware in place for complete and proper installation. Lubricate bearing surfaces for proper function.
- B. Replace, rework or otherwise correct defective door hardware, including incorrect hand or function.

3.05 CLEANING

- A. Remove protective materials and devices and thoroughly clean exposed surfaces of hardware.
- B. Check for surface damage prior to final cleaning for acceptance of project.

END OF SECTION

SECTION 09910

PAINTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Field applied paints and coatings for normal exposures.
 - 2. Painting Accessories.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 01300 - Submittals.
 - b. Section 01605 - Product Requirements.
 - c. Section 01700 - Contract Closeout.

1.02 DEFINITIONS

- A. Paints: Manufacturer's best ready-mixed coatings, except when field catalyzed, with fully ground pigments having soft paste consistency and capable of being readily and uniformly dispersed to complete homogeneous mixture, having good flowing and brushing properties, and capable of drying or curing free of streaks or sags.
- B. Volatile Organic Compound (VOC): Content of air polluting hydrocarbons in uncured coating product measured in units of grams per liter or pounds per gallon.

1.03 SUBMITTALS

- A. General: Submit as specified in Section 01300.
- B. Shop drawings: Include schedule of where and for what use coating materials are proposed in accordance with requirements for Product Data.
- C. Product data: Include description of physical properties of coatings including solids content and ingredient analysis, VOC content, temperature resistance, typical exposures and limitations, and manufacturer's standard color chips.
- D. Samples: Include 8-inch square draw-downs or brush-outs of topcoat finish when requested. Identify each sample as to finish, formula, color name and number and sheen name and gloss units.

- E. Manufacturer's instructions: Submit in accordance with requirements for Product Data. Include:
 - 1. Special requirements for transportation and storage.
 - 2. Mixing instructions.
 - 3. Shelf life.
 - 4. Pot life of material.
 - 5. Precautions for applications free of defects.
 - 6. Surface preparation.
 - 7. Method of application.
 - 8. Recommended number of coats.
 - 9. Recommended thickness of each coat.
 - 10. Recommended total thickness.
 - 11. Drying time of each coat, including prime coat.
 - 12. Required prime coat.
 - 13. Compatible and non-compatible prime coats.
 - 14. Recommended thinners, when recommended.
 - 15. Limits of ambient conditions during and after application.
 - 16. Time allowed between coats.
 - 17. Required protection from sun, wind and other conditions.
 - 18. Touch-up requirements and limitations.
- F. Submit notarized certificate that:
 - 1. All paints and coatings to be used on this project comply with the State of California Air Resources Board Rule 1113 VOC Regulations effective as of January 1, 2004; and that
 - 2. All paints and coatings to be used on this project comply with the VOC regulations of the State of California Air Management District in which the coatings will be used, effective January 1, 2004.

1.04 QUALITY ASSURANCE

- A. Products: First line or best grade.
- B. Materials for each paint system: By single manufacturer.
- C. Applicator qualifications: Applicator of products similar to specified products with minimum 3 years' experience.
- D. Regulatory requirements: Comply with by using paints that do not exceed governing agency's VOC limits or do not contain lead.
- E. Field samples:
 - 1. Paint 1 complete surface of each color scheme to show colors, finish texture, materials, and workmanship.
 - 2. Obtain approval before painting other surfaces.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products as specified in Section 01600 and 01605.
- B. Remove unspecified and unapproved paints from Project site immediately.

- C. Deliver containers with labels identifying:
 - 1. Manufacturer's name.
 - 2. Brand name.
 - 3. Product type.
 - 4. Batch number.
 - 5. Date of manufacturer.
 - 6. Expiration date or shelf life.
 - 7. Color.
 - 8. Mixing and reducing instructions.
- D. Store coatings in well-ventilated facility that provides protection from the sun weather, and fire hazards.
 - 1. Maintain ambient storage temperature between 45 and 90 degrees Fahrenheit, unless otherwise recommended by the manufacturer.
- E. Take precautions to prevent fire and spontaneous combustion.

1.06 ENVIRONMENTAL CONDITIONS

- A. Surface moisture contents: Do not paint surfaces that exceed manufacturer specified moisture contents, or when not specified by the manufacturer, the following moisture contents:
 - 1. Plaster and gypsum wallboard: 12 percent.
 - 2. Masonry, concrete and concrete block: 12 percent.
 - 3. Interior located wood: 15 percent.
 - 4. Concrete floors: 7 percent.
- B. Do not paint or coat:
 - 1. Under dusty conditions.
 - 2. When light on surfaces measures less than 15 foot-candles.
 - 3. When ambient or surface temperature is less than 50 degrees Fahrenheit or unless manufacturer allow a lower temperature.
 - 4. When relative humidity is higher than 85 percent, unless manufacturer allows a higher relative humidity.
 - 5. When surface temperature is less than 5 degrees Fahrenheit above dew point.
 - 6. When surface temperature exceeds the manufacturer's recommendation.
 - 7. When ambient temperature exceeds 90 degrees Fahrenheit, unless manufacturer allows a higher temperature.
 - 8. Apply clear finishes at minimum 65 degrees Fahrenheit.
- C. Provide fans, heating devices, or other means recommended by coating manufacturer to prevent formation of condensate or dew on surface of substrate, coating between coats and within curing time following application of last coat.
- D. Provide adequate continuous ventilation and sufficient heating facilities to maintain minimum 50 degrees Fahrenheit for 24 hours before, during and 48 hours after application of finishes.

1.07 PROTECTION

- A. Protect adjacent surfaces from paint and damage. Repair damage resulting from inadequate or unsuitable protection.

- B. Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being painted and in particular, surfaces within storage and preparation area.
- C. Place cotton waste, cloths, and material that may constitute fire hazard in closed metal containers and remove daily from site.
- D. Remove electrical plates, surface hardware, fittings and fastenings, prior to painting operations.
 - 1. Carefully store, clean and replace on completion of painting in each area.
 - 2. Do not use solvent or degreasers to clean hardware that may remove permanent lacquer finish.

1.08 EXTRA MATERIALS

- A. Extra materials: Deliver as specified in Section 01770. Include minimum 1 gallon of each type and color of coating applied:
 - 1. When manufacturer packages material in gallon cans, deliver unopened labeled cans as comes from factory.
 - 2. When manufacturer does not package material in gallon cans, deliver material in new gallon containers, properly sealed and identified with typed labels indicating brand, type, and color.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Paints: One of the following or equal:
 - 1. Carboline: Carboline, St. Louis, MO.
 - 2. ICI/Devoe: ICI/Devoe/AkzoNobel, Strongsville, OH.
 - 3. Rustoleum: Rustoleum Corp., Sommerset, NJ.
 - 4. S/W: Sherwin-Williams Co., Cleveland, OH.
 - 5. Tnemec: Tnemec Co., Kansas City, MO.
- B. Submit requests for substitutions as specified in General Conditions:
 - 1. Include certified ingredient analyses.
 - 2. Provide colors that match specified colors.

2.02 PRETREATMENT, PRIMERS, PRIMER-SEALERS, AND WOOD STAIN

- A. Aluminum primer: One of following or equal:
 - 1. Carboline: Carbocrylic 120.
 - 2. ICI/Devoe: Devflex 4020 DTM.
 - 3. S/W: DTM Wash Primer.
- B. Concrete masonry filler/primer: One of following or equal:
 - 1. Carboline: Sanitile 100.
 - 2. ICI/Devoe: Bloxfill 4000.
 - 3. S/W: HD Block Filler, B42W46.
 - 4. Tnemec:
 - a. Series 130, Envirofill.
 - b. Series 180, Tneme-crete.

- C. Concrete, porous, filler/primer: One of following or equal:
 - 1. Carboline: Sanitile 100.
 - 2. ICI/Devoe: Bloxfill 4000.
 - 3. S/W: HD Block Filler, B42W46.
 - 4. Tnemec:
 - a. Series 130, Envirofill.
 - b. Series 180, Tneme-crete.
- D. Concrete, smooth, filler/primer: One of following or equal:
 - 1. Carboline: Sanitile 100.
 - 2. Carboline: Carbocrylic 120.
 - 3. ICI/Devoe:
 - a. Bloxfill 4000.
 - b. Prep & Prime, Bond Prep 3030.
 - 4. S/W:
 - a. HD Block Filler, B42W46.
 - b. Epoxy Masonry Tilt Primer White B42WW49.
 - 5. Tnemec: Series 180, Tneme-Crete.
- E. Ferrous metal primer: One of following or equal:
 - 1. Carboline: Carbocrylic 890.
 - 2. ICI/Devoe: Barrust 233.
 - 3. S/W: Macropoxy 646.
 - 4. Tnemec: Series 104.
- F. Galvanized metal surface pretreatment materials: One of following or equal:
 - 1. Carboline: Surface Cleaner 3.
 - 2. ICI/Devoe: Devprep 88.
- G. Galvanized metal surface primer: One of following or equal:
 - 1. Carboline: Carbocrylic 890.
 - 2. ICI/Devoe: Barrust 233.
 - 3. S/W: Macropoxy 646.
 - 4. Tnemec: Series 104.
- H. Plaster sealer: One of following or equal:
 - 1. Carboline: Sanitile 120.
 - 2. ICI/Devoe: Prep & Prime, Bond Prep 3030.
 - 3. S/W:
 - a. Promar 200 Primer B28W8200.
 - b. Loxon Masonry Primer A24W300.
- I. Plywood, latex finishes: One of following or equal:
 - 1. Carboline: Sanitile 120.
 - 2. ICI/Devoe:
 - a. Exterior: Prep & Prime, Hydrosealer 6001.
 - b. Interior: Prep & Prime, Hi Hide Wall 1000.
 - 3. S/W: A100 Latex Primer B42W8041.
- J. Wood primer for opaque finish paint, interior exposure: One of following or equal:
 - 1. Carboline: Sanitile 120.
 - 2. ICI/Devoe: Prep & Prime, Gripper 3210.
 - 3. S/W: PrepRite Latex Primer B28W111.

- K. Wood primer for opaque finish paint, exterior exposure: One of following or equal:
1. Carboline: Sanitile 120.
 2. S/W: A-100 Primer B42W.
 3. ICI/Devoe: Prep & Prime, Hydrosealer 6001.
 4. Wood stain: One of following or equal:
 - a. S/W:
 - 1) Interior: Wood Classic.
 - 2) Exterior: Woodscapes.
 - b. Approved equal.

2.03 PAINTS, INTERIOR EXPOSURE

- A. Latex, flat: One of following or equal:
1. Carboline: Carbocrylic 3359MC flat.
 2. ICI/Devoe:
 - a. Dulux Ultra 1201.
 - b. Dulux Lifemaster 9100N.
 3. S/W: Promar 200, B30W200.
- B. Latex, semi-gloss: One of following or equal:
1. Carboline: Carbocrylic 3359MC.
 2. ICI/Devoe:
 - a. Dulux Ultra 1407.
 - b. Dulux Lifemaster 9200N.
 3. S/W: Promar 200, B77W3402D.
- C. Alkyd, gloss: One of following or equal:
1. ICI/Devoe: Glidden Lifemaster Oil 1508.
 2. S/W:
 - a. Industrial Enamel, B54Z-100.
 - b. Water based Industrial Enamel, B53W311.
- D. Acrylic, semi-gloss: One of following or equal:
1. Carboline: Carbocrylic 3359MC.
 2. ICI/Devoe:
 - a. Dulux Ultra 1407.
 - b. Dulux Lifemaster 9200N.
 3. S/W: Promar 200, B77W3402D.
 4. Tnemec: Series 1029, Enduratone.
- E. Urethane varnish, clear: One of following or equal:
1. ICI/Devoe: Woodpride 1802 Clear Interior Water-based Varnish.
 2. S/W: Wood Classics Waterborne Polyurethane Varnish Gloss Clear A68V91.
 3. Rustoleum: Varathane Exterior Liquid Plastic.
- F. Oil: The following or equal:
1. Watco Danish Oil.

2.04 PAINTS, EXTERIOR EXPOSURE

- A. Latex, flat: One of following or equal:
1. Carboline: Carbocrylic 3359MC flat.

2. ICI/Devoe:
 - a. Dulux Professional 2200V.
 3. S/W: A-100, Flat Exterior Latex A6-100.
 4. Tnemec: 1028 Enduratone.
- B. Alkyd, gloss: One of following or equal:
1. ICI/Devoe: Glidden Lifemaster Oil 1508.
 2. S/W:
 - a. Industrial Enamel, B54Z.
 - b. Water based Industrial Enamel B53W311.
- C. Acrylic latex, semi-gloss: One of following or equal:
1. Carboline: Carbocrylic 3359 flat.
 2. ICI/Devoe:
 - a. Dulux Professional 2406V.
 3. S/W: A-100, Flat Exterior Latex A6-100.
 4. Tnemec: 1028 Enduratone.
- D. Urethane varnish, clear: One of following or equal:
1. ICI/Devoe: FLOOD Spa-N-Deck Waterborne System.
 2. Rustoleum: Varathane Exterior Liquid Plastic.
 3. SW: Wood Classics.

PART 3 EXECUTION

3.01 INSPECTION

- A. Thoroughly examine surfaces scheduled to be painted before starting work.
- B. Start painting when unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Prepare surfaces in accordance with paint manufacturer's instructions or when none, the following:
 1. Aluminum:
 - a. Remove surface contamination by steam, high-pressure water, or degreasers.
 - b. Abrade surface by abrasive blasting, power tool cleaning or hand tool cleaning.
 - c. Apply etching primer.
 2. Reinforced concrete panels:
 - a. Remove dirt, powdery residue, and foreign matter.
 - b. Paint immediately; both sides when applicable.
 3. Canvas and cotton insulation coverings: Remove dirt, grease, and oil.
 4. Concrete floors:
 - a. Remove contamination, abrasive blast or acid etch and rinse with clear water.
 - b. Ensure required acid-alkali balance is achieved. Allow to dry thoroughly.
 5. Copper for paint finish:
 - a. Remove contamination by steam, high-pressure water, or degreasers.

- b. Abrade surface by abrasive blasting, power tool cleaning or hand tool cleaning.
 - c. Apply vinyl etch primer.
- 6. Copper for oxidized finish:
 - a. Remove contamination.
 - b. Apply oxidizing solution of copper acetate and ammonium chloride in acetic acid.
 - c. Rub on repeatedly for correct effect.
 - d. Once attained rinse surfaces well with clear water and allow to dry.
- 7. Gypsum wallboard:
 - a. Remove contamination and prime to show defects.
 - b. Repair and prime defects.
- 8. Galvanized surfaces:
 - a. Remove surface contamination and oils and wash with degreasers.
 - b. Apply coat of etching type primer.
- 9. Zinc coated surfaces: Remove surface contamination and oils and prepare for priming in accordance with metal manufacturer's recommendations.
- 10. Concrete and concrete masonry:
 - a. Remove dirt, loose mortar, scale, powder and other foreign matter.
 - b. Remove oil and grease with solution of tri-sodium phosphate.
 - c. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate.
 - d. Rinse well and allow to thoroughly dry.
 - e. Spot prime exposed metal with alkyl primer.
- 11. Plaster:
 - a. Fill hairline cracks, small holes and imperfections with patching plaster.
 - b. Smooth off to match adjacent surfaces.
 - c. Wash and neutralize high alkali surfaces where they occur.
- 12. Unprimed steel and iron: Remove grease, rust, scale, dirt and dust by wire brushing, sandblasting or other necessary method.
- 13. Shop primed steel:
 - a. Sand and scrape to remove loose primer and rust.
 - b. Feather out edges to make touch-up patches inconspicuous.
 - c. Clean surfaces.
 - d. Prime bare steel surfaces.
- 14. Wood and millwork:
 - a. Sandpaper to smooth even surface.
 - b. Wipe off dust and grit prior to priming.
 - c. Spot coat knots, pitch streaks, and sappy sections with sealer.
 - d. Fill nail holes and cracks after primer has dried and sand between coats.
- 15. Exterior wood siding:
 - a. Remove dust, grit, and foreign matter.
 - b. Seal knots, pitch streak, and sappy sections.
 - c. Fill nail holes with exterior caulking compound after prime coat has been applied.
- 16. Mildew:
 - a. Remove by scrubbing with solution of tri-sodium phosphate and chlorine bleach.
 - b. Rinse with clean water and allow surface to dry completely.
- 17. Glue laminated woods:
 - a. Remove grease and dirt.
 - b. Wash down surfaces with degreasers.

3.03 APPLICATION

- A. Apply each coat at proper consistency.
- B. Tint each coat of paint slightly darker than preceding coat.
- C. Sand lightly between coats to achieve required finish.
- D. Do not apply finishes on surfaces that are not sufficiently dry.
- E. Allow each coat of finish to dry before following coat is applied, unless directed otherwise by manufacturer.
- F. Where clear finishes are required ensure tint fillers match wood.
 - 1. Work fillers well into grain before set.
 - 2. Wipe excess from surface.
- G. Backprime exterior woodwork, which is to receive paint finish, with exterior primer paint.
- H. Backprime interior woodwork, which is to receive paint or enamel finish, with enamel undercoat paint.
- I. Backprime interior and exterior woodwork, which is to receive stain or varnish finish, with gloss varnish reduced 25 percent with mineral spirits.
- J. Prime top and bottom edges of wood and metal doors with enamel undercoat when they are to be painted.
- K. Prime top and bottom edges of wood doors with gloss varnish when they are to receive stain or clear finish.

3.04 MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Identify equipment, ducting, piping, and conduit in accordance with Related Sections.
- B. Remove grilles, covers, and access panels for mechanical and electrical system from location and paint separately.
- C. Finish paint primed equipment with color selected by the Engineer.
- D. Prime and paint insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars, and supports, except where items are plated or covered with prefinished coating.
- E. Replace identification markings on mechanical or electrical equipment when painted over or spattered.
- F. Paint interior surfaces of air ducts, convectors, and baseboard heating cabinets that are visible through grilles and louvers with 1 coat of flat black paint, to limit of sight line.

- G. Paint dampers exposed immediately behind louvers, grilles, convectors, and baseboard cabinets to match face panels.
- H. Paint exposed conduit and electrical equipment occurring in finished areas with color and texture to match adjacent surfaces.
- I. Paint both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.
- J. Color code equipment, piping, conduit, exposed ductwork, and apply color banding and identification, such as flow arrows, naming and numbering, in accordance with the Contract Documents.

3.05 SURFACES NOT REQUIRING FINISHING

- A. Stainless steel, brass, bronze, copper, monel, chromium, anodized aluminum: Specially finished articles such as porcelain enamel, plastic coated fabrics, and baked enamel.
- B. Finished products such as ceramic tile, windows, glass, brick, resilient flooring, acoustical tiles, board and metal tees; other architectural features, such as finish hardware, furnished in aluminum, bronze or plated ferrous metal, prefinished panels, or other items that are installed prefinished.
- C. Items completely finished at factory, such as preformed metal roof and wall panels, aluminum frames, toilet compartments, sound control panels, acoustical tiles, shower compartments, folding partition, and flagpole.

3.06 CLEANING

- A. As work proceeds and upon completion, promptly remove paint where spilled, splashed, or spattered.
- B. During progress of work, keep premises free from unnecessary accumulation of tools, equipment, surplus materials, and debris.
- C. Upon completion of work, leave premises neat and clean.

3.07 INTERIOR PAINT SCHEDULE

- A. Concrete, porous: 2 coats of following finish paints over block filler:
 - 1. Walls and ceilings.
 - a. Latex, eggshell.
 - b. Acrylic, semi-gloss.
- B. Concrete, smooth: 2 coats of following finish paints over specified sealer:
 - 1. Walls and ceilings.
 - a. Latex, eggshell.
 - b. Acrylic, semi-gloss.

3.08 EXTERIOR PAINT SCHEDULE

- A. Concrete masonry: 2 coats of following finish paints over specified block filler:
 - 1. Latex, eggshell.
 - 2. Acrylic, semi-gloss.
- B. Concrete, porous: 2 coats of following finish paints over specified primer/sealer.
 - 1. Items as specified on drawings.
 - a. Latex, eggshell.
 - b. Acrylic, semi-gloss.
- C. Concrete, smooth: 2 coats of following finish paints over specified primer/sealer:
 - 1. Items as specified on drawings.
 - a. Latex, eggshell.
 - b. Acrylic, semi-gloss.
- D. Wood, painted: 2 coats of following finish paints over specified primer:
 - 1. Trim and items as specified on drawings.
 - a. Latex, eggshell.
 - b. Acrylic, semi-gloss.

END OF SECTION

SECTION 09960

HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Field-applied coatings.
- B. Related sections:
 - 1. Section 01030 - Special Project Constraints.
 - 2. Section 01300 - Submittals.
 - 3. Section 01605 - Product Requirements.
 - 4. Section 01700 - Contract Closeout.
 - 5. Section 15075 - Equipment Identification.
 - 6. Section 16075 - Electrical Identification.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. D 16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
 - 2. D 4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- B. International Concrete Repair Institute (ICRI):
 - 1. Guideline 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
- C. NACE International (NACE):
 - 1. SP0178 - Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service.
 - 2. SP0188 - Discontinuity (Holiday) Testing of Protective Coatings.
- D. National Association of Pipe Fabricators (NAPF):
 - 1. 500-03 - Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.
- E. Society for Protective Coatings (SSPC):
 - 1. SP COM - Surface Preparation Commentary for Steel and Concrete Substrates.
 - 2. SP 1 - Solvent Cleaning.
 - 3. SP 2 - Hand Tool Cleaning.
 - 4. SP 3 - Power Tool Cleaning.
 - 5. SP 5 - White Metal Blast Cleaning.
 - 6. SP 6 - Commercial Blast Cleaning.
 - 7. SP 7 - Brush-Off Blast Cleaning.
 - 8. SP 10 - Near-White Blast Cleaning.
 - 9. SP 13 - Surface Preparation of Concrete.

- F. United States Environmental Protection Agency (EPA):
 - 1. Method 24 - Surface Coatings.

1.03 DEFINITIONS

- A. Submerged metal: Steel or iron surfaces below tops of channel or structure walls that will contain water even when above expected water level.
- B. Submerged concrete and masonry surfaces: Surfaces that are or will be:
 - 1. Underwater.
 - 2. In structures that normally contain water.
 - 3. Below tops of walls of water-containing structures.
- C. Exposed surface: Any metal or concrete surface, indoors or outdoors, that is exposed to view.
- D. Dry film thickness (DFT): Thickness of fully cured coating, measured in mils.
- E. Volatile organic compound (VOC): Content of air polluting hydrocarbons in uncured coating product measured in units of grams per liter or pounds per gallon, as determined by EPA Method 24.
- F. Ferrous: Cast iron, ductile iron, wrought iron, and all steel alloys except stainless steel.
- G. Where SSPC surface preparation standards are specified or implied for ductile iron pipe or fittings, the equivalent NAPF surface preparation standard shall be substituted for the SSPC standard.

1.04 PERFORMANCE REQUIREMENTS

- A. Coating materials shall be especially adapted for use in wastewater pump stations.

1.05 SUBMITTALS

- A. General: Submit as specified in Section 01300.
- B. Shop drawings:
 - 1. Schedule of proposed coating materials.
 - 2. Schedule of surfaces to be coated with each coating material.
- C. Product data: Include description of physical properties of coatings including solids content and ingredient analysis, VOC content, temperature resistance, typical exposures and limitations, and manufacturer's standard color chips:
 - 1. Regulatory requirements: Submit data concerning the following:
 - a. VOC limitations.
 - b. Coatings containing lead compounds and polychlorinated biphenyls .
 - c. Abrasives and abrasive blast cleaning techniques, and disposal.
- D. Samples: Include 8-inch square drawdowns or brush-outs of topcoat finish when requested. Identify each sample as to finish, formula, color name and number, sheen name, and gloss units.

- E. Certificates: Submit in accordance with requirements for Product Data.
- F. Manufacturer's instructions: Include the following:
 - 1. Special requirements for transportation and storage.
 - 2. Mixing instructions.
 - 3. Shelf life.
 - 4. Pot life of material.
 - 5. Precautions for applications free of defects.
 - 6. Surface preparation.
 - 7. Method of application.
 - 8. Recommended number of coats.
 - 9. Recommended DFT of each coat.
 - 10. Recommended total DFT.
 - 11. Drying time of each coat, including prime coat.
 - 12. Required prime coat.
 - 13. Compatible and non-compatible prime coats.
 - 14. Recommended thinners, when recommended.
 - 15. Limits of ambient conditions during and after application.
 - 16. Time allowed between coats (minimum and maximum).
 - 17. Required protection from sun, wind, and other conditions.
 - 18. Touch-up requirements and limitations.
 - 19. Minimum adhesion of each system submitted in accordance with ASTM D 4541.
- G. Manufacturer's Representative's Field Reports.
- H. Operations and Maintenance Data: Submit as specified in Section 01730.
 - 1. Reports on visits to project site to view and approve surface preparation of structures to be coated.
 - 2. Reports on visits to project site to observe and approve coating application procedures.
 - 3. Reports on visits to coating plants to observe and approve surface preparation and coating application on items that are "shop coated."
- I. Quality Assurance Submittals:
 - 1. Quality assurance plan.
 - 2. Qualifications of coating applicator including List of Similar Projects.
- J. Certifications:
 - 1. Submit notarized certificate that:
 - a. All paints and coatings to be used on this project comply with current federal, state, and local VOC regulations.
 - 2. California certifications:
 - a. All paints and coatings to be used on this project comply with the current VOC regulations of the State of California Air Management District in which the coatings will be used.

1.06 QUALITY ASSURANCE

- A. Applicator qualifications:
 - 1. Minimum of 5 years of experience applying specified type or types of coatings under conditions similar to those of the Work:
 - a. Provide qualifications of applicator and references listing 5 similar projects completed in the past 2 years.
 - 2. Manufacturer-approved applicator when manufacturer has approved applicator program.
- B. Regulatory requirements: Comply with governing agencies regulations by using coatings that do not exceed permissible VOC limits and do not contain lead:
 - 1. Do not use coal-tar epoxy in contact with drinking water or exposed to ultraviolet radiation.
- C. Certification: Certify that applicable pigments are resistant to discoloration or deterioration when exposed to hydrogen sulfide. Other sewage gases and product data designates coating as suitable for wastewater service.
- D. Field samples:
 - 1. Prepare and coat a minimum 100-square-foot area between corners or limits such as control or construction joints of each system.
 - 2. Approved field sample may be part of the Work.
 - 3. Obtain approval before painting other surfaces.
- E. Pre-installation conference:
 - 1. Notify Engineer 7 calendar days in advance of pre-installation meeting date.
 - 2. Require attendance of parties directly affecting, or affected by, Work of specific section.
- F. Compatibility of coatings: Use products by same manufacturer for prime coats, intermediate coats, and finish coats on same surface, unless specified otherwise.
- G. Services of coating manufacturer's representative: Arrange for coating manufacturer's representative to attend pre-installation conferences. Make periodic visits to the project site to provide consultation and inspection services during surface preparation and application of coatings, and to make visits to coating plants to observe and approve surface preparation procedures and coating application of items to be "shop-primed and coated."

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products as specified in Section 01600 and 01605.
- B. Remove unspecified and unapproved paints from Project site immediately.
- C. Deliver new unopened containers with labels identifying the manufacturer's name, brand name, product type, batch number, date of manufacturer, expiration date or shelf life, color, and mixing and reducing instructions.
 - 1. Do not deliver materials aged more than 12 months from manufacturing date.

- D. Store coatings in well-ventilated facility that provides protection from the sun weather, and fire hazards. Maintain ambient storage temperature between 45 and 90 degrees Fahrenheit, unless otherwise recommended by the manufacturer.
- E. Take precautions to prevent fire and spontaneous combustion.

1.08 PROJECT CONDITIONS

- A. Surface moisture contents: Do not coat surfaces that exceed manufacturer-specified moisture contents, or when not specified by the manufacturer, with the following moisture contents:
 - 1. Plaster and gypsum wallboard: 12 percent.
 - 2. Masonry, concrete, and concrete block: 12 percent.
 - 3. Interior located wood: 15 percent.
 - 4. Concrete floors: 7 percent.
- B. Do not apply coatings:
 - 1. Under dusty conditions or adverse environmental conditions, unless tenting, covers, or other such protection is provided for structures to be coated.
 - 2. When light on surfaces measures less than 15 foot-candles.
 - 3. When ambient or surface temperature is less than 55 degrees Fahrenheit unless manufacturer allows a lower temperature.
 - 4. When relative humidity is higher than 85 percent.
 - 5. When surface temperature is less than 5 degrees Fahrenheit above dew point.
 - 6. When surface temperature exceeds the manufacturer's recommendation.
 - 7. When ambient temperature exceeds 90 degrees Fahrenheit, unless manufacturer allows a higher temperature.
 - 8. Apply clear finishes at minimum 65 degrees Fahrenheit.
- C. Provide fans, heating devices, dehumidifiers, or other means recommended by coating manufacturer to prevent formation of condensate or dew on surface of substrate, coating between coats and within curing time following application of last coat.
- D. Provide adequate continuous ventilation and sufficient heating facilities to maintain minimum 55 degrees Fahrenheit for 24 hours before, during, and 48 hours after application of finishes.
- E. Dehumidification and heating for coating of digester interiors, wet wells, and high humidity enclosed spaces:
 - 1. Provide dehumidification and heating of digester interior spaces in which surface preparation, coating application, or curing is in progress according to the following schedule:
 - a. October 1 to April 30: Provide continuous dehumidification and heating as required to maintain the tanks within environmental ranges as specified in this Section and as recommended by the coating material manufacturer. For the purposes of this Section, "continuous" is defined as 24 hours per day and 7 days per week.
 - b. May 1 to September 30: Provide temporary dehumidification and heating as may be required to maintain the tanks within the specified environmental ranges in the event of adverse weather or other temporary condition. At Contractor's option and at his sole expense, Contractor may suspend work until such time as acceptable environmental conditions are

restored, in lieu of temporary dehumidification and heating. Repair or replace any coating or surface preparation damaged by suspension of work, at Contractor's sole expense.

2. Equipment requirements:

- a. Capacity: Provide dehumidification, heating, and air circulation equipment with minimum capacity to perform the following:
 - 1) Maintain the dew point of the air in the tanks at a temperature at least 5 degrees Fahrenheit less than the temperature of the coldest part of the structure where work is underway.
 - 2) Reduce dew point temperature of the air in the tanks by at least 10 degrees Fahrenheit in 20 minutes.
 - 3) Maintain air temperature in the tanks at 60 degrees Fahrenheit minimum.
- b. Systems:
 - 1) Site electrical power: Not available for Contractor's use.
 - 2) Internal combustion engine generators: May be used; Contractor shall obtain all required permits and provide air pollution and noise control devices on equipment as required by permitting agencies.
 - 3) Dehumidification: Provide desiccant or refrigeration drying. Desiccant types shall have a rotary desiccant wheel capable of continuous operation. No liquid, granular, or loose lithium chloride drying systems will be allowed.
 - 4) Heating: Electric, indirect combustion, or steam coil methods may be used. Direct-fired combustion heaters will not be allowed during abrasive blasting, coating application, or coating cure time.

3. Design and submittals:

- a. Contractor shall prepare dehumidification and heating plan for this project, including all equipment and operating procedures.
- b. Suppliers of services and equipment shall have not less than 3 years' experience in similar applications.
 - 1) Supplier: The following or equal:
 - a) Cargocaire Corporation (Munters) or equal.
- c. Submit dehumidification and heating plan for Engineer's review.

4. Monitoring and performance:

- a. Measure and record relative humidity and temperature of air, and structure temperature twice daily (beginning and end of work shifts) to verify that proper humidity and temperature levels are achieved inside the work area after the dehumidification equipment is installed and operational. Test results shall be made available to the Engineer upon request.
- b. Interior space of the working area and tank(s) shall be sealed, and a slight positive pressure maintained as recommended by the supplier of the dehumidification equipment.
- c. The filtration system used to remove dust from the air shall be designed so that it does not interfere with the dehumidification equipment's ability to control the dew point and relative humidity inside the reservoir.
 - 1) The air from the tank, working area, or dust filtration equipment shall not be recirculated through the dehumidifier during coating application or when solvent vapors are present.

1.09 SEQUENCING AND SCHEDULING

- A. Sequence and Schedule: As specified in Section 01030 and 01310.

1.10 MAINTENANCE

- A. Extra materials: Deliver as specified in Section 01730. Include minimum 1 gallon of each type and color of coating applied:
 - 1. When manufacturer packages material in gallon cans, deliver unopened labeled cans as comes from factory.
 - 2. When manufacturer does not package material in gallon cans, deliver material in new gallon containers, properly sealed and identified with typed labels indicating brand, type, and color.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Special coatings: One of the following or equal:
 - 1. Carboline: Carboline, St. Louis, MO.
 - 2. Ceilcote: International Protective Coatings, Berea, OH.
 - 3. Dampney: The Dampney Company, Everett, MA.
 - 4. Devoe: International Protective Coatings, Louisville, KY.
 - 5. Dudick: Dudick, Inc., Streetsboro, OH.
 - 6. GET: Global Eco Technologies, Pittsburg, CA.
 - 7. Henkel: Henkel North America, Madison Heights, MI.
 - 8. IET: Integrated Environmental Technologies, Santa Barbara, CA.
 - 9. PPC: Polymorphic Polymers Corp., North Miami, FL.
 - 10. PPG Amercoat: PPG Protective & Marine Coatings, Brea, CA.
 - 11. Rustoleum: Rustoleum Corp., Sommerset, NJ.
 - 12. Sanchem: Sanchem, Chicago, IL.
 - 13. Superior: Superior Environmental Products, Inc., Addison, TX.
 - 14. S-W: Sherwin-Williams Co., Cleveland, OH.
 - 15. Tnemec: Tnemec Co., Kansas City, MO.
 - 16. Wasser: Wasser High Tech Coatings, Kent, WA.
 - 17. ZRC: ZRC Worldwide Innovative Zinc Technologies, Marshfield, MA.

2.02 PREPARATION AND PRETREATMENT MATERIALS

- A. Metal pretreatment: As manufactured by one of the following or equal:
 - 1. Henkel: Galvaprep 5.
 - 2. International: AWLGrip Alumiprep 33.
- B. Surface cleaner and degreaser: As manufactured by one of the following or equal:
 - 1. Carboline Surface Cleaner No. 3.
 - 2. Devoe: Devprep 88.
 - 3. S-W: Clean and Etch.

2.03 COATING MATERIALS

- A. Alkali-resistant bitumastic: As manufactured by one of the following or equal:
 - 1. Carboline: Bitumastic No. 50.

2. S-W: Targuard.
 3. Wasser: MC-Tar.
- B. Wax coating: As manufactured by the following or equal:
1. Sanchem: No-Ox-Id A special.
- C. High solids epoxy (self-priming) not less than 72 percent solids by volume: As manufactured by one of the following or equal:
1. Carboline: Carboguard 891.
 2. Devoe: Bar Rust 233H.
 3. PPG Amercoat: Amerlock 2.
 4. S-W: Macropoxy 646.
 5. Tnemec: HS Epoxy Series 104.
- D. Aliphatic or aliphatic-acrylic polyurethane: As manufactured by one of the following or equal:
1. Carboline: Carbothane 134 VOC.
 2. Devoe: Devthane 379.
 3. PPG Amercoat: Amershield VOC.
 4. Non-submerged: S-W High Solids Polyurethane CA.
 5. Tnemec: Endura-Shield II Series 1075 (U).
- E. Asphalt varnish: AWWA C 500.
- F. Protective coal tar: as specified for Alkali-resistant bitumastic.
- G. Concrete floor coatings: As manufactured by one of the following or equal:
1. Carboline: Semstone 140SL.
 2. Devoe: Devran 124.
 3. Dudick: Polymer Alloy 1000.
 4. Tnemec: Tneme-Glaze Series 282.
- H. Waterborne acrylic emulsion: As manufactured by one of the following or equal:
1. S-W: DTM Acrylic B66W1.
 2. Tnemec: Tneme-Cryl Series 6.
- I. Galvanizing zinc compound: As manufactured by one of the following or equal:
1. ZRC: Cold Galvanizing Compound.

2.04 MIXES

- A. Mix in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.01 GENERAL PROTECTION

- A. Protect adjacent surfaces from coatings and damage. Repair damage resulting from inadequate or unsuitable protection.

- B. Protect adjacent surfaces not to be coated from spatter and droppings with drop cloths and other coverings:
 - 1. Mask off surfaces of items not to be coated or remove items from area.
- C. Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being coated and, in particular, surfaces within storage and preparation areas.
- D. Place cotton waste, cloths, and material that may constitute a fire hazard in closed metal containers and remove daily from site.
- E. Remove electrical plates, surface hardware, fittings, and fastenings prior to application of coating operations. Carefully store, clean, and replace on completion of coating in each area. Do not use solvent or degreasers to clean hardware that may remove permanent lacquer finish.

3.02 GENERAL PREPARATION

- A. Prepare surfaces in accordance with coating manufacturer's instructions, unless more stringent requirements are specified in this Section.
- B. Protect the following surfaces from abrasive blasting by masking or other means:
 - 1. Threaded portions of valve and gate stems, grease fittings, and identification plates.
 - 2. Machined surfaces for sliding contact.
 - 3. Surfaces to be assembled against gaskets.
 - 4. Surfaces of shafting on which sprockets are to fit.
 - 5. Surfaces of shafting on which bearings are to fit.
 - 6. Machined surfaces of bronze trim, including slide gates.
 - 7. Cadmium-plated items except cadmium-plated, zinc-plated, or sherardized fasteners used in assembly of equipment requiring abrasive blasting.
 - 8. Galvanized items, unless scheduled to be coated.
- C. Protect installed equipment, mechanical drives, and adjacent coated equipment from abrasive blasting to prevent damage caused by entering sand or dust.
- D. Concrete:
 - 1. Allow new concrete to cure for minimum of 28 days before coating.
 - 2. Clean concrete surfaces of dust, mortar, fins, loose concrete particles, form release materials, oil, and grease. Fill voids so that surface is smooth. Prepare concrete surface for coating in accordance with SSPC SP 13. Provide ICRI 310.2 CSP-3 surface profile, or as recommended by coating manufacturer. All concrete surfaces shall be vacuumed clean prior to coating application.
- E. Ferrous metal surfaces:
 - 1. Remove grease and oil in accordance with SSPC SP 1.
 - 2. Remove rust, scale, and welding slag and spatter, and prepare surfaces in accordance with appropriate SSPC standard as specified.
 - 3. Abrasive blast surfaces prior to coating.
 - a. When abrasive blasted surfaces rust or discolor before coating, abrasive blast surfaces again to remove rust and discoloration.
 - b. When metal surfaces are exposed because of coating damage, abrasive blast surfaces and feather in to a smooth transition before touching up.

- c. Ferrous metal surfaces not to be submerged: Abrasive blast in accordance with SSPC SP 10, unless blasting may damage adjacent surfaces, prohibited, or specified otherwise. Where not possible to abrasive blast, power tool clean surfaces in accordance with SSPC SP 3.
 - d. Ferrous metal surfaces to be submerged: Unless specified otherwise, abrasive blast in accordance with SSPC SP 5 to clean and provide roughened surface profile of not less than 2 mils and not more than 4 mils in depth when measured with Elcometer 123, or as recommended by the coating manufacturer.
- 4. All abrasive blast cleaned surfaces shall be blown down with clean dry air and/or vacuumed.
- F. Ductile iron pipe and fittings to be lined or coated: Abrasive blast clean in accordance with NAPF 500-03.
- G. Sherardized, aluminum, copper, and bronze surfaces: Prepare in accordance with coating manufacturer's instructions.
- H. Galvanized surface:
 - 1. Degrease or solvent clean (SSPC SP 1) to remove oily residue.
 - 2. Power tool or hand tool clean or whip abrasive blast.
 - 3. Test surface for contaminants using copper sulfate solution.
 - 4. Apply metal pretreatment within 24 hours before coating galvanized surfaces that cannot be thoroughly abraded physically, such as bolts, nuts, or preformed channels.
- I. Shop-primed metal:
 - 1. Certify that primers applied to metal surfaces in the shop are compatible with coatings to be applied over such primers in the field.
 - 2. Remove shop primer from metal to be submerged by abrasive blasting in accordance with SSPC SP 10, unless greater degree of surface preparation is required by coating manufacturer's representative.
 - 3. Correct abraded, scratched, or otherwise damaged areas of prime coat by sanding or abrasive blasting to bare metal in accordance with SSPC SP 2, SP 3, or SP 6, as directed by the Engineer. When entire shop priming fails or has weathered excessively (more than 25 percent of the item), or when recommended by coating manufacturer's representative, abrasive blast shop prime coat to remove entire coat and prepare surface in accordance with SSPC SP 10.
 - 4. When incorrect prime coat is applied, remove incorrect prime coat by abrasive blasting in accordance with SSPC SP 10.
 - 5. When prime coat not authorized by Engineer is applied, remove unauthorized prime coat by abrasive blasting in accordance with SSPC SP 10.
 - 6. Shop applied bituminous paint or asphalt varnish: Abrasive blast clean shop applied bituminous paint or asphalt varnish from surfaces scheduled to receive non-bituminous coatings.
- J. Cadmium-plated, zinc-plated, or sherardized fasteners:
 - 1. Abrasive blast in the same manner as unprotected metal when used in assembly of equipment designated for abrasive blasting.

- K. Abrasive blast components that are to be attached to surfaces that cannot be abrasive blasted before components are attached.
- L. Grind sharp edges to approximately 1/16-inch radius before abrasive blast cleaning.
- M. Remove and grind smooth all excessive weld material and weld spatter before blast cleaning in accordance with NACE SP0178.
- N. Poly vinyl chloride (PVC) and FRP surfaces:
 - 1. Prepare surfaces to be coated by light sanding (de-gloss) and wipe-down with clean cloths, or by solvent cleaning in strict accordance with coating manufacturer's instructions.
- O. Cleaning of previously coated surfaces:
 - 1. Utilize cleaning agent to remove soluble salts such as chlorides and sulfates from concrete and metal surfaces:
 - a. Cleaning agent: Biodegradable non-flammable and containing no VOC.
 - b. Manufacturer: The following or equal:
 - 1) CHLOR*RID International, Inc.
 - 2. Steam clean and degrease surfaces to be coated to remove oils and grease.
 - 3. Cleaning of surfaces utilizing the decontamination cleaning agent may be accomplished in conjunction with abrasive blast cleaning, steam cleaning, high-pressure washing, or hand washing as approved by the coating manufacturer's representative and the Engineer.
 - 4. Test cleaned surfaces in accordance with the cleaning agent manufacturer's instructions to ensure all soluble salts have been removed. Additional cleaning shall be carried out as necessary.
 - 5. Final surface preparation prior to application of new coating system shall be made in strict accordance with coating manufacturer's printed instructions.

3.03 MECHANICAL AND ELECTRICAL EQUIPMENT PREPARATION

- A. Identify equipment, ducting, piping, and conduit as specified in Section 15075 and Section 16075.
- B. Remove grilles, covers, and access panels for mechanical and electrical system from location and coat separately.
- C. Prepare and finish coat primed equipment with color selected by the Engineer.
- D. Prepare and prime and coat insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars, and supports, except where items are covered with prefinished coating.
- E. Replace identification markings on mechanical or electrical equipment when coated over or spattered.
- F. Prepare and coat interior surfaces of air ducts, and convactor and baseboard heating cabinets that are visible through grilles and louvers with 1 coat of flat black paint, to limit of sight line.
- G. Prepare and coat dampers exposed immediately behind louvers, grilles, and convactor and baseboard heating cabinets to match face panels.

- H. Prepare and coat exposed conduit and electrical equipment occurring in finished areas with color and texture to match adjacent surfaces.
- I. Prepare and coat both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.
- J. Color code equipment, piping, conduit, and exposed ductwork and apply color banding and identification, such as flow arrows, naming, and numbering, in accordance with the Contract Documents.

3.04 GENERAL APPLICATION REQUIREMENTS

- A. Apply coatings in accordance with manufacturer's instructions.
- B. Coat metal unless specified otherwise:
 - 1. Aboveground piping to be coated shall be empty of contents during application of coatings.
- C. Verify metal surface preparation immediately before applying coating in accordance with SSPC SP COM.
- D. Allow surfaces to dry, except where coating manufacturer requires surface wetting before coating.
- E. Wash coat and prime sherardized, aluminum, copper, and bronze surfaces, or prime with manufacturer's recommended special primer.
- F. Prime shop-primed metal surfaces. Spot prime exposed metal of shop-primed surfaces before applying primer over entire surface.
- G. Multiple coats:
 - 1. Apply minimum number of specified coats.
 - 2. Apply additional coats when necessary to achieve specified thicknesses.
 - 3. Apply coats to thicknesses specified, especially at edges and corners.
 - 4. When multiple coats of same material are specified, tint prime coat and intermediate coats with suitable pigment to distinguish each coat.
 - 5. Lightly sand and dust surfaces to receive high-gloss finishes, unless instructed otherwise by coating manufacturer.
 - 6. Dust coatings between coats.
- H. Coat surfaces without drops, overspray, dry spray, runs, ridges, waves, holidays, laps, or brush marks.
- I. Remove spatter and droppings after completion of coating.
- J. Apply coating by brush, roller, trowel, or spray, unless particular method of application is required by coating manufacturer's instructions or these Specifications.
- K. Plural component application: Drums shall be premixed each day. All gauges shall be in working order prior to the start of application. Ratio checks shall be completed prior to each application. A spray sample shall be sprayed on plastic sheeting to

ensure set time is complete prior to each application. Hardness testing shall be performed after each application.

L. Spray application:

1. Stripe coat edges, welds, nuts, bolts, and difficult-to-reach areas by brush before beginning spray application, as necessary, to ensure specified coating thickness along edges.
2. When using spray application, apply coating to thickness not greater than that recommended in coating manufacturer's instructions for spray application.
3. Use airless spray method, unless air spray method is required by coating manufacturer's instruction or these Specifications.
4. Conduct spray coating under controlled conditions. Protect adjacent construction and property from coating mist, fumes, or overspray.

M. Drying and recoating:

1. Provide fans, heating devices, or other means recommended by coating manufacturer to prevent formation of condensate or dew on surface of substrate, coating between coats and within curing time following application of last coat.
2. For submerged service, the Contractor shall provide a letter to the Engineer that the lining system is fully cured and ready to be placed into service.
3. Limit drying time to that required by these Specifications or coating manufacturer's instructions.
4. Do not allow excessive drying time or exposure, which may impair bond between coats.
5. Recoat epoxies within time limits recommended by coating manufacturer.
6. When time limits are exceeded, abrasive blast clean and de-gloss clean prior to applying another coat.
7. When limitation on time between abrasive blasting and coating cannot be met before attachment of components to surfaces that cannot be abrasive blasted, coat components before attachment.
8. Ensure primer and intermediate coats of coating are unscarred and completely integral at time of application of each succeeding coat.
9. Touch-up suction spots between coats and apply additional coats where required to produce finished surface of solid, even color, free of defects.
10. Leave no holidays.
11. Sand and feather in to a smooth transition and recoat scratched, contaminated, or otherwise damaged coating surfaces so damages are invisible to the naked eye.

N. Concrete:

1. Apply first coat (primer) only when surface temperature of concrete is decreasing in order to eliminate effects of off-gassing on coating.

3.05 ALKALI-RESISTANT BITUMASTIC

A. Preparation:

1. Prepare surfaces in accordance with general preparation requirements.

B. Application:

1. Apply in accordance with general application requirements and as follows:
 - a. Apply at least 2 coats, 8 to 14 mils DFT each.

3.06 WAX COATING

- A. Preparation:
 - 1. Prepare surfaces in accordance with general preparation requirements.
- B. Application:
 - 1. Apply in accordance with general application requirements and as follows:
 - a. Apply at least 1/32-inch thick coat with 2-inch or shorter bristle brush.
 - b. Thoroughly rub coating into metal surface with canvas covered wood block or canvas glove.

3.07 HIGH SOLIDS EPOXY SYSTEM

- A. Preparation:
 - 1. Prepare surfaces in accordance with general preparation requirements and as follows:
 - a. Abrasive blast ferrous metal surfaces to be submerged at jobsite in accordance with SSPC SP 5 prior to coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP 10.
 - b. Abrasive blast non-submerged ferrous metal surfaces at jobsite in accordance with SSPC SP 10, prior to coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP 6.
 - c. Abrasive blast clean ductile iron surfaces at jobsite in accordance with SSPC SP 7.
- B. Application:
 - 1. Apply coatings in accordance with general application requirements and as follows:
 - a. Apply minimum 2-coat system with minimum total DFT of 12 mils.
 - b. Recoat or apply succeeding epoxy coats within time limits recommended by manufacturer. Prepare surfaces for recoating in accordance with manufacturer's instructions.
 - c. Coat metal to be submerged before installation when necessary, to obtain acceptable finish, and to prevent damage to other surfaces.
 - d. Coat entire surface of support brackets, stem guides, pipe clips, fasteners, and other metal devices bolted to concrete.
 - e. Coat surface of items to be exposed and adjacent 1 inch to be concealed when embedded in concrete or masonry.

3.08 HIGH SOLIDS EPOXY AND POLYURETHANE COATING SYSTEM

- A. Preparation:
 - 1. Prepare surfaces in accordance with general preparation requirements and as follows:
 - a. Prepare concrete surfaces in accordance with general preparation requirements.
 - b. Touch up shop-primed steel and miscellaneous iron.
 - c. Abrasive blast ferrous metal surfaces at jobsite prior to coating. Abrasive blast clean rust and discoloration from surfaces.
 - d. Degrease or solvent clean, whip abrasive blast, power tool, or hand tool clean galvanized metal surfaces.

- e. Lightly sand (de-gloss) fiberglass and PVC pipe to be coated and wipe clean with dry cloths, or solvent clean in accordance with coating manufacturer's instructions.
 - f. Abrasive blast clean ductile iron surfaces.
- B. Application:
 - 1. Apply coatings in accordance with general application requirements and as follows:
 - a. Apply a 3-coat system consisting of:
 - 1) Primer: 4 to 5 mils DFT high solids epoxy.
 - 2) Intermediate coat: 4 to 5 mils DFT high solids epoxy.
 - 3) Topcoat: 2.5 to 3.5 mils DFT aliphatic or aliphatic-acrylic polyurethane topcoat.
 - 2. Recoat or apply succeeding epoxy coats within 30 days or within time limits recommended by manufacturer, whichever is shorter. Prepare surfaces for recoating in accordance with manufacturer's instructions.

3.09 ASPHALT VARNISH

- A. Preparation:
 - 1. Prepare surfaces in accordance with general preparation requirements.
- B. Application:
 - 1. Apply coatings in accordance with general application requirements and as follows:
 - a. Apply minimum 2 coats.

3.10 CONCRETE FLOOR COATINGS

- A. Preparation:
 - 1. Prepare surfaces in accordance with general application requirements and in strict accordance with coating manufacturer's instructions.
- B. Application:
 - 1. Apply primer if required by coating manufacturer.
 - 2. Apply 1 or more coats as recommended by coating manufacturer to receive a minimum total DFT of 25 mils; color as selected by the Owner.
- C. Final topcoat shall include non-skid surface, applied in strict accordance with coating manufacturer's instructions.

3.11 WATERBORNE ACRYLIC EMULSION

- a. Preparation:
 - 2. Remove all oil, grease, dirt, and other foreign material by solvent cleaning in accordance with SSPC SP 1.
 - 3. Lightly sand all surfaces and wipe thoroughly with clean cotton cloths before applying coating.
- B. Application:
 - 1. Apply 2 or more coats to obtain a minimum DFT of 5.0 mils.

3.12 FIELD QUALITY CONTROL

- A. Each coat will be inspected. Strip and remove defective coats, prepare surfaces, and recoat. When approved, apply next coat.
- B. Control and check DFT and integrity of coatings.
- C. Measure DFT with calibrated thickness gauge.
- D. DFT on ferrous-based substrates may be checked with Elcometer Type 1 Magnetic Pull-Off Gauge or PosiTector® 6000.
- E. Verify coat integrity with low-voltage sponge or high-voltage spark holiday detector, for submerged service, in accordance with NACE SP0188. Allow Engineer to use detector for additional checking.
- F. Arrange for services of coating manufacturer's field representative to provide periodic field consultation and inspection services to ensure proper surface preparation of facilities and items to be coated, and to ensure proper application and curing:
 - 1. Notify Engineer 24 hours in advance of each visit by coating manufacturer's representative.
 - 2. Provide Engineer with a written report by coating manufacturer's representative within 48 hours following each visit.

3.13 SCHEDULE OF ITEMS NOT REQUIRING COATING

- A. General: Unless specified otherwise, the following items do not require coating:
 - 1. Items that have received final coat at factory and are not listed to receive coating in field.
 - 2. Aluminum, brass, bronze, copper, plastic (except PVC pipe), rubber, stainless steel, chrome, Everdur, or lead.
 - 3. Buried or encased piping or conduit.
 - 4. Exterior concrete.
 - 5. Galvanized steel wall framing, galvanized electrical conduits, galvanized pipe trays, galvanized cable trays, and other galvanized items:
 - a. Areas on galvanized items or parts where galvanizing has been damaged during handling or construction shall be repaired as follows:
 - 1) Clean damaged areas by SSPC SP 1, SP 2, SP 3, or SP 7 as required.
 - 2) Apply 2 coats of a galvanizing zinc compound in strict accordance with manufacturer's instructions.
 - 6. Grease fittings.
 - 7. Fiberglass ducting or tanks in concealed locations.
 - 8. Steel to be encased in concrete or masonry.

3.14 SCHEDULE OF SURFACES TO BE COATED IN THE FIELD

- A. In general, apply coatings to steel, iron, galvanized surfaces, and wood surfaces unless specified or otherwise indicated on the Drawings. Coat concrete surfaces and anodized aluminum only when specified or indicated on the Drawings. Color coat all piping as specified in Section 15075.

- B. The following schedule is incomplete. Coat unlisted surfaces with same coating system as similar listed surfaces. Verify questionable surfaces.
- C. Concrete:
 - 1. High solids epoxy:
 - a. Safety markings.
 - 2. Alkali-resistant bitumastic:
 - a. Exterior of manholes.
 - 3. Concrete floor coating:
 - a. Existing Control Room Floor.
- D. Metals:
 - 1. Alkali-resistant bitumastic:
 - a. Aluminum surfaces to be placed in contact with wood, concrete, or masonry.
 - b. Underground pipe flanges, excluding pipe, corrugated metal pipe couplings, flexible pipe couplings and miscellaneous underground metals not otherwise specified to receive another protective coating.
 - 2. Wax coating:
 - a. Sliding faces of sluice and slide gates and threaded portions of gate stems.
 - 3. High solids epoxy and polyurethane system: Interior and exterior non immersed ferrous metal surfaces including:
 - a. Doors, doorframes, ventilators, louvers, grilles, exposed sheet metal, and flashing.
 - b. Pipe, valves, pipe hangers, supports and saddles, conduit, cable tray hangers, and supports.
 - c. Motors and motor accessory equipment.
 - d. Drive gear, drive housing, coupling housings, and miscellaneous gear drive equipment.
 - e. Valve and gate operators and stands.
 - f. Structural steel including galvanized structural steel.
 - 1) Exposed metal decking.
 - g. Crane and hoist rails.
 - h. Exterior of tanks and other containment vessels.
 - i. Mechanical equipment supports, drive units, and accessories.
 - j. Pumps not submerged.
 - k. Other miscellaneous metals.
 - 4. High solids epoxy system:
 - a. Field priming of ferrous metal surfaces with defective shop-prime coat where no other prime coat is specified; for non-submerged service.
 - b. Bell rings, underside of manhole covers and frames.
 - c. Sump pumps and grit pumps, including underside of base plates and submerged suction and discharge piping.
 - d. Exterior of submerged piping and valves other than stainless steel or PVC piping.
 - e. Submerged pipe supports and hangers.
 - f. Stem guides.
 - g. Vertical shaft mixers and aerators below supports.
 - h. Other submerged iron and steel metal unless specified otherwise.
 - i. Interior surface of suction inlet and volute of submersible influent pumps. Apply coating prior to pump testing.

- j. Submerged piping.
 - k. Exterior of influent pumps and influent pump submerged discharge piping.
- 5. Asphalt varnish:
 - a. Underground valve boxes.
- E. Fiberglass and PVC pipe surfaces:
 - 1. Waterborne acrylic emulsion.
 - a. Exterior of fiberglass ducting and fan housings.
 - b. Fiberglass expose to sunlight.
 - c. PVC piping exposed to view.
 - d. ABS piping as determined by Engineer.

END OF SECTION

SECTION 11292A

FLAP GATES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Stainless steel, round flap gates.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 01756 - Commissioning and Process Start-Up.
 - b. Section 09960 - High-Performance Coatings.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. A 48 - Standard Specification for Gray Iron Castings.
 - 2. A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 3. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
 - 4. B 139 - Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.
 - 5. B 584 - Standard Specification for Copper Alloy Sand Castings for General Application.
 - 6. D 2000 - Standard Classification System for Rubber Products in Automatic Applications.

1.03 DESIGN REQUIREMENTS

- A. Flap gates shall open when there is a differential pressure across the flap of 0.2 feet or less.
- B. Allowable leakage through the flap gate, due to seating load, shall not exceed 0.2 gallons per day per foot of wetted perimeter.

1.04 SUBMITTALS

- A. Product data.
- B. Shop drawings.
- C. Manufacturer's installation instructions.

- D. Design data and calculations substantiating conformance with the drawings and Specifications.
- E. Manufacturer shall certify in writing that installed flap gates meet specified leakage requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. One of the following or equal:
 - 1. Fontaine - Series 60.
 - 2. Penn-Troy Standard Flap Valve.

2.02 MATERIALS

- A. Stainless steel: ASTM A 240 or ASTM 276, Type 316, or 316L.
- B. Neoprene: ASTM D 2000, Grade 2, BC-510.
- C. Ultra-high molecular weight polyethylene (UHMWPE): ASTM D 4020.

2.03 GATE COMPONENTS

- A. Body frame and cover: stainless steel.
 - 1. Frame:
 - a. Size(s) as indicated on the Drawings.
 - b. Flange mount.
 - 2. Cover:
 - a. Cast in one piece or welded and shall be of a dished or reinforced design to maximize strength, rigidity, and minimize weight.
 - b. Provide a lifting eye at the top of the cover for manual operation.
- B. Seats: Neoprene
- C. Hinge arms: Stainless steel type 316 stainless steel.
- D. Hinge pins: Type 316 stainless steel pin with UHMWPE bushing.
- E. Bolts, nuts, and fittings: stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

A. Testing:

1. Leakage tests: Demonstrate compliance with allowable leakage limits set forth herein.
2. After the gate installation and checking, exercise each gate from the closed position to fully open position and back to the closed position at least twice and verify gate is properly seated.
3. Provide certificate of proper installation. As specified in Section 01756.

END OF SECTION

SECTION 11312G

SUBMERSIBLE CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for provision of pump systems including submersible non-clog motor-driven pumps for service as scheduled.
- B. Related sections:
 - 1. Section 01030 - Special Project Constraints.
 - 2. Section 01605 - Product Requirements.
 - 3. Section 01610 - Project Design Criteria.
 - 4. Section 01730 - Operation and Maintenance Data.
 - 5. Section 01756 - Commissioning.
 - 6. Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
 - 7. Section 09960 - High-Performance Coatings.
 - 8. Section 15050 - Common Work Results for Mechanical Equipment.
 - 9. Section 15958 - Mechanical Equipment Testing.
 - 10. Section 16222 - Motors.

1.02 REFERENCES

- A. American Bearing Manufacturers' Association (ABMA):
 - 1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. ASTM International (ASTM):
 - 1. A48 - Standard Specification for Gray Iron Castings.
 - 2. A108 - Standard Specification for Steel Bars, Carbon and Alloy, Cold-Finished.
 - 3. A276 - Standard Specification for Stainless Steel Bars and Shapes.
 - 4. A582 - Standard Specification for Free-Machining Stainless Steel Bars.
 - 5. B148 - Standard Specification for Aluminum-Bronze Sand Castings.
 - 6. B505 - Standard Specification for Copper Alloy Continuous Castings.
 - 7. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
 - 8. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - 9. F594 - Standard Specification for Stainless Steel Nuts. CSA International (CSA).
- C. Food and Drug Administration (FDA).
- D. FM Global (FM).
- E. Hydraulic Institute (HI):
 - 1. 1-1.2 - Centrifugal Pumps for Nomenclature and Definitions.
 - 2. 1.3 – Rotodynamic (Centrifugal) Pumps for Design and Application.
 - 3. 9.1-9.5 – Pumps - General Pump Standards for Types, Definitions, Application, and Sound Measurements and Decontamination.

4. 14.6 - Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

- F. Insulated Cable Engineer's Association (ICEA).
- G. National Electrical Code (NEC).
- H. National Electrical Manufacturers Association (NEMA).
- I. Underwriters Laboratories, Inc. (UL).

1.03 DEFINITIONS

- A. Pump head (total dynamic head, TDH), flow capacity, pump efficiency, net positive suction head available (NPSHa), and net positive suction head required (NPSHr): As defined in HI 1.1-1.2, 1.3, 9.1-9.5 and 14.06 and as modified in the Specifications.
- B. Suction head: Gauge pressure available at pump intake flange or bell in feet of fluid above atmospheric; average when using multiple suction pressure taps, regardless of variation in individual taps.

1.04 SYSTEM DESCRIPTION

- A. Submersible pumps and components: Submersible pump, motor driver, electrical cable, lifting eyes, lifting cable or chain and guide rails, guide rail supports, self-aligning discharge connection, and other items specified in the Pump Schedule as required for complete operational units.
- B. Design requirements:
 - 1. Pump performance characteristics:
 - a. As specified in the Pump Schedule.
 - b. Performance tolerances shall be the same as the test tolerances specified in Section 15958.
 - 2. Motor characteristics: As specified in the Pump Schedule.

1.05 SUBMITTALS

- A. Submit as specified in Sections 15050.
- B. Torsional analysis: Submit when scheduled and as specified in Section 15050.
- C. Furnish motor submittals as specified.
- D. Manufacturer's Representatives qualifications as specified in Section 01756.
- E. Provide vendor operation and maintenance manual as specified in Section 01730

1.06 QUALITY ASSURANCE

- A. As specified in Section 15050.
- B. Provide pumps in this Section from same manufacturer.

- C. Manufacture's Certificate of Installation and Functionality Compliance as specified in Section 01756

1.07 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 15050.

1.08 PROJECT CONDITIONS

- A. Environmental requirements: As specified in Section 01610.

1.09 SEQUENCING AND SCHEDULING

- A. Coordinate with restrictions as specified in Section 01030.
- B. Coordinate work with Commissioning as specified in Section 01756.

1.10 WARRANTY

- A. As specified in Section 01783.

1.11 MAINTENANCE

- A. Special tools: Deliver 1 set for every furnished pump type and size needed to assemble and disassemble pump system. Spare parts: Provide 1 of the following for each size or type of pump; deliver as specified in Section 01605.
- B. Spare parts: Deliver the following as specified in Section 01605:
 - 1. Upper bearing set.
 - 2. Lower bearing set.
 - 3. Upper and lower mechanical seal set.
 - 4. Wear ring set (rotating and stationary).
 - 5. Casing seal gaskets or O-rings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Pump:
 - 1. Flygt Xylem, NP3153 series.
 - 2. No Equal.

2.02 MATERIALS

- A. General: When materials are referenced in this Section or on the pump schedule, the compositions shall be the UNS Alloys, Types, or Grades unless specified or scheduled otherwise.
- B. Cast iron: ASTM A48, Class 35 B minimum.
- C. Hard Iron: ASTM A532-Alloy III A, 25% Chrome.

- D. Nickel cast iron: ASTM A48, Class 35 minimum with 3 percent nickel added.
- E. Steel: ASTM A108, Grade or UNS Alloy as specified or scheduled.
- F. Stainless steel: ASTM A276 or ASTM A582, Type or UNS Alloy as specified or scheduled.
- G. Bronze: ASTM B505 or ASTM B584, UNS Alloy C83600.
- H. Zincless bronze: ASTM B505 or ASTM B584, Leaded Tin Bronze, UNS Alloy C92700.
- I. Aluminum bronze: ASTM B148, ASTM B505 or ASTM B584, UNS Alloy C95200.
- J. Fasteners: Stainless steel, ASTM F593 or ASTM F594, type or grade as specified.

2.03 PUMP CASINGS

- A. Type: 2 piece; pump and motor casing bolted together; machined seal faces with Nitrile or Buna N rubber O-ring seal; Type 304 stainless steel bolting.
- B. Material: As scheduled.
- C. Construction: Of sufficient strength, weight, and thickness to provide accurate alignment and watertightness.
- D. Design working pressure: Minimum 1.10 times maximum shutoff total dynamic head with maximum installable impeller diameter at maximum operating speed plus maximum suction static head; suitable for submergence in up to 65 feet of water.
- E. Hydrostatic test: 5-minute hydrostatic test minimum 1.5 times Design Working Pressure.
- F. Discharge interface:
 - 1. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal-to-metal watertight contact.
 - 2. Self-aligning without bolting or having to enter the wet well.
 - 3. The use of o-rings, diaphragms, or rubber products is not acceptable.

2.04 IMPELLERS

- A. The impeller shall be of ASTM A-48, Class 35B grey iron, dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The leading edges of the impeller shall be hardened to Rc 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.
- B. Type: As scheduled.
- C. Material: Hard Iron, ASTM A532, Alloy III A, 25% Chrome.

- D. Maximum number of vanes: As scheduled.
- E. Water passages: Smooth, able to prevent clogging by stringy or fibrous and to pass spherical solids of size scheduled.
- F. Method of securing to shafts: Keyed and secured by bronze nut or allen head bolt locked in place, but readily removable without use of special tools.
- G. Rotation: Clockwise looking from driver, unless otherwise indicated on the Drawings.
- H. Balance: As specified in Section 15050 to meet the vibration criteria as specified in Section 15958.

2.05 VOLUTE/SUCTION COVER

- A. The pump volute shall be a single piece grey cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be of ASTM A-48, Class 35B grey iron and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

2.06 WEAR RINGS AND WEAR PLATES

- A. Provide one of the following systems:
 - 1. Wear ring system:
 - a. General: Used to provide efficient sealing between the volute and suction inlet of the impeller.
 - 2. Wear plate system:
 - a. Material: Hard iron, ASTM A532, Alloy III A, 25% Chrome.
 - b. Attached to the pump volute to prevent rotation.
 - c. Replaceable and adjustable to maintain proper clearances between the wear plate and the impeller.

2.07 PUMP SHAFTS

- A. Material: 420 stainless steel, turned, ground, and polished.
- B. Strength: Able to withstand minimum 1.5 times maximum operating torque and other loads.
- C. Resonant frequency: As specified in Sections 15050 and 15958.
- D. Deflection: Maximum 0.002 inches under operating conditions.

2.08 MECHANICAL SEALS

- A. Provide dual tandem mechanical seal system with oil for seal lubrication and cooling:
 - 1. Shaft sealing system shall be capable of withstanding volute pressure up to 1.5 times pump shutoff head.
 - 2. No seal damages shall result from operating the pumping unit in its liquid environment, from running pump dry, or from reverse pump operation.

- B. Oil chamber:
 - 1. Provide oil chamber for shaft sealing system. Design oil chamber to assure that air is left in the oil chamber to absorb the expansion of the oil due to temperature variations.
 - 2. Provide drain and inspection plug, with positive anti-leak seal, easily accessible from the outside.
- C. Upper seal:
 - 1. Tungsten carbide rotating seal and tungsten carbide stationary seal as specified in Section 15050.
 - 2. Submerged in oil chamber located below the stator housing.
- D. Lower seal:
 - 1. Tungsten Carbide rotating and stationary seals as specified in Section 15050.
- E. Springs and other hardware: Stainless steel, 300 or 400 series.

2.09 BEARINGS

- A. Pump shaft shall rotate on a minimum of 2 permanently sealed, grease lubricated bearings:
 - 1. Upper bearing for radial forces.
 - 2. Lower bearing for combined axial and radial forces.
- B. Bearing type: Anti-friction in accordance with ABMA standards.
- C. Bearing lubrication system shall be sized sufficiently to safely absorb heat energy normally generated in bearing under maximum ambient temperature of 60 degrees Celsius when pump scheduled for dry running. Bearing life: Minimum L10 life of 50,000 hours at rated design point or 24,000 hours in accordance with ABMA 9 or 11 at bearing design load imposed by pump shutoff with maximum sized impeller at rated speed, whichever provides longest bearing life in intended service.

2.10 MOTORS AND POWER CABLES

- A. Motors: Features as specified and as scheduled:
 - 1. Provide motors that are rated suitable for continuous operation in 40 degrees Celsius ambient temperature at project site altitude.
 - 2. Horsepower:
 - a. As scheduled in the Pump Schedule.
 - 1) Listed motor horsepower is the minimum to be supplied. Increase motor horsepower if required to prevent motor overload while operating at any point on the supplied pump operating head-flow curve, including runout. However, variable frequency drives, generator, and other electrical equipment are sized for scheduled motor horsepower.
 - 2) Make all structural, mechanical, and electrical changes required to accommodate increased horsepower.
 - 3. Revolutions per minute: As scheduled in the Pump Schedule.
 - 4. Enclosure: As scheduled in the Pump Schedule.
 - 5. Electrical characteristics: As scheduled in the Pump Schedule.
- B. Motor Construction:
 - 1. Squirrel cage induction motor, shell design.
 - 2. If explosion proof motor is scheduled, provide motor that is UL or FM listed for NEC Class I, Division 1, Groups C and D service, whether submerged or unsubmerged.

3. NEMA design type: B.
 4. Motor insulation:
 - a. Class H, moisture resistant, rated for 185 degrees Celsius.
 5. The motor shall be designed for continuous duty handling pumped media of 40 degrees Celsius and capable of a minimum of 15 evenly spaced starts per hour.
 6. The motor shall be capable of continuous operation under load with the motor submerged, partially submerged, or exposed, without derating the motor
 7. Motor cooling system:
 - a. Design to provide adequate cooling:
 - 1) With motor submerged.
 - 2) With motor dry.
 - 3) Each unit shall be provided with an integral motor cooling system. A stainless steel motor cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F (40°C.). Operational restrictions at temperatures below 104°F are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted external to the pump motor are not acceptable.
 - 4) With non-clogging ports and channels.
 - b. Provide capability to relieve entrapped air from the system.
 - c. Spray systems, air moving equipment or other secondary cooling systems are not acceptable.
 8. Motor sealing: Design motor case and seals to withstand 65 feet of submergence.
- C. Power cables:
1. Submersible to same water depth as motor casing.
 2. Type SPC with Hypalon/Buna N jacket.
 3. Insulation rated for 90 degrees Celsius.
 4. Non-wicking fillers.
 5. Length: Sufficient to connect to surface junction box (without the need of splices) as indicated on the Drawings or 30 feet, whichever is greater.
 6. Sized to conform to NEC, ICEA, and CSA specifications.
 7. Provide stainless steel cable and stainless steel wire braid sleeve to support power cable from underside of wet well roof slab or access frame.
- D. Cable entry seal and junction chamber:
1. Cable entry seal design shall not require specific torque requirements to insure a watertight and submersible seal.
 2. Cable entry seal shall consist of dual cylindrical elastomer grommets, flanked by stainless steel washers.
 3. The cable entry seal shall provide strain relief for the cable.
 4. The cable entry junction chamber shall be separate from the motor chamber to prevent foreign material from gaining access to the top of the pump.
 5. Provide a moisture detection sensor in the cable junction chamber. If leakage is detected, the sensor shall activate an alarm and shut down the pump/motor.

- E. Control/protection module:
 - 1. Each pump shall be supplied with its own self-contained control/protection module to provide for the direct connection to all internal pump monitoring devices, including:
 - a. Thermal protection: Provide automatic reset motor stator temperature detectors, 1 switch in each phase winding. If any detector is activated, the sensor shall activate an alarm and shut down the motor. The thermal detectors shall activate when the stator temperature exceeds 125 degrees Celsius.
 - b. Moisture detection: One of the following:
 - 1) Provide capacitive type leakage sensor for the detection of water in the oil chamber or a moisture sensor in the lower motor chamber to detect any fluid in the motor. The sensor shall have an explosion proof rating.
 - 2) Provide a small float to detect the presence of water in the stator chamber.
- F. The module shall signal an alarm condition if any of the internal monitoring devices is activated.

2.11 SUPPORT BASE AND DISCHARGE ELBOW

- A. Provide cast iron support base and discharge elbow for installation in wet pit.
- B. Discharge elbow to mate to pump discharge and transition to discharge piping.
- C. The entire weight of the pump/motor shall be borne by the pump discharge elbow.

2.12 GUIDE RAILS AND LIFTING DEVICES

- A. General: Provide guide rails and lifting devices suitable for wet pit installation as scheduled in Execution and as indicated on the Drawings.
- B. Materials:
 - 1. Guide rails, lifting cable or chain and wall supports: Type 316 stainless steel.
 - 2. Anchor bolts: As specified in Section 05190.
- C. Wet pit guide rails.
- D. Lifting device.

2.13 FINISHES

- A. Pump manufacturer to factory prime and coat pump/motor and discharge elbow as specified in Section 09960.
- B. Contractor to provide touch-up field coatings as specified in Section 09960.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be as indicated on the Drawings, in accordance with written instructions of the manufacturer, and as specified in Section 15050.

3.02 COMMISSIONING

A. As specified in Section 01756 and this Section.

B. Manufacturer services:

		Manufacturer Rep Onsite					
Training Requirements		Installation Testing		Functional Testing		Process Operational Period	
Maintenance (hrs per session)	Operation (hrs per session)	Trips	Days (each trip)	Trips	Days (each trip)	Trips	Days (each trip)
4	2	1	1	1	1	24 hour on-call	

C. Source Testing:

1. Pump:

- Test witnessing: As scheduled and as specified in Section 01756.
- Performance test: Test level as scheduled; test as specified in Section 15958.
- Vibration test: Test level as scheduled; test as specified in Section 15958.
- Noise test: Test level as scheduled; test as specified in Section 15958.

2. Pump casing: Hydrostatic pressure tests if specified in this Section.

3. Motor: Test as specified in Section 16950.

D. Functional Testing:

1. Pump assembly:

- Performance test: Test level as scheduled; test as specified in Section 15958.
- Vibration test: Not required for wet pit pump.
- Noise test: Not required for wet pit pump.

2. Motor: Test as specified in Section 16950.

3.03 PUMP SCHEDULE

Tag Numbers	PMP-001 PMP-002
<u>General Characteristics</u>	
Service	Raw Sewage
Quantity	2
Max. Noise, dBA at 3 Feet	Not Required
Torsional Analysis	Not Required
Minimum Pumped Fluid Degrees Fahrenheit	60
Normal Pumped Fluid Degrees Fahrenheit	70
Max. Pumped Fluid Degrees Fahrenheit	80
Installation Configuration	Wet Pit
<u>Pump Characteristics</u>	
Impeller Type	Semi-Open
Impeller, Maximum Number Vanes	2

Tag Numbers	PMP-001 PMP-002
Pass Minimum Sphere Size, Inch	2.5
Speed Control	Constant
Pump Speed, rpm	1755
<u>Rated Design Point: (at Maximum rpm)</u>	
Flow, gpm	700
Head, Feet	53
Minimum Overall Efficiency, Percent	60.5
Maximum Active Input Horsepower	16
<u>Required Condition 2: (at Maximum rpm)</u>	
Flow, gpm	400
Head, Feet	37 to 41
Minimum Overall Efficiency, Percent	56
Maximum Active Input Horsepower	16.5
<u>Required Condition 3: (at Maximum rpm)</u>	
Flow, gpm	900
Head, Feet	37 to 41
Minimum Overall Efficiency, Percent	52
Maximum Active Input Horsepower	16.5
<u>Required Condition 4: (at Maximum rpm)</u>	
Flow, gpm	550
Head, Feet	63 to 67
Minimum Overall Efficiency, Percent	60
Maximum Active Input Horsepower	15
<u>Required Condition 5: (at Maximum rpm)</u>	
Flow, gpm	800
Head, Feet	45 to 49
Minimum Overall Efficiency, Percent	56
Maximum Active Input Horsepower	16
<u>Other Conditions:</u>	
Shut Off Head, Feet	113
Maximum NPSHr at Every Specified Flow, Feet	26
Minimum Suction Static Head, Feet	2

Tag Numbers	PMP-001 PMP-002
Minimum Discharge Size, Inches	4
<u>Pump Materials:</u>	
Pump and Motor Casing	Cast Iron
Impeller	Hard Iron
Shaft	420 Stainless Steel
Shaft Key	316 Stainless Steel
Water Jacket	Cast Iron
<u>Motor Characteristics:</u>	
Minimum Submergence	Exposed
Maximum Driver Speed, rpm	1800
Motor Horsepower, Minimum	15
Voltage/Phases/hertz	480/3/60
Service Factor	1.15
Full Load Current, Amperes	19
Locked Rotor Current, Amperes	112
Motor Efficiency (At 100 Percent Load) Minimum	87
Enclosure Type	Submersible, Explosion Proof
<u>Source Testing:</u>	
Test Witnessing	Not Witnessed
Performance Test Level	2
Vibration Test Level	None
Noise Test Level	None
<u>Functional Testing:</u>	
Performance Test Level	2
Vibration Test Level	None
Noise Test Level	None

END OF SECTION

**SECTION 13000
INSTRUMENT AND CONTROL SYSTEM****PART 1 GENERAL****1.1 SYSTEM DESCRIPTION**

- A. This Section gives general requirements for the instrument and control system (I&CS) which includes primary elements and transmitters, analog display and control elements, discrete display and control elements, control panels, and associated devices.

1.2 RELATED SECTION

- A. Section 13470 PROGRAMMABLE LOGIC CONTROLLER SYSTEM
- B. Division 16 Electrical sections

1.3 SUBMITTALS

- A. Shop Drawings

Shop drawing submittals shall be neatly arranged in 3-ring binders which may have pockets for full-size drawings folded and CD. Tabs shall be used to separate individual items in the submittal. Loose submittals without a binder shall be rejected without review. Deviations if any from the specifications shall be summarized and tabulated on a separate document pages titled "Notes to Reviewer". Shop drawings that do not follow the required format shall be rejected without being reviewed.

- 1. Bill of Materials: List of required I&CS equipment.
 - a. Group equipment items by common enclosure, and equipment type.
 - b. Data Included:
 - 1) Equipment tag number.
 - 2) Description.
 - 3) Manufacturer, complete model number and all options not defined by model number.
 - 4) Quantity supplied.
- 2. Catalog Cuts: I&CS Components, Electrical Devices, and Mechanical Devices:
 - a. Catalog information.
 - b. Descriptive literature.
 - c. External power and signal connections.
 - d. Scaled drawings showing exterior dimensions and locations of all electrical and mechanical interfaces.

3. Component Data Sheets: Data sheets for all I&CS components.
 - a. Format and Level of Detail in accordance with ISA-S20.
 - b. Specific features and configuration data for each component:
 - 1) Location or service.
 - 2) Manufacturer and complete model number.
 - 3) Size and scale range.
 - 4) Set points.
 - 5) Materials of construction.
 - 6) Options included.
 - c. Name, address, and telephone number of manufacturer's local office, representative, distributor, or service facility.
4. Panel Construction Drawings:
 - a. Scale Drawings: Show location of panel mounted devices, doors, louvers, and subpanels.
 - b. Panel Legend: List front of panel devices by tag numbers, nameplate inscriptions, service legends, and annunciator inscriptions.
 - c. Bill of Materials: List devices mounted within panels that are not listed in panel legend. Include tag number, description, manufacturer, and model number.
 - d. Construction Details: NEMA rating, materials, material thickness, structural stiffeners and brackets, lifting lugs, mounting brackets and tabs, door hinges and latches, and welding and other connection callouts and details.
 - e. Construction Notes: Finishes, wire color schemes, wire ratings, and wire numbering and labeling scheme.
5. Interconnection Diagrams: For discrete control and power circuits.
 - a. Diagram Type: Ladder diagrams in a format similar to those shown on Drawings. Include devices requiring electrical connections. Show unique rung numbers on left side of each rung where applicable.
 - b. Item Identification: Identify each item with attributes listed.
 - 1) Wires: Wire number and color. Cable number if part of multiconductor cable.
 - 2) Terminals: Location (enclosure number, terminal junction box number, or MMC number), terminal strip number, and terminal block number.

- 3) Discrete Components:
 - a) Tag number, terminal numbers, and location ("FIELD", enclosure number, or MCC number).
 - b) Switching action (open or close on rising or falling process variable), set point value and units, and process variable description.
- 4) Relay Coils:
 - a) Tag number and its function.
 - b) On right side of rung where coil is located, list contact location by ladder number and sheet number. Underline normally closed contacts.
- 5) Relay Contacts: Coil tag number, function, and coil location (ladder number and sheet number).
 - a) Show each circuit individually. No "typical" diagrams will be allowed.
 - b) Ground wires and connections.
 - c) Circuit Names: Show names corresponding to Circuit and Raceway Schedule for circuits entering and leaving a panel. Refer to Division 16, ELECTRICAL.
6. Loop Diagrams: Individual wiring diagram for each analog or pulse frequency loop.
 - a. Loop diagrams similar to ISA format or one preferred by DISTRICT.
 - b. Conform to the minimum requirements of ISA S5.4.
 - c. Under paragraph 5.3 of ISA S5.4, include the information listed under subparagraphs 2, 5, 6 and 9.
 - d. Drawing Size: Individual 11-inch by 17-inch sheet for three loops maximum. Loop drawings smaller than 11" x 17" will be rejected without review.
 - e. Divide each loop diagram into areas for field panel, field, terminal junction boxes, control panel and PLC.
 - f. Show:
 - 1) Terminal numbers, location of DC power supply, and location of common dropping resistors.
 - 2) Switching contacts in analog loops and output contacts of analog devices. Reference specific control diagrams where functions of these contacts are shown.
 - 3)

Tabular summary on each diagram:

- a) Transmitting Instruments: Output capability.
 - b) Receiving Instruments: Input impedance.
- 4) Circuit and raceway schedule.
- 7. Panel Power Requirements and Heat Dissipation: For control panels tabulate and summarize:
 - a. Required voltages, currents, and phases(s).
 - b. Maximum heat dissipations Btu per hour.
 - c. All calculations.
- 8. Termination Wiring Diagrams:
 - a. Diagrams, device designations, and symbols in accordance with NEMA ICS 250.
 - b. Show:
 - 1) Electrical connections between equipment, consoles, panels, terminal junction boxes, and field mounted components.
 - 2) Component and panel terminal identification numbers, and external wire and cable numbers.
 - 3) Circuit names matching Circuit and Raceway Schedules.
 - 4) Intermediate terminations between field elements and panels for, but not limited to terminal junction boxes and pull boxes.
- 9. Installation Details: Provide installation details and bill of materials required for the proper installation of AS Components.
- 10. Spares, expendables, and test equipment.
- B. Samples: Color schedule with color samples for control panels.
- C. Quality Control Submittals:
 - 1. Testing Related Submittals: In accordance with this Section
 - 2. O&M Manuals:
 - a. Refer to paragraph Shop Drawings for the following items:
 - 1) Bill of Materials.
 - 2) Catalog Cuts.
 - 3) Component Data Sheets.
 - 4) Interconnection Diagrams, one reproducible copy.

- 5) Loop Diagrams, one reproducible copy.
- 6) Termination Wiring Diagrams, one reproducible copy.
- b. Device O&M manuals for I&CS components, electrical devices, and mechanical devices shall include:
 - 1) Operations procedures.
 - 2) Installation requirements and procedures.
 - 3) Maintenance requirements and procedures.
 - 4) Troubleshooting procedures.
 - 5) Calibration procedures.
 - 6) Internal schematic and wiring diagrams.
 - 7) ORT Component and Calibration Sheets.
 - 8) List of required test equipment.
- c. List of spares and expendables required and recommended.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with this Section

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Standard Environmental Requirements: Unless otherwise noted, design AS equipment for continuous operation in these environments:

- 1. Inside (pump station building):
 - a. Temperature: 20 to 115 Deg. F.
 - b. Relative humidity: 10 to 95 percent non- condensing.
 - c. NEC classification: Non-hazardous.
- 2. Outside:
 - a. Temperature: -32 to 120 Deg. F.
 - b. Rain
 - c. NEC classification: Non-hazardous except in enclosed wetwell where it is classified as Class 1 Div I hazardous location.

- B. Furnish and provide I&CS components and panels for continuous operation in its operating environments as shown and located on the Drawings. All equipment shall be suitable and designed for installation as per California Building Code regarding seismic requirements and compliance.

1.6 SEQUENCING AND SCHEDULING

- A. In accordance with the DISTRICT general construction schedule.

1.7 MAINTENANCE

A. Spares Parts:

Provide the following spare parts with no additional cost to the DISTRICT. See section 13470 for additional spare parts for PLC system.

Description	Percent of Each Type and Size Used	No Less Than
Fuses	20	5
Indicating light bulbs	20	10
Relays	2	2
Terminal Blocks	10	5
Hand Switches	2	2

B. Expendables: None

1.8 WARRANTY

- A. The Contractor shall provide a written warranty covering the performance, workmanship, and installation of all equipment furnished under this Section for a period of two (2) years. The Contractor shall assume responsibility for all costs incurred in achieving satisfactory performance during the warranty period. Warranties shall be in accordance with these specifications.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT AND TOOLS

Contractor shall provide the following tool to the DISTRICT for no additional cost.

Equipment	Quantity	Manufacturer and Model number
Large tool kit	1	Jensen Tools Model JTK-17LST with heavy duty case
Termination kit	1	Jensen Tools Model JTK-23B210

2.2 I&CS COMPONENTS

- A. Components for Each Loop: Components for each loop shall be listed in ISA Data Sheets. Furnish all equipment that is necessary to achieve required loop performance.

2.3 NAMEPLATES AND TAGS

- A. Panel Nameplates: Enclosure identification located on the enclosure face.
 - 1. Location and Inscription: As shown on panel Drawing.
 - 2. Materials: 16-gauge, Type 316, stainless steel, stamped, mounted with stainless steel screws.
 - 3. Letters: 1/2-inch, unless otherwise noted.
- B. Component Nameplates-Panel Face: Component identification located on panel face under or near component.
 - 1. Location and Inscription: As shown on panel Drawing.
 - 2. Materials: Adhesive backed laminated plastic.
 - 3. Letters: 3/16-inch white on black background, unless otherwise noted.
- C. Component Nameplates-Back of Panel: Component identification located on or near component inside of enclosure.
 - 1. Inscription: Component tag number.
 - 2. Materials: Adhesive back, laminated plastic.
 - 3. Letters: 3/16-inch white on black background, unless otherwise noted.
- D. Service Legends: Component identification nameplate located on face of component.
 - 1. Inscription: As shown on panel Drawing.
 - 2. Materials: Adhesive backed laminated plastic.
 - 3. Letters: 3/16-inch white on black background, unless otherwise noted.
- E. Nametags: Component identification for field devices.
 - 1. Inscription: Component tag number.
 - 2. Materials: 16-gauge, 316 stainless steel.
 - 3. Letters: 1/4-inch imposed.
 - 4. Mounting: Affix to component/field instruments with 16- or 18-gauge stainless steel wire or stainless steel screws.

2.4 PANEL FABRICATION

A. General:

1. Panels with external dimensions and instruments arrangement as shown on Drawings except as modified in Engineer approved shop drawings.
2. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), state and local codes, and applicable sections of NEMA, ANSI, UL, and ICECA.
3. Fabricate panels, install instruments, wire, and plumb, all at the ICS subcontractor's factory.
4. All panels shall be UL listed and shall bear UL label stating "LISTED ENCLOSED INDUSTRIAL CONTROL PANELS". (UL508)
5. Electrical Work: In accordance with the applicable requirements of Division 16, ELECTRICAL.

B. Temperature Control:

1. Smaller Panels (that are not freestanding): Size to adequately dissipate heat from equipment mounted inside panel or in panel face.

C. Panel Construction:

1. Materials: Sheet steel unless otherwise shown on Drawings with minimum thickness of 10-gauge. For NEMA 4X, 309 stainless steel shall be used.
2. Panel Fronts:
 - a. Fabricated from a single piece of sheet steel unless otherwise shown on Drawings.
 - b. No seams or bolt heads visible when viewed from front.
 - c. Panel Cutouts: Smoothly finished with rounded edges.
 - d. Stiffeners: Steel angle or plate stiffeners or both on back of panel face to prevent panel deflection under instrument loading or operation.
3. Internal Framework:
 - a. Provide structural steel for instrument support and panel bracing.
 - b. Permit panel lifting without racking or distortion.
4. Lifting rings to allow simple, safe rigging and lifting of panel during installation.
5. Adjacent Panels: Securely bolted together so front faces are parallel.

6. Doors:
 - a. Full height, fully gasketed access doors where shown on Drawings.
 - b. Key lockable.
 - c. Latches: Three-point, Southco Type 44 or equal.
 - d. Handles: "D" ring, foldable type.
 - e. Hinges: Full length, continuous, piano type, steel hinges with stainless steel pins.
 - f. Rear Access Doors: Extend no further than 24 inches beyond panel when opened to 90-degree position.
 - g. Front and Side Access Doors: As shown on Drawings.
 - h. Provide a latch to hold door at full open position.
- D. Non-Freestanding Panel Construction:
 1. Based on environmental design requirements required and referenced in Article ENVIRONMENTAL REQUIREMENTS, provide the following:
 - a. For panels located inside:
 - 1) Enclosure Type: NEMA 12.
 - 2) Materials: Steel.
 - b. For all other panels:
 - 1) Enclosure Type: NEMA 4X.
 - 2) Materials: ABX.
 2. Doors:
 - a. Oil resistant gasket sealed with continuous hinge.
 - b. Fiberglass lockable quick release latches.
 3. Manufacturers:
 - a. Hoffman or equal.
- F. Control Panel Electrical and control components:

Control panel shall be NEMA 3RX stainless steel for outdoor installation and shall be NEMA 12 for indoor locations. Panels shall have the following features:

 1. Power Distribution, motor starter within panels:
 - a. Feeder Circuits and motor starters:
 - 1) One or more 120V ac, 60-Hz feeder circuits as shown on Drawings.
 - 2) Make provisions for feeder circuit and starter conduit entry.

- 3) Furnish terminal board for termination of wires.
- b. Power Panel: Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel.
 - 1) Locate to provide clear view of and access to breakers when door is open.
 - 2) Breaker sizes: Coordinate such that fault in branch circuit will blow only branch fuse but not trip the main breaker.
 - 3) Breaker and motor starter manufacturers and products:
 - a) Refer to Division 16, ELECTRICAL.
2. Signal Distribution:
 - a. Within Panels: 4 to 20 mA dc signals (may be distributed as 1 to 5V dc with a precision 250 OHM resistor).
 - b. Outside Panels: Isolated 4 to 20 mA dc only.
 - c. All signal wiring shall be twisted, shielded pairs, minimum 18 AWG.
3. Signal Switching:
 - a. Use dry circuit type relays or switches.
 - b. No interruption of 4 to 20 mA loops during switching.
 - c. Switching Transients in Associated Signal Circuit:
 - 1) 4 to 20 mA dc Signals: 0.2 mA, maximum.
 - 2) 1 to 5V dc Signals: 0.05V, maximum.
4. Relays:
 - a. General:
 - 1) Relay Mounting: Plug-in type socket.
 - 2) Relay Enclosure: Furnish dust cover.
 - 3) Socket Type: Screw terminal interface with wiring.
 - 4) Socket Mounting: Rail.
 - 5) Provide holddown clips.
 - b. Signal Switching Relay:
 - 1) Type: Dry circuit.
 - 2) Contact Arrangement: 4 Form C contacts.
 - 3) Contact Rating: 0 to 5 amps at 28V dc or 120V ac.
 - 4) Contact Material: Gold or silver.
 - 5) Coil Voltage: As noted or shown.

- 6) Coil Power: 0.9 watts (dc), 1.2VA (ac).
- 7) Expected Mechanical Life: 10,000,000 operations.
- 8) Expected Electrical Life at Rated Load: 100,000 operations.
- 9) Indication Type: LED indicator lamp.
- 10) Seal Type: Hermetically sealed case.
- 11) Manufacturer and Product: Potter and Brumfield; Series KH/KHA, Idec equivalent, or equal.

c. Control Circuit Switching Relay, Nonlatching:

- 1) Type: Compact general purpose plug-in.
- 2) Contact Arrangement: 3 Form C contacts.
- 3) Contact Rating: 10A at 28V dc or 240V ac.
- 4) Contact Material: Silver cadmium oxide alloy.
- 5) Coil Voltage: As noted or shown.
- 6) Coil Power: 1.8 watts (dc), 2.7VA (ac).
- 7) Expected Mechanical Life: 10,000,000 operations.
- 8) Expected Electrical Life at Rated Load: 100,000 operations.
- 9) Indication Type: Neon or LED indicator lamp.
- 10) Push to test button.
- 11) Manufacturer and Product: Potter and Brumfield; Series KUP, Idec equivalent, or equal.

d. Control Circuit Switching Relay, Latching:

- 1) Type: Dual coil mechanical latching relay.
- 2) Contact Arrangement: 2 Form C contacts.
- 3) Contact Rating: 10A at 28V dc or 120V ac.
- 4) Contact Material: Silver cadmium oxide alloy.
- 5) Coil Voltage: As noted or shown.
- 6) Coil Power: 2.7 watts (dc), 5.3VA (ac).
- 7) Expected Mechanical Life: 500,000 operations.
- 8) Expected Electrical Life at Rated Load: 50,000 operations.
- 9) Manufacturer and Product: Potter and Brumfield; Series KB/KBP, Idec equivalent, or equal.

- e. Submersible pumps thermal and leak detection relays:
Refer to Section 11312G- Submersible Pumps for detailed requirements.
Relays shall be manufactured by Flygt Model CAS II, Goulds Pumps equivalent, or equal.

- f. Signal conditioners:
Signal conditioners shall be manufactured by AGM Electronics, Phoenix Contact, or equal. They shall have the following characteristics:
- 1) Din rail mounted
 - 2) 24VDC power input or two wire as required by design loop drawings.
 - 3) 4-20mADC input with two identical 4-20mADC outputs or

- 4) Pulse input with 4-20mADC output or
- 5) 4-20mADC input with isolated 4-20mADC output

- g. Intrinsically safe relays:
These relays shall be suitable for use with 24VDC power input with pilot devices such as float switches located in the classified hazardous locations as defined by NEC Article 500. Each relay shall have two double-pole double throw contacts, each rated for 5 amperes at 240V. These relays shall be manufactured by Consolidated Electric, Gem Sensors, R. Stahl, Inc., or equal.

5. Centralized Power Supplies:

- a. Furnish as required where shown on the drawings to power instruments requiring external dc power, including two-wire transmitters and dc relays.
- b. Convert 120V ac, 60-Hz power to dc power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.
- c. Furnish redundant dc power supplies connected in such a way that DC output power is uninterrupted when one power supply is removed or is not delivering the correct output voltage.
- d. Provide a contact closure for alarm in case of dc power supply failure.
- e. Provide a voltmeter for each power supply.
- f. Provide output over voltage and over current protective devices to:
 - 1) Protect instruments from damage due to power supply failure.
 - 2) Protect power supply from damage due to external failure.
- g. Enclosures: NEMA 1.
- h. Mount such that dissipated heat does not adversely affect other components.
Fuses: For each dc supply line to each individual two-wire transmitter.
 - 1) Type: Indicating.
 - 2) Mount so fuses can be easily seen and replaced.
- i. Manufacturer and Products: Acopian Redundant Power Packages, Sola equivalent, or equal.

6. Standard Pushbutton Colors and Inscriptions:

- a. Use following color code and inscriptions for pushbuttons unless otherwise noted:

Tag Function	Inscription(s)	Color
OO	ON OFF	Red Green
OC	OPEN CLOSE	Red Green
OCA	OPEN CLOSE AUTO	Red Green White
OOA	ON OFF AUTO	Red Green White
MA	MANUAL AUTO	Yellow White
SS	START STOP	Red Green
RESET	RESET	Red
EMERGENCY STOP	EMERGENCY STOP	Red
LOCAL	LOCAL	White

b. Unused or Noninscribed Buttons: Black.

c. Lettering Color:

- 1) Black on white and yellow buttons.
- 2) White on black, red and green buttons.

7. Standard Light Colors and Inscriptions:

a. Use following color code and inscriptions for service legends and lens colors for indicating lights, unless otherwise noted in Instrument List:

Tag Function	Inscription(s)	Color
ON	ON	Red
OFF	OFF	Green
OPEN	OPEN	Red
CLOSED	CLOSED	Green
LOW	LOW	Green
FAIL	FAIL	Red
HIGH	HIGH	Red
AUTO	AUTO	White
MANUAL	MANUAL	Yellow
LOCAL	LOCAL	White
REMOTE	REMOTE	Yellow

- b. Lettering Color:
 - 1) Black on white lenses.
 - 2) White on red and green lenses.

2.5 SOURCE QUALITY CONTROL

- A. Factory Demonstration Tests: Demonstrate to Engineer that I&CS panel and assemblies included in these tests for conformance to related submittals and requirements specified.

2.6 REQUIRED INSTRUMENTS FURNISHED AND INSTALLED BY CONTRACTOR

2.6.1 PRESSURE INSTRUMENTS

- A. Pressure Switches and gauges:
 - 1. General:
 - a. Function: Monitor differential pressure, and provide contact closure(s) when differential pressure is at the noted set point.
 - b. Type: Diaphragm actuated.
 - 2. Performance:
 - a. Set Point: As noted.
 - 1) Adjustable over the full range.
 - 2) Set as noted.
 - b. Range: The noted set point shall fall between 30 and 70 percent of the range.
 - c. Set Point Repeatability: Plus or minus 1/2 percent of range span.
 - 3. Features:
 - a. Diaphragm Materials: Buna-N, unless otherwise noted.
 - b. Pressure Connection: Nickel-plated brass, unless otherwise noted.
 - 4. Enclosure: NEMA 4X, unless otherwise noted.
 - 5. Signal Interface:
 - a. Contact Type: SPDT, snap action switch, rated for 5 amps at 120V ac.
 - 6. Manufacturers:
 - a. Ashcroft, B Series.

- b. United Electric, Series 300
- c. Mercoid, Series DP

B. Pressure Transmitter

1. General: Furnish and install transmitter where shown on the drawings.
 - a. Measure pressure by detecting force on an integral capacitance diaphragm capsule.
2. Performance:
 - a. Range: As required for process.
 - b. Provide zero elevation and adjustment.
 - c. Span shall be adjustable over 100 to 1 or greater range.
 - d. Adjustable damping shall be provided.
 - e. Wetted parts shall be 316SS unless otherwise specified.
 - f. Accuracy shall be $\pm 0.25\%$ of span.
 - g. Transmitter housing shall be rated explosion proof, NEMA 7.
 - h. Integral LCD meter with the transmitter housing.
 - i. HART protocol
3. Signal Interface:
 - a. Transmitter output: 4-20mA current regulated to drive any load between 0-750 ohms at 24V DC.
 - b. Transmitter: Two wire type (loop powered)
4. Manufacturers:
 - a. Rosemount 2051C
 - b. Foxboro, ABB
 - c. Equal

2.6.2 FLOW INDICATING TRANSMITTERS

A. Magnetic flow meters

1. General:
 - a. Measure flow by flange type low frequency electromagnetic element with DC pulse signal proportional to and linear with liquid flow rate.
2. Performance:
 - a. Range: 0 to 800 gpm
 - b. Sensor: Minimum two bullet-nosed, self-cleaning electrodes
 - c. Meter housing hardware: NEMA 6 Submergence, epoxy painted
 - d. Sensor electrode: 316 Stainless Steel, Polyurethane liner, grounding rings

- e. Accuracy: 0.25% of full rate
 - f. Electronic transmitter with 4-20mA DC output, 3-line, 16-character LCD Display and pulse/frequency for totalization signals. NEMA 4X enclosure, 120VAC input, HART protocol,
 - g. Environment: 20 to 140 degrees F, humidity 90% non-condensing
 - h. Hand-held calibrator/programmer (shall be provided at no additional cost)
3. Manufacturers:
- a. ABB Magmaster to match District's Standards.

2.6.3 LEVEL MEASUREMENT

Furnish and install level transmitter where shown on the drawings.

A. Level transmitter (Ultrasonic type)

- 1. Continuous level measurement by soundwave
- 2. Characteristics:
 - a. Ultrasonic probe/sensor with max 30 feet length
 - b. Remote level transmitter NEMA 4X with 4-20mA DC output
 - c. Power input 120VAC
 - d. Local level transmitter, keypad type with engineering unit.
 - e. HART protocol
 - f. Ultrasonic level sensor with narrow beam
 - f. Provided with required mounting hardware, brackets, and cables.
- 3. Manufacturer:
 - a. Siemens Milltronics HydroRanger with Echomax XPS-15 sensor to match District's Standards.

B. Level switches (float type)

There are four float switches required for this project, and they are furnished by the District to be installed by the Contractor.

Floats shall be non-mercury switch completely sealed with water resistant, stainless steel ball with PVC outer jacket, suspended with submarine type cable. Contact shall be rated for 5 amps, 120VAC, complete with stainless steel mounting hardware such as supports. Floats shall be manufactured by Siemens Model B100 9G-EF, and are furnished by the District with mounting clips.

Installation of these floats shall be as shown on the drawings.

PART 3 EXECUTION**3.1 GENERAL**

- A. Floor plan layout for I&CS components are diagrammatic and not intended to specifically define element locations or piping and tubing run lengths. Base materials and installations on field measurements.
- B. Coordinate Work with Division 11, EQUIPMENT and Division 15, MECHANICAL.
- C. Wiring: Refer to this Section and Division 16, ELECTRICAL.

3.2 FIELD QUALITY CONTROL

- A. Perform functional tests to assure all devices are functional individually prior to system testing.
- B. Perform final acceptance testing at the presence of the DISTRICT's representative, the Engineer.

3.3 TRAINING

- A. Operation: For DISTRICT's operations personnel on operation of I&CS.
 - 1. Training Session Duration: 1 instructor day.
 - 2. Number of Training Sessions: 2
 - 3. Location: Project site.
 - 4. Content: Conduct training on loop-by-loop basis.
 - a. Loop Functions: Understanding of loop functions including interlocks for each loop.
 - b. Loop Operation: For example, adjusting process variable set points, AUTO/MANUAL control transfer, AUTO and MANUAL control, annunciator acknowledgement and resetting.
 - c. Interfaces with ICS Subsystems.
- B. Maintenance Training:
 - 1. Training Session Duration: 1 instructor day.
 - 2. Number of Training Sessions: 2
 - 3. Location: Project site.

4. Content: Provide training for each type of component and function provided.
 - a. Loop Functions: Understanding details of each loop and how they function.
 - b. Component calibration.
 - c. Adjustments: For example, device setup parameters, controller tuning constants, current switch trip points, and similar items.
 - d. Troubleshooting and diagnosis for and components.
 - e. Replacing lamps, chart paper, fuses.
 - f. As components removal and replacement.
 - g. Periodic maintenance.

END OF SECTION

SECTION 13470
SCADA - PROGRAMMABLE LOGIC CONTROLLER SYSTEM**PART 1 – GENERAL****1.1 DESCRIPTION****A. Scope:****1. General:**

- a. The Contractor shall furnish, install and wire all SCADA system hardware required for this project. The SCADA system control panel shall be manufactured by Calcon Systems Inc to match existing system installation. However, the PLC and local HMI software programming requirements provided in the Contract Documents is for reference purposes only as it will be provided and performed by a third party (Calcon) hired by the District. The Contractor however shall be required to provide all labor and materials to wire and connect all new signals to the new PLC systems as specified and as shown on the drawings.
- b. The existing PLC cabinet shall remain functional during construction, and shall be disconnected and returned to the District after successful switch-over to the new system.

2. Control System Responsibilities:

- a. The Contractor shall be responsible for all control systems work described in these specifications and drawings, including PLCs, network/communication equipment, except for programming and configuration services explicitly specified to be provided by the District. The Contractor shall be responsible for all submittals, purchasing, assembly, packing, shipping, installation, set up, startup, specified testing, and as-built drawings for all control system equipment and purchased standard software.
- b. The Contractor or subcontractor shall test the PLC/I/O system as specified herein to verify proper performance independent of the use of the PLC software provided by the District.
- c. The Contractor shall provide the communications network as specified herein and indicated on the Drawings and other sections of the specification.
- d. Perform testing and training as described in this section.

3. Definitions:

- a. Where a term is used in this section relating to instrumentation, and the meaning is not defined therein or elsewhere in the Contract Documents, the meaning of the term shall be as defined in ISA S51.1 Process Instrumentation Terminology, or if not contained in ISA 51.1, as defined in listed reference standards under "References".
- b. CEET - Complete End to End Testing.

- c. Control Circuit: Any logical circuit (operating usually at 120VAC or less or DC) whose principal purpose is the conveyance of control and interlock/protection information and not the conveyance of energy for the operation of an electrically powered device.
 - d. HMI: Human Machine Interface.
 - e. LAN: Local Area Network e.g. Ethernet is a local area network based on IEEE standard 802.3 with TCP/IP protocol.
 - f. NAT - Network Acceptance Testing.
 - g. Panel: An instrument support system which may be either a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems. Unless otherwise specified or clearly indicated by the context, the term "panel" in these Contract Documents shall be interpreted as a general term, which includes flat panels, enclosures, cabinets and consoles.
 - h. PLC: Programmable Logic Controller.
 - i. Power Circuit: Any circuit operating at 120 VAC or more, whose principal purpose is the conveyance of power for motors, lighting and other power devices.
- B. Test:
- 1. General:
 - a. Any testing or startup activity that requires the participation of the District shall be scheduled by the Contractor through written notification to the District. Contractor shall provide regularly updated testing and startup schedules to the District. In addition to any other form of notification, Contractor shall notify the District by email, or other mutually agreed upon means, five working days immediately prior to any testing or other activity requiring the participation of the District. Failure to properly notify District shall result in rescheduling of test activity, solely at Contractor expense and without an extension to the project completion schedule.
 - 2. Operational Readiness Tests (ORT):
 - a. General: Prior to startup and the Functional Acceptance Test, the entire system shall be certified (inspected, tested and documented) that it is ready for operation.
 - b. Basic End-to-End Testing (BEET):
 - i. For each and every analog and discrete circuit, perform Basic End-to-End Testing (BEET). This includes, but is not limited to, all local control panels, MCCs, VFDs, and hardwired circuits in control panels.
 - ii. For each input, activate the signal at the primary field device, either by creating necessary process and equipment conditions or by disconnecting the wires at the field device and simulating the input signal. At the PLC, using the PLC programming software, verify proper receipt of the signal.
 - iii. For each output signal from the PLC, activate the PLC output signal using the PLC programming software, and verify proper receipt of the signal at the controlled device in the field, either by observing equipment operation or

by disconnecting the wires at the equipment and verifying proper receipt of the signal.

- iv. Verify proper signal receipt at all intermediate devices, such as indicators, signal trip and relay modules, etc.
- v. The Loop/Component Inspections and Tests shall be implemented using District-approved forms and checklists.
- vi. Each loop shall have a Loop Status Report to organize and track its inspection, adjustment and calibration. These reports shall include the following information and check off items with spaces for sign off by the system supplier:
 - a). Project Name.
 - b). Loop Number.
 - c). Tag Number for each component.
 - d). Check offs/signoffs for each component.
 - e). Tag/identification.
 - f). Installation.
 - g). Termination - wiring.
 - h). Termination - tubing.
 - i). Calibration/adjustment.
 - j). Signoffs/signoffs for the loop.
 - k). Panel interface terminations.
 - l). I/O interface terminations.
 - m). I/O signal operation.
 - n). Inputs/outputs operational: received/sent, processed, adjusted.
 - o). Total loop operation.
 - p). Space for comments.
 - q). Each active Analog Subsystem element and each I/O module shall have a Component Calibration Sheet. These sheets shall have the following information, spaces for data entry and a space for sign off by the system supplier:
 - 1). Project Name.
 - 2). Loop Number.
 - 3). Component Tag Number of I/O Module Number.
 - 4). Component Code Number Analog System.
 - 5). Manufacturer (for Analog system element).
 - 6). Model Number/Serial Number (for Analog system).

- 7). Summary of Functional Requirements. For example:
 - (a). For Indicators and Recorders: Scale and chart ranges
 - (b). For Transmitters/Converters: Scale and chart ranges
 - (c). For Computing Elements: Function
 - (d). For Controllers: Action (direct/reverse) control modes (PID)
 - (e). For Switching Elements: Unit range, differential (FIXED/ADJUSTABLE), reset (AUTO/MANUAL)
 - (f). For I/O Modules: Input or output
 - r). Calibrations; for example:
 - 1). For Analog Devices: Required and actual inputs and outputs at 0, 25, 50, 75 and 100 percent of span, rising and falling.
 - 2). For Discrete Devices: Required and actual trip points and reset points.
 - 3). For Controllers: Mode settings (PID).
 - 4). For I/O Modules: Required and actual inputs or outputs for 0, 10, 25, 50, 75 and 100 percent of span, rising and falling; 9 points calibration (5 points calibration will be rejected).
 - 5). Space for comments.
 - 6). Space for sign off by the ISS.
 - 7). The ISS shall maintain the Loop Status Reports and Components Calibration sheets at the job site and make them available to the Construction Administrator/District at any time.
 - s). These inspections and tests do not require witnessing. However, the Construction Administrator will review and initial all Loop Status Sheets and Component Calibration Sheets and spot-check their entries periodically and upon completion of the Operational Readiness Tests. Any deficiencies found shall be corrected.
- c. Complete End-to-End Acceptance Tests (CEET):
- i. For each PLC, CEET testing shall not commence until all Loop Acceptance Tests for the PLC have been satisfactorily completed, and all test results (including all forms signed off) have been submitted for review and accepted. For each and every analog and discrete circuit, perform an end-to-end test between the field device and the HMI computer operator station, and including all intermediate readouts. Also test each signal circuit transmitted over digital networks (i.e. ETHERNET, RS-422 links, etc.).
 - ii. In general, the end-to-end testing is a two or more person test. The Contractor shall provide personnel to operate equipment or simulate signals that are to be verified as part of this test.

- iii. Check each loop from the field element to the respective computer control display. Include all intermediate field instruments, control devices, panels, indicators and other devices in the loop to ensure proper operation and linkage to computer control station displays.
- iv. Analog signals shall be tested at 0, 50, and 100 percent of scale to verify the proper receipt on computer control displays.
- v. Discrete input circuits shall be tested to verify proper state when the field device is switched between states. Discrete output circuits shall be tested to verify equipment responds properly (start, stop, etc.).
- vi. Contractor shall provide adequate time in the Construction Schedule for CEET testing.

3. FUNCTIONAL ACCEPTANCE TEST (FAT)

- a. Prior to startup and the Functional Acceptance Test (FAT), the entire installed instrument and control system shall be certified that it is ready for operation. All preliminary testing, inspection, and calibration shall be complete as defined in the Operational Readiness Tests.
- b. Once the facility has been started up and is operating, a witnessed FAT shall be performed on the complete system to demonstrate that it is operating and in compliance with these Specifications. Each specified function shall be demonstrated on a paragraph-by-paragraph, loop-by-loop, and site-by-site basis.
- c. Strategy Field Testing (SFT):
 - i. This test shall be performed by the Integrator with the assistance and cooperation of the Contractor. The Contractor shall provide a qualified start-up and testing representative on-site, assisting and participating in the testing full-time, for the duration of the SFT.
 - ii. The Contractor shall include in the Construction Schedule at least two days of SFT testing work for each of the control strategies and shall provide staff for these periods, as required above for this work.
 - iii. For each control strategy and for each electrical schematic diagram, demonstrate the proper operation of all hardware and software logic and control functions. Perform a step by step test of each function described in each control strategy.
 - iv. Perform separate tests on each individual piece of equipment, and for each control loop.
 - v. Perform the proper operation of each discrete control loop to ensure the proper operation of motors, hand switches, interlocks, solenoid valves, other auxiliary devices, status lights, computer control operator interfaces, and alarms.
 - vi. Updated versions of the documentation specified to be provided for during the Factory Tests shall be made available at the job site both before and during the tests. In addition, one copy of all O&M Manuals shall be made available at the job site both before and during testing.

- vii. The system shall operate for a continuous 96 hours without failure before this test will be considered successful.

1.2 QUALITY ASSURANCE

A. References:

1. Work specified in this Section shall follow the applicable code and standards: EIA, ANSI, IEEE, ISA and NFPA.
2. Where provisions of the pertinent codes and regulations, requirements of the referenced standards, or these specifications conflict, the more stringent of the requirements shall govern.

1.3 SUBMITTALS

A. General:

1. Make all submittals and resubmittals in strict accordance with the provisions of Division 1, Section 1A-7 - Submittals, Manuals, Operating Instructions, and Affidavits.
2. Make all submittals listed in Part 1.03-B, and any others required to fully describe what is to be furnished and/or installed under this Section.

B. Required Submittals:

1. Drawing index.
2. System configuration diagram.
3. Hardware list and cutsheets.
4. Test plan.

PART 2 – PRODUCTS

2.1 MANUFACTURER AND SUPPLIER

- A. The PLC shall be manufactured by Automation Direct DL4 Series to match the District SCADA Standards. No other manufacturers are acceptable. New I/O hardware/cards are required for connections to new signals. Contractor shall provide complete wiring from the field to the I/O cards' terminals as detailed on the drawings. The Contractor shall obtain the PLC Control Panel from Calcon System Inc (925) 277-0665 as shown on the Drawings and as specified in this section:
- B. Provide and install the following hardware to the PLC as shown on the drawings and as described in this section:
 1. One 8-point Analog Input card model no. F2-08AD-1
 2. Two 16-point Digital Input cards model no. D2-16ND3-2

3. One 8-point Digital output card model no. F2-08TRS
 4. Main CPU model no. D2-250-1
 5. Power Supply Base model D2-09B-1
 6. ETHERNET communication card model no. H2-ECOM
 7. 12-slot rack
 8. HMI Model EZ-S6C-KS
 9. Radio Satel West Model Satlline-3SD/250/10W
 10. Radio Satel West Model Satlline-3SD/250/2W
 11. Industrial 6-port ETHERNET switch, din rail mounted, 24VDC made by Moxa, Phoenix Contacts, or equal.
 12. UPS 500VA, 120VAC input with 120VAC output, 20 minute battery full load capacity manufactured by Best, Direct Automation, or Eaton.
 13. Miscellaneous accessories such as interposing 24VDC relays, DC Power supplies model PS24-150D, fuses, terminal strips, contact blocks, pulse converters, line surge protector, panel's security switch, signal isolators, wire ducts, convenience outlet, NEMA 12 main enclosure, UL-508A label with Short Circuit Current Rating of 22kA minimum, FLA.
- C. Loose spare parts:
1. One 8-point Analog Input card model no. F2-08AD-1
 2. Three 16-point Digital Input cards model no. D2-16ND3-2
 3. One 8-point Digital output card model no. F2-08TRS

PART 3 – EXECUTION

3.1 ACCEPTANCE TESTING

- A. Perform final acceptance testing with the presence of the District and the District's representative. Demonstrate all correct signal wirings and control logics to the District's satisfaction. (The District will furnish PLC/HMI software). Retest shall be performed at no cost to the District if the first test is not satisfactory.

3.2 TRAINING

- A. Provide two 4-hour training sessions for 2 plant personnel at the site. The training shall include classroom and hands-on practice of the system furnished.
- B. Perform factory tests in the District's presence. Notify the District one week prior to actual scheduled factory test. See Part 1 for additional requirements.

3.3 PLC/HMI SOFTWARE TESTING ASSISTANCE

- A. The PLC/HMI application software is provided by a third party (Calcon) hired by the District. However, the Contractor shall provide assistance to this third party when they perform software testing in the field during final pump station startup operations. Provide field staff for at least two weeks to assist this effort. See Part 1 for additional requirements.

3.4 CONTROL STRATEGIES

SEE SECTION 13475 FOR REFERENCES

END OF SECTION

**SMCSD
HIGHWAY BOOSTER PUMP STATION
REHABILITATION PROJECT**

**Project No. 395
May 2016**

ITEM No.	EQUIPMENT DESCRIPTION	EQUIPT. NO.	TAG NAME	LOOP No.	SIGNAL FUNCTION	TYPE	DWG No.	COMMENTS
1	Submersible Pump No. 1	PMP-1	YA	101	Fail Overload	DI		
2	Submersible Pump No. 1	PMP-1	YL	101	In Remote Mode	DI		
3	Submersible Pump No. 1	PMP-1	YL	101	Run Status	DI		
4	Submersible Pump No. 1	PMP-1	TAH	101	Hi motor temp.	DI		
5	Submersible Pump No. 1	PMP-1	MAH	101	Seal leak	DI		
6	Submersible Pump No. 1	PMP-1	HS	101	Auto start/stop	DO		
7	Submersible Pump No. 2	PMP-2	YA	102	Fail Overload	DI		
8	Submersible Pump No. 2	PMP-2	YL	102	In Remote Mode	DI		
9	Submersible Pump No. 2	PMP-2	YL	102	Run Status	DI		
10	Submersible Pump No. 2	PMP-2	TAH	102	Hi motor temp.	DI		
11	Submersible Pump No. 2	PMP-2	MAH	102	Seal leak	DI		
12	Submersible Pump No. 2	PMP-2	HS	102	Auto start/stop	DO		
13	Emergency Generator	GEN	YA	106	Fail	DI		
14	Emergency Generator	GEN	YL	106	Run status	DI		
15	Pump 1 Discharge Pressure	PE/PIT	PI	101	Discharge Pressure	AI		
16	Pump 2 Discharge Pressure	PE/PIT	PI	102	Discharge Pressure	AI		
17	Magnetic Flowmeter	FE/FIT	FI	103	Flow indication	AI		
18	Wet well level Transmitter	LE/LIT	LI	104	Wet well level ind.	AI		
19	Fuel tank level	LE/LIT	LI	106	Fuel level	AI		
20	Automatic Transfer Switch	ATS	YL	109	Station on PG&E power	DI		
21	Automatic Transfer Switch	ATS	YL	109	Station on standby power	DI		
22	Station attended/unattended	HS	ZA	108	Intrusion disable	DO		
23	Station Intrusion Alarm	ZS	ZA	107	Intrusion alarm	DI		
24	Float backup to ultrasonic	FS	LSH	105C	Hi level start backup	DI		
25	Emergency Generator Leak	GEN	LAH	106	Fuel tank Leak	DI		
26	Low low level in wet well	LS	LSL	105A	Backup low low level	DI		
27	High high level in wet well	LS	LSH	105D	Backup hi hi level	DI		
28	Station Power Available	JY	JL	110	Power Available	DI		

DI : Discrete Input
 DO : Discrete Output
 AI : Analog Input
 AO : Analog Output

**SECTION 13475
CONTROL STRATEGIES****PART 1 GENERAL****1.1 DESCRIPTION****A. WORK SCOPE**

This Section specifies requirements regarding software configuration for programmable logic controller, Local HMI display and SCADA System. All these software programming and configuration in this project shall be performed by third party hired by the District.

1.2 RELATED SECTIONS

- A. Section 13400 – Instrument and Control System.
- B. Section 13470 – Programmable Logic Controller System.

PART 2 PRODUCTS (NOT USED)**PART 3 EXECUTION****3.1 GENERAL**

This Pump Station is designed with a programmable logic controller (PLC) based control system which primarily provides the control and monitoring functions of the pumping equipment and associated facility auxiliary equipment. In general, the PLC will have control logic to execute the required control functions based on process parameters such as level in the wet well. Exact system process parameter set points shall be as determined and directed by the District during final start up. In addition, the control system shall be programmed to provide all alarm and monitoring functions such as equipment run, fail, overload, open, close, process parameter values (low, high high) , and software generated failure-to-start, failure-to-open, failure-to-close. Each alarm and monitoring functions of each equipment shall be duplicated at HMI and SCADA communication network.

In addition to the functions described in the later loop specifications, at each programmed layer, provide the following general functions as they apply to the signals available to that layer.

1. Monitor and Display Discrete Inputs. Receive inputs, display, and alarm where applicable. Provide alarm logging.

2. Display and Allow Tuning of Set Points. Display set points, allow them to be changed and where password protection functions are available, and implement them to restrict access to set points.
3. Monitor and Display Analog and Pulse-Frequency Inputs. Received inputs, and display. Provide configurable low and high alarm set points for each signal. Trench each input for a configuration interval, in a first-in first-out arrangement. Provide resettable and non-resettable flow, run time and power consumption totalizers for each applicable input.
4. Elapsed Time. Provide resettable and non-resettable elapsed time integrators for pump runtime. For the resettable variable, provide a configurable set point unique to each pump at which an alarm will occur, triggering the need for service.
5. Loss of Input. Hold the last known value, alarm.
6. Attempt to Command Only Controllable Equipment. Monitor equipment status where available (such as LOCAL/REMOTE selection), and attempt to control equipment which is available to the PLC and which has not failed.
7. Pump Fail to Start/Fail to Stop. Upon issuance of an START or STOP command, if within a configuration interval the pump does not reach the command position, an alarm shall be issued. Provide a configurable interval on a pump-by-pump basis. Lock out the gate until a RESET command is issued.
8. Equipment Fail. On receipt of a FAIL or similar discrete input, or when the item of equipment fails to attain the commanded state within a configurable interval, an alarm shall be issued. Provide a configurable interval for each item of equipment. Lock out the item of equipment until a RESET command is issued.
9. Loss of Communication. Alarm on loss of communications from SCADA HMI host to site PLCs or/and from site PLCs to SCADA.

3.2 CONTROL STRATEGIES

CS-101 SEWAGE PUMP CONTROL STRATEGIES:

A. Highway Booster Pump Station Sewage Pumps:

1. References:
 - a. Process Area: Highway Booster Pump Station.
 - b. P&ID Drawings: I-2.
 - c. Mechanical Drawings: M-1, M-2.

- d. Specification Section: 11312G (new submersible pump)
 - e. PLC: New SCADA control located in existing pump building.
2. Mechanical Equipment:
- | <u>Tag Number</u> | <u>Equipment Name</u> |
|-------------------|-----------------------|
| PMP-1 | Pump 1. |
| PMP-2 | Pump 2. |
3. General Description:
- a. The Highway Booster Pump Station pumps raw sewage from the pump station to 8-inch force main.
 - b. Two existing vertical non-clog dry pit pumps (P-1, P-2,) are located in a dry well adjacent to the pump station wet well. The existing dry pit pumps discharge into a common header then through a 8 inch diameter pipe to 16 inch District force main across freeway 101.
 - c. Two new submersible non-clog wet pit pumps (PMP-1 and PMP-2) will be installed to replace the existing pumps in the pump station new wet well as part of this project. The submersible pump discharges into a separate discharge pipe header then through a new 8 inch diameter flow meter located in vault outside the pump station.
 - d. Flow from the submersible pump are combined downstream of a new flowmeter vault.
 - e. All the pumps will normally operate to pump sewage out of the wet well based on level which is continuously monitored by an ultrasonic level transmitter.
 - f. Pump PMP-1 and PMP-2 have identical capacity of 465 gpm. Only one pump is required to handle the incoming flow into the new wet well. The second pump operates as a standby/backup pump.
 - g. In utility (PG&E) power mode or standby power mode, either pump and the auxiliaries can operate without any constraints.
4. Field Controls and Instrumentation:
- a. Instruments and Protective Devices:
 - 1) Wet Well:
 - a) Level indicating transmitter (LIT-104).
 - b) Low-Low level float switch. (LSLL-105A).
 - c) Low level float switch (LSL-105B).

- d) High level float switch (LSH-105C).
 - e) High-High level float switch (LSHH-105D).
- 2) Submersible Pumps (PMP-1 and PMP-2):
 - a) Motor winding temperature switch.
 - b) Motor moisture detection sensor.
- 3) New Flow Meter Vault:
 - a) Magnetic flow meter sensor (FE-103) (Flow Transmitter FIT-103 is located in the Motor Controller Panel)
- b. Control Devices at motor controller panel :
 - 1) Each Pump 1 and 2:
 - a) LOCK-OUT-STOP pushbutton
 - b) START push button
 - c) HAND OFF AUTO selector switch
 - d) RUN indication
 - e) FAIL indication (Overload)
 - f) Hi motor temperature
 - g) Seal leak
- c. Indicators and Alarms:
 - 1) Wet Well:
 - a) Level indication.
 - 2) New Flowmeter Vault:
 - a) Flow rate indication: Displays total flow from submersible pumps.
 - 3) Standby Generator:
 - a) Fuel tank Level
 - b) Fuel Leak Alarm

- c) Generator Run
 - d) Generator failure
 - 4) Pumping discharge piping:
 - a) Pressure indication
- 5. Float backup controls and Interlocks
 - a. Hardwired Interlocks from floats:
 - 1) Shut down the pump and generate FAULT alarm.
 - 2) Motor High Temperature (Pump 1 and 2): Shut down and latch out the pump and generate MOTOR HIGH TEMPERATURE alarm.
 - 3) Moisture (Seal Leak) Detection (Pump 1 and 2): Shut down and latch out the associated pump and generate MOISTURE DETECTION alarm when the motor moisture detection sensor is activated.
 - 4) Low-Low Wet Well Level: Shut down the pumps and generate a LOW-LOW WET WELL LEVEL alarm. Activating the Low-Low Level Bypass Selector Switch deactivates this hardwired interlock in case sewage level can be pumped lower than set points.
 - 5) When a pump is latched out, it shall not start until the RESET pushbutton is pressed.
 - 6) There is a manual switch provided to override the low low level so that in manual mode, the sewage level in the wet well can be pumped lower than the shut down level by the District's staff.
 - 7) If the PLC fails, an alarm will initiate via the autodialer, and the floats will automatically control the pumps.
- 6. PLC/SCADA Functions:
 - a. Automatic Controls:
 - 1) PLC control of the pumps is activated by the placing the HAND-OFF-AUTO/PLC switch at the Motor Controller (MC) panel in AUTO.
 - 2) Selection of Remote Manual or Remote Automatic modes can be made at the local HMI.

- 3) Remote Manual Mode:
 - a) START-STOP control for each pump.
- 4) Remote Automatic Mode:
 - a) In remote automatic mode, the PLC will control the pump station in a single setpoint level control mode. The logic for this mode is outlined below.
 - b) Provide a LEAD1/STANDBY2 or /LEAD2/STANDBY1 pump selector to select order of pump operation (default order: P-1/P-2).
 - c) Automatically replace any lead pump that fails with the STANDBY pump.
 - d) The operation of the pumps is controlled by the PLC based on the level in the wet well. If the ultrasonic level transmitter fails, the PLC will automatically start and stop pumps based on backup signals from the floats. See section 8) below.
 - e) Provide the following operator adjustable setpoints on the local LOI:
 - (1) Lead pump start level (El. -X.00 to X.00 ft; default: El -X.00 feet).
 - (2) Lead pump shut down level (El. -3.00 to -6.00 ft; default: El. -5.00 feet).
- 5) Set Point Level Control Logic:
 - a) When the Lead Pump Start Level is reached, the LEAD pump will start at its constant speed.
 - b) When the level in the wet well lowers to a STOP Level, the LEAD pump shall stop.
 - c) If the Lead pump fails, the Standby pump shall automatic start.
- 6) Utility (PG&E) Power Operation:
 - a) The pump station is designed such that one pump can handle the required incoming flow.
- 7) Utility (PG&E) Power Failure/Standby Generator Operation:
 - a) On loss of utility power, shut down all pumps for an adjustable time delay (0 to 120 seconds, default 60 seconds).
 - b) The pumps shall resume their automatic operations in identical manner as in utility power mode.

- 8) Primary Level Element Failure:
 - a) When the primary level transmitter (LIT-104) fails, the PLC resets the control algorithm to operate the pumps using level set points provided by the four back-up floats installed in the wet well.
 - b) A Low-Low Level (LSLL-105A) stops all operating pumps.
 - c) A High-High Level (LSHH-105D) generates a system high level alarm.
 - d) A High Level (LSH-105C) starts the LEAD pump in the LEAD/STANDBY sequence.
 - e) A Low Level (LSL-105B) stops the each pump in LEAD/STANDBY sequence
- b. Screen Indicators and Alarms at SCADA:
 - 1) Pump Station:
 - a) Level setpoint indication.
 - b) LOW-LOW WET WELL LEVEL alarm (Low-low level float switch; initial setpoint El. -X.00 ft).
 - c) LOW WET WELL LEVEL alarm. (Low level float switch; initial setpoint El. X ft).
 - d) HIGH WET WELL LEVEL alarm. (High level float switch; initial setpoint El. X ft.).
 - e) HIGH-HIGH WET WELL LEVEL alarm (High-high level float switch; initial setpoint El. X ft).
 - f) Intrusion Alarm. (This alarm shall be programmed with time delay for staff to disable on the local LOI when attending the station)
 - 2) Each Pump:
 - a) RUN indication.
 - b) AUTO indication (i.e. under PLC control or not)
 - c) LEAD/STANDBY designation.
 - d) FAIL (overload) alarm.
 - e) MOTOR HIGH TEMPERATURE alarm.
 - f) MOISTURE DETECTION alarm.

- c. Software Interlocks: As per constraints and descriptions above in this section.
- d. Trend Variables at SCADA:
 - 1) Pump Station
 - a) Wet well Level indication.
 - b) Totalized flow rate indication.
 - c) Submersible pumps flow rate indication.
 - d) Discharge piping pressure indication
 - e) Diesel Fuel indication
 - 2) Each Pump:
 - a) Run time indication.
 - b) Pump fault indication.
 - c) Pump mode of selection
 - d) Manual/Auto selection
 - e) Pump shut off

CS-102 FLOWMETER VAULT

- A. Reference: Drawing I-2
- B. Summary description:

The SCADA monitors and displays the flow rate and total flow from flowmeter FIT-103 which measures the flow when any of the two submersible pump operates.

CS-103 PHONE DIALER

- A. Reference: Drawing I-2
- B. Summary Description:

From this 8-channel phone dialer, only two channels are use for:

- a) Combined/common alarm for PLC failure/intrusion/Utility Power failure
- b) Wet well high level Alarm

CS-103 ODOR CONTROL UNIT (FUTURE)

- A. Reference: Drawing I-2
- B. Summary description:

The SCADA monitors and displays status of the odor control unit when it operates.
There are two signals initiated by the odor control unit control panel: Run and Fail.

END OF SECTION

SECTION 15050

COMMON WORK RESULTS FOR MECHANICAL EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Basic design and performance requirements for mechanical equipment.
- B. Related sections:
 - 1. Section 01605 - Product Requirements.
 - 2. Section 01610 - Project Design Criteria.
 - 3. Section 01612 - Seismic Design Criteria.
 - 4. Section 01756 - Commissioning.
 - 5. Section 01770 - Closeout Procedures.
 - 6. Section 01730 - Operating and Maintenance Data.
 - 7. Section 03600 - Grouting.
 - 8. Section 05190 - Mechanical Anchoring and Fastening to Concrete And Masonry.
 - 9. Section 05120 - Structural Steel.
 - 10. Section 09960 - High-Performance Coatings.
 - 11. Section 15052 - Common Work Results for General Piping.
 - 12. Section 15958 - Mechanical Equipment Testing.
 - 13. Section 16950 - Electrical Testing.
 - 14. Section 17950 - Testing Calibration and Commissioning.

1.02 REFERENCES

- A. American Gear Manufacturer's Association (AGMA) Standards:
 - 1. 6001-E08 – Design and Selection of Components for Enclosed Gear Drives.
- B. American Bearing Manufacturers Association (ABMA) Standards:
 - 1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. 11 - Load Ratings and Fatigue Life for Roller Bearings.
- C. American Petroleum Institute (API):
 - 1. 682 - Shaft Sealing Systems for Centrifugal and Rotary Pumps.
- D. ASTM International (ASTM):
 - 1. A36 - Standard Specification for Carbon Structural Steel.
 - 2. A48 - Standard Specification for Gray Iron Castings.
 - 3. A125 - Standard Specification for Steel Springs, Helical, Heat-Treated.
 - 4. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 5. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - 6. A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

7. A320 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
 8. A536 - Standard Specification for Ductile Iron Castings.
 9. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 10. B61 - Standard Specification for Steam or Valve Bronze Castings.
 11. B62 - Standard specification for Composition Bronze or Ounce Metal Castings.
 12. B505 - Standard Specification for Copper Alloy Continuous Castings.
 13. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
 14. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 15. F594 - Standard Specification for Stainless Steel Nuts.
 16. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
- E. Food and Drug Administration (FDA).
- F. International Concrete Repair Institute (ICRI):
1. 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
- G. Hydraulic Institute (HI).
- H. NSF International (NSF).

1.03 DEFINITIONS

- A. Special tools: Tools that have been specifically made for use on unit of equipment for assembly, disassembly, repair, or maintenance.
- B. Resonant frequency: That frequency at which a small driving force produces an ever-larger vibration if no dampening exists.
- C. Rotational frequency: The revolutions per unit of time usually expressed as revolutions per minute.
- D. Critical frequency: Same as resonant frequency for the rotating elements or the installed machine and base.
- E. Peak vibration velocity: The root mean square average of the peak velocity of the vibrational movement times the square root of 2 in inches per second.
- F. Rotational speed: Same as rotational frequency.
- G. Maximum excitation frequency: The excitation frequency with the highest vibration velocity of several excitation frequencies that are a function of the design of a particular machine.
- H. Critical speed: Same as critical frequency.

- I. Free field noise level: Noise measured without any reflective surfaces (an idealized situation); sound pressure levels at 3 feet from the source unless specified otherwise.
- J. Operating weight: The weight of unit plus weight of fluids or solids normally contained in unit during operation.

1.04 SYSTEM DESCRIPTION

- A. General:
 - 1. Product requirements as specified in Section 01605.
 - 2. Materials in contact with drinking water as specified in Section 01605.
 - 3. Provisions specified under each technical equipment specification prevail over and supersede conflicting provisions as specified in this Section.
 - 4. Provide equipment and parts that are suitable for stresses, which may occur during fabrication, transportation, erection, and operation.
 - 5. Provide equipment that has not been in service prior to delivery, except as required by tests.
 - 6. Like parts of duplicate units are to be interchangeable.
 - 7. When 2 or more units of equipment for the same purpose are required, provide products of same manufacturer.
 - 8. Equipment manufacturer's responsibility extends to selection and mounting of gear drive units, motors or other prime movers, accessories, and auxiliaries required for proper operation.
 - 9. When necessary, modify manufacturer's standard product to conform to specified requirements or requirements indicated on the Drawings and contained in Laws and Regulations.
- B. Material requirements:
 - 1. Materials: Suitable for superior corrosion resistance and for services under conditions normally encountered in similar installations.
 - 2. Dissimilar metals: Separate contacting surfaces with dielectric material.
- C. Power transmission systems:
 - 1. Power transmission equipment: V-belts, sheaves, shaft couplings, chains, sprockets, mechanical variable-speed drives, variable frequency drives, gear reducers, open and enclosed gearing, clutches, brakes, intermediate shafting, intermediate bearings, and U-joints are to be rated for 24 hour-a-day continuous service or frequent stops-and-starts intermittent service, whichever is most severe, and sized with a minimum service factor of 1.5:
 - a. Apply 1.5 service factor to nameplate horsepower and torque of prime source of power and not to actual equipment loading.
 - b. Apply service factors higher than 1.5 when recommended for continuous 24 hour per day operation and shock loadings in accordance with AGMA 6001-E08, other applicable AGMA standards, or other applicable referenced standards.
 - c. When manufacturer recommends service factor greater than 1.5, manufacturer's recommendation takes precedence.

- D. Vibration:
1. Resonant frequency:
 - a. For single speed equipment, ensure there are no natural resonant frequencies within 25 percent above or below the operating rotational frequencies or multiples of the operating rotational frequencies that may be excited by the equipment design.
 - b. For variable speed equipment, ensure there are no natural resonant frequencies within 25 percent above or below the range of operating frequencies.
 2. Design, balance, and align equipment to meet the vibration criteria specified in Section 15958.
- E. Equipment mounting and anchoring:
1. Mount equipment on cast iron or welded steel bases with structural steel support frames.
 - a. Utilize continuous welds to seal seams and contact edges between steel members.
 - b. Grind welds smooth.
 2. Provide bases and supports with machined support pads, dowels for alignment of mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits.
 3. Provide jacking screws in bases and supports for equipment weighing over 1,000 pounds.
 4. Design equipment anchorage, supports, and connections for dead load, running loads, loads during start-up, seismic load specified in Section 01612, and other loads as required for proper operation of equipment.
 5. Anchorage of equipment to concrete or masonry:
 - a. Perform calculations and determine number, size, type, strength, and location of anchor bolts or other connections.
 - b. Unless otherwise indicated on the Drawings, select and provide anchors from the types specified in Section 05190.
 - c. Provide bolt sleeves around cast-in anchor bolts for heavy equipment.
 - 1) Adjust bolts to final location and fill sleeve with polyurethane foam.
 6. Anchorage of equipment to metal supports: Perform calculations and determine number, size, type, strength, and location of bolts used to connect equipment to metal supports.
 7. Unless otherwise indicated on the Drawings, install equipment supported on concrete over non-shrink grout pads as specified in this Section.
- F. Seismic design:
1. Design equipment anchorage and related details for seismic design criteria as specified in Section 01612.
 2. For equipment with operating weight of 400 pounds and greater that is supported 4 feet or less above the floor and all equipment that is supported higher than 4 feet above the floor, provide calculations for:
 - a. The operating weight and location of the centroid of mass for the equipment.
 - b. Forces and overturning moments.
 - c. Shear and tension forces in equipment anchorages, supports, and connections.
 - d. The design of equipment anchorage, supports, and connections based on calculated shear and tension forces.

- G. Equipment units weighing 50 pounds or more: Provide with lifting lugs or eyes to allow removal with hoist or other lifting device.

1.05 SUBMITTALS

- A. Product data:
 - 1. For each item of equipment:
 - a. Design features.
 - b. Load capacities.
 - c. Efficiency ratings.
 - d. Material designations by UNS alloy number or ASTM Specification and Grade.
 - e. Data needed to verify compliance with the Specifications.
 - f. Catalog data.
 - g. Name plate data.
 - h. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.
 - 2. Gear reduction units:
 - a. Engineering information in accordance with applicable AGMA standards.
 - b. Gear mesh frequencies.
- B. Shop drawings:
 - 1. Drawings for equipment:
 - a. Drawings that include outline drawings, cut-away drawings, parts lists, material specification lists, and other information required to substantiate that proposed equipment complies with specified requirements.
 - 2. Outline drawings showing equipment, driver, driven equipment, pumps, seal, motor(s) or other specified drivers, variable frequency drive, shafting, U-joints, couplings, drive arrangement, gears, base plate or support dimensions, anchor bolt sizes and locations, bearings, and other furnished components.
 - 3. Installation instructions including leveling and alignment tolerances, grouting, lubrication requirements, and initial Installation Testing procedures.
 - 4. Wiring, control schematics, control logic diagrams and ladder logic or similar for computer based controls.
 - 5. Recommended or normal operating parameters such as temperatures and pressures.
 - 6. Alarm and shutdown set points for all controls furnished.
- C. Calculations:
 - 1. Calculations and other information to substantiate equipment base plates, supports, bolts, anchor bolts, and other connections meet minimum design strength requirements and seismic design criteria specified in Section 01612.
 - 2. ABMA 9 or ABMA 11 L10 life for bearings calculation methods for drivers, pumps, gears, shafts, motors, and other driveline components with bearings.
 - 3. Calculations and other information to substantiate that operating rotational frequencies meet the requirements of this Section.
 - 4. Torsional analysis of power transmission systems: When torsional analysis specified in the equipment sections, provide:
 - a. Sketch of system components identifying physical characteristics including mass, diameter, thickness, and stiffness.
 - b. Results of analysis including first and second critical frequencies of system components and complete system.

5. Calculations shall be signed and stamped by a civil or structural engineer registered to practice in the state where the Project is located.
- D. Quality control submittals:
1. Source quality control reports and certified test data as specified in Section 15958.
 2. Submit factory test reports before shipment.
 3. Certified static and dynamic balancing reports for rotating equipment.
 4. Field quality control reports and test data as specified in Section 15958.
 5. Submit material test reports as specified in the equipment sections.
- E. Operation and maintenance manuals:
1. As specified in Section 01730.
 2. Submit prior to training of Owner's personnel.
 3. Make available at project site complete copy of manuals for use by field personnel and Engineer during commissioning and process start-up of equipment.
 4. Include manufacturer and model number of every bearing; include calculated ball pass frequencies of the installed equipment for both the inner and outer raceways.
- F. Commissioning and process start-up submittals: As specified in Section 01756.
- G. Project closeout documents: As specified in Section 01700.

1.06 QUALITY ASSURANCE

- A. Manufacturer's field service:
1. Furnish services of authorized representative specially trained in installation of equipment:
 - a. Visit project site and perform tasks necessary to certify installation as specified in Section 01756.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping:
1. Equipment: Pack in boxes, crates, or otherwise protect from damage and moisture, dust, or dirt during shipment, handling, and storage.
 2. Bearings: Separately pack or otherwise suitably protect during transport.
 3. Spare parts: Deliver in boxes labeled with contents, equipment to which spare parts belong, and name of Contractor.
- B. Storage:
1. Equipment having bearings:
 - a. Store in enclosed facilities.
 - b. Rotate units at least once per month or more often as recommended by the manufacturer to protect rotating elements and bearings.
 2. Gear boxes: Oil filled or sprayed with rust preventive protective coating.
- C. Protection:
1. Equipment: Protect equipment from deleterious exposure.
 2. Painted surfaces: Protect against impact, abrasion, discoloration, and other damage.

1.08 SEQUENCING AND SCHEDULING

- A. Equipment anchoring: Obtain anchoring material and templates or setting drawings from equipment manufacturers in adequate time for anchors to be cast-in-place when concrete is placed.
- B. Coordinate details of equipment with other related parts of the Work, including verification that structures, piping, wiring, and equipment components are compatible.
- C. Commissioning submittals: As specified in Section 01756:
 - 1. Perform general commissioning and process start-up and testing procedures after operation and maintenance manuals for equipment have been received and accepted.
 - 2. Conduct functional testing of mechanical or electrical systems when each system is substantially complete and after general Installation testing procedures have been successfully completed.
 - 3. Functional testing requirements as specified in Sections 01756, 15958, and 16950 and the equipment sections.

1.09 MAINTENANCE

- A. Special tools:
 - 1. When specified, provide special tools required for operation and maintenance.
 - 2. Mark or tag and list such tools in maintenance and operations instructions. Describe use of each tool.
- B. Spare belts:
 - 1. When spare belts are specified, furnish 1 spare belt for every different type and size of belt-driven unit:
 - a. Where 2 or more belts are involved, furnish matched sets.
 - b. Identify as to equipment, design, horsepower, speed, length, sheave size, and use.
 - c. Package in boxes labeled with identification of contents.
- C. Spare parts:
 - 1. Assume responsibility until turned over to Owner.
 - 2. Store in enclosed facilities.
 - 3. Furnish itemized list and match identification tag attached to every part.
 - 4. List parts by generic title and identification number.
 - 5. Furnish name, address, and telephone number of supplier and spare parts warehouse.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials in contact with drinking water as specified in Section 01605.
- B. Ferrous materials:
 - 1. Steel for members used in fabrication of assemblies: ASTM A36.

2. Iron castings: ASTM A48, tough, close-grained gray iron, free from blowholes, flaws, and other imperfections.
 3. Ductile iron castings: ASTM A536, Grade 65-45-12, free from flaws and imperfections.
 4. Galvanized steel sheet: ASTM A653, minimum 0.0635 inch (16 gauge).
 5. Expanded metal: ASTM A36, 13 gauge, 1/2-inch flat pattern expanded metal.
- C. Nonferrous materials:
1. Stainless steel: Type 304 or 316 as specified. Provide L grade where welding required.
 2. Bronze in contact with wastewater: Composition of not more than 2 percent aluminum nor more than 6 percent zinc; UNS Alloy C83600,] C92200, or C93700 in accordance with ASTM B61, B62, B505, or B584, when not specified otherwise.
- D. Dielectric materials for separation of dissimilar metals:
1. Neoprene, bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other materials.
- E. Non-shrink grout: As specified in Section 03600.

2.02 FASTENERS

- A. General:
1. Material: As specified in the individual specifications.
 2. Where fasteners are specified to be galvanized, shall be galvanized in accordance with ASTM A153 or ASTM F2329.
- B. Mechanical anchors:
1. As specified in Section 01612 and Section 05190.
- C. High-strength fasteners:
1. As specified in Section 05120.
- D. Flange bolts:
1. As specified in Section 15052.
- E. Mechanical assembly fasteners:
1. Stainless steel:
 - a. High Temperature Service or High Pressure Service.
 - 1) Bolts: ASTM A193, Grade B8 (304 SST) or Grade B8M (316 SST), Class 1, heavy hex.
 - 2) Nuts: ASTM A194, Grade 8, heavy hex.
 - 3) Washers: Alloy group matching bolts and nuts.
 - b. Low Temperature Service:
 - 1) Bolts: ASTM A320, Grade B8 (304 SST) or Grade B8M (316 SST), Class 1, heavy hex.
 - 2) Nuts: ASTM A194, Grade 8 (304 SST) or Grade B8M (316 SST), heavy hex.
 - 3) Washers: Alloy group matching bolts and nuts.
 - c. General service:
 - 1) Bolts: ASTM F593, Alloy group 1 (304 SST) or Alloy group 2 (316 SST).

- 2) Nuts: ASTM F594, Alloy group 1 (304 SST) or Alloy group 2 (316 SST).
- 3) Washers: Alloy group matching bolts and nuts.
2. Carbon steel.

2.03 SHAFT COUPLINGS

- A. General:
 1. Type and ratings: Provide nonlubricated type, designed for not less than 50,000 hours of operating life.
 2. Sizes: Provide as recommended by manufacturer for specific application, considering horsepower, speed of rotation, and type of service.
 3. Use: Use of couplings specified in this Section does not relieve Contractor of responsibility to provide precision alignment of driver-driven units as required by equipment manufacturer and alignment criteria specified elsewhere in this Section.
- B. Shaft couplings - close coupled: Shaft couplings for close coupled electric motor driven equipment 1/2 horsepower or larger and subject to sudden torque reversals or shock loading:
 1. Manufacturers: One of the following or equal:
 - a. T.B. Woods, Dura-Flex, L-Jaw C-Jaw or G-Jaw.
 - b. Lovejoy, S-Flex.
 2. Provide flexible couplings designed to accommodate angular misalignment, parallel misalignment, and end float.
 3. Manufacture flexible component of coupling from synthetic rubber, or urethane.
 4. Provide service factor of 2.5 for electric motor drives and 3.5 for engine drives.
 5. Do not allow metal-to-metal contact between driver and driven equipment.
 6. Examples of loads where sudden torque reversals may be expected:
 - a. Reciprocating pumps, blowers, and compressors.
 - b. Conveyor belts.
 - c. Reversing equipment.
- C. Shaft couplings - direct connected: Shaft couplings for direct connected electric motor driven equipment 1/2 horsepower or larger and subject to normal torque, non-reversing applications:
 1. Manufacturers: One of the following or equal:
 - a. Rexnord - Falk.
 - b. T.B. Woods, Dura-Flex, Sure-Flex or Form-Flex.
 2. Provide flexible couplings designed to accommodate shock loading, vibration, and shaft misalignment or offset.
 3. Provide flexible connecting element of rubber and reinforcement fibers.
 4. Connect stub shafts through collars or round flanges, firmly keyed to their shafts with neoprene cylinders held to individual flanges by through pins.
- D. Spacer couplings: Where cartridge type mechanical seals or non-split seals are specified, provide a spacer type coupling of sufficient length to remove the seal without disturbing the driver or driven equipment unless noted otherwise in the individual equipment specifications.

- E. Specialized couplings: Where requirements of equipment dictate specialized features, supply coupling recommended for service by manufacturer.

2.04 STUFFING BOX, SEAL CHAMBER, AND SHAFT SEALS

A. General:

1. Unless otherwise noted in the equipment section, provide cartridge type, double mechanical shaft seals for pumps.
2. Provide a stuffing box large enough for a double mechanical seal.
3. Where packing is specified, provide stuffing box large enough to receive a double mechanical seal.
4. Provide seal or packing flush connections, (3/4-inch size unless another size is indicated on the Drawings).
5. Provide and route leakage drain line to nearest equipment floor drain indicated on the Drawings.
6. For pumps with packing, design packing gland to allow adjustment and repacking without dismantling pump except to open up packing box.
7. Seal or packing flush requirements shall be in accordance with API Standard 682 requirements. Unless otherwise indicated, specified or required by the equipment and seal manufacturers, the following API flushing Plan arrangements shall be utilized as appropriate for the application:
 - a. Single seal, clean water applications: Plan 11 (Discharge bypass to seal).
 - b. Single seal, vertical pump applications: Plan 13 (Seal bypass to suction).
 - c. Single seal, clean hot water (greater than 180 degrees Fahrenheit) applications: Plan 23 (Seal cooler and pumping ring).
 - d. Single seal, solids, or contaminants containing water applications: Plan 32 (External seal water- see Carollo typical detail # M262).
 - e. Double seal applications: Plan 54 (External seal water- see Carollo typical detail # M262).

B. Packing: When specified in the equipment section of the specifications, provide the following type of packing:

1. Wastewater, water, and sludge applications:
 - a. Asbestos free.
 - b. PTFE (Teflon) free.
 - c. Braided graphite.
 - d. Manufacturers: One of the following or equal:
 - 1) Chesterton, 1400.
 - 2) John Crane Inc., equivalent product.
2. Drinking water service:
 - a. Approved by the FDA.
 - b. As specified in Section 01605.
 - c. Asbestos free.
 - d. Material: Braided PTFE (Teflon).
 - e. Manufacturers: One of the following or equal:
 - 1) Chesterton, 1725.
 - 2) John Crane, Inc., equivalent product.

C. Mechanical seals: Provide seal types specified in the equipment sections and as specified.

1. Provide seal types meeting the following requirements:
 - a. Balanced hydraulically.

- b. Spring: Stationary, out of pumping fluid, Hastelloy C; Type Elgiloy or 17-7 PH stainless steel for split seals.
 - c. O-ring: Viton 747.
 - d. Gland: Type 316L stainless steel.
 - e. Set screws: Type 316L stainless steel.
 - f. Faces: Reaction bonded, Silicon Carbide.
 - g. Seal designed to withstand 300 pounds per square inch gauge minimum differential pressures in either direction; no requirement for seal buffer pressure to be maintained when pump is not operational even though process suction head may be present in pump.
- 2. Cartridge type single mechanical: Manufacturers: One of the following or equal:
 - a. Chesterton, S10.
 - b. John Crane, 5610 Series.
- 3. Cartridge type double mechanical: Manufacturers: One of the following or equal:
 - a. Chesterton, S20.
 - b. John Crane, 5620 Series.
- 4. Split face single mechanical: Manufacturers: One of the following or equal:
 - a. Chesterton, 442.
 - b. John Crane, 3740.
- 5. Cartridge type flushless mechanical: Manufacturers: One of the following or equal:
 - a. Chesterton, 156.
 - b. John Crane, 5870.
- D. Special techniques: Use applicable special tools and equipment, including precision machinist levels, dial indicators, and gauges as required in equipment installations.
- E. Tolerances:
 - 1. Completed equipment installations: Comply with requirements for intended use and specified vibration and noise tolerances.
- F. Warning signs: Mount securely with stainless fasteners at equipment that can be started automatically or from remote locations.

2.05 FIELD QUALITY CONTROL

- A. Test equipment as specified in Section 15958 and the individual equipment section of the Specifications.

2.06 COMMISSIONING

- A. Perform commissioning as specified in Section 01756.

END OF SECTION

SECTION 15052

COMMON WORK RESULTS FOR GENERAL PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Basic piping materials and methods.
- B. Related sections:
 - 1. Section 01756 - Commissioning.
 - 2. Section 09960 - High-Performance Coatings.
 - 3. Section 15061 - Pipe Supports.
 - 4. Section 15211 - Ductile Iron Pipe : AWWA C151.
 - 5. Section 15244 - Polyvinyl Chloride (PVC) Pipe: AWWA C900.
 - 6. Section 15956 - Piping Systems Testing.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through 24.
 - 2. B16.47 - Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard.
- B. American Water Work Association (AWWA):
 - 1. C105 – Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - 2. C207 - Standard for Steel Pipe Flanges for Waterworks Services-Size 4 In. Through 144 In.
- C. ASTM International (ASTM):
 - 1. A 193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - 2. A 194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - 3. A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - 4. A 563 – Standard Specification for Carbon and Alloy Steel Nuts.
 - 5. F 37 - Standard Test Methods for Sealability of Gasket Materials.
- D. California Health and Safety Code.

1.03 DEFINITIONS

- A. Buried pipe: Pipe that is buried in the soil, or cast in a concrete pipe encasement that is buried in the soil.
- B. Exposed pipe: Pipe that is located above ground, or pipe that is located inside a structure, supported by a structure, or cast into a concrete structure.

- C. Underground piping: Piping actually buried in soil or cast in concrete that is buried in soil.
- D. Underwater piping: Piping below tops of walls in basins or tanks containing water.
- E. Wet wall: Wall with water on at least 1 side.

1.04 SUBMITTALS

- A. Product data:
 - 1. Escutcheons.
 - 2. Flange bolts.
 - 3. Gaskets.
 - 4. Grooved joint couplings and fittings.
 - 5. Link -type seals.
 - 6. Certifications of compliance with reference standard for lead limits.
- B. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756.
- C. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756.

PART 2 PRODUCTS

2.01 ESCUTCHEONS

- A. Material: Chrome-plated steel plate.
- B. Manufacturers: One of the following or equal:
 - 1. Dearborn Brass Company, Model Number 5358.
 - 2. Keeney Manufacturing Company, Model Number 102 or Number 105.

2.02 LINK TYPE SEALS

- A. Characteristics:
 - 1. Modular mechanical type, consisting of interlocking neoprene or synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening.
 - 2. Assemble links solely with stainless steel bolts and nuts to form a continuous rubber belt around the pipe.
 - 3. Provide a nylon polymer pressure plate with Type 316 stainless steel hardware. Isolate pressure plate from contact with wall sleeve.
- B. Manufacturers: One of the following or equal:
 - 1. Calpico, Incorporated.
 - 2. Pipeline Seal and Insulator, Inc., Link-Seal.

2.03 FLANGE BOLTS

- A. Ductile iron pipe:
 - 1. Bolts and nuts for ductile iron pipe flanges located indoors, outdoors above ground, or in dry vaults and structures and where pressures do not exceed

150 pounds per square inch shall be hot-dip galvanized carbon steel, ASTM A 307, Grade B A 563 - Standard Specification for Carbon and Alloy Steel Nuts.

2. Bolts and nuts for ductile iron pipe flanges located indoors, outdoors above ground, or in dry vaults and structures where the pressures exceed 150 pounds per square inch shall be alloy steel, ASTM A 193, Grade B7 for bolts and in accordance with ASTM A 194, Grade 2H for nuts.
3. Bolts and nuts for ductile iron pipe flanges submerged in water or wastewater, buried, in wet vaults or structures, adjacent to wet walls, or above open water-containing structures shall be Type 316 stainless steel in accordance with ASTM A 193, Grade B8M for bolts and in accordance with ASTM A 194, Grade 8M for nuts.
4. Provide a washer for each nut. Washer shall be of the same material as the nut.
5. Nuts shall be Heavy hex-head.
6. Cut and finish flange bolts to project a maximum of 1/4 inch beyond outside face of nut after assembly.
7. Tap holes for cap screws or stud bolts when used.

B. Plastic pipe:

1. Bolts and nuts for flanges on plastic pipe located indoors, outdoors above ground, or in dry vaults and structures shall be hot-dip galvanized carbon steel, in accordance with ASTM A 307, Grade B for bolts and in accordance with ASTM A 563, Grade A for nuts.
2. Bolts and nuts for flanges on plastic pipe submerged in water or wastewater, buried, in wet vaults or structures, adjacent to wet walls, or above open water-containing structures and plastic pipe carrying corrosive chemicals shall be-Type 316 stainless steel in accordance with ASTM A 193, Grade B8M for bolts and in accordance with ASTM A 194, Grade 8M for nuts.
3. Provide a washer for each nut. Washer shall be of the same material as the nut.
4. Nuts shall be Heavy hex-head.
5. Cut and finish flange bolts to project a maximum of 1/4 inch beyond outside face of nut after assembly.
6. Tap holes for cap screws or stud bolts when used.

C. Steel pipe:

1. Bolts and nuts for ASME B16.5 Class 150 flanges and AWWA C207 Class D flanges located indoors, outdoors above ground, or in dry vaults and structures shall be hot-dip galvanized carbon steel, ASTM A 307, Grade B for bolts and in accordance with ASTM A 563, Grade A for nuts.
2. Bolts and nuts for ASME B16.5 and B16.47 Class 300 flanges and AWWA C207 Class E and F flanges located indoors, outdoors above ground, or in dry vaults and structures in accordance with ASTM A 193, Grade B7 for bolts and in accordance with ASTM A 194, Grade 2H for nuts.
3. Bolts and nuts for flanges submerged in water or wastewater, buried, in wet vaults or structures, adjacent to wet walls, or above open water-containing structures shall be Type 316 stainless steel in accordance with ASTM A 193, Grade B8M for bolts and in accordance with ASTM A 194, Grade 8M for nuts.
4. Provide a washer for each nut. Washer shall be of the same material as the nut.
5. Nuts shall be Heavy hex-head.

6. Cut and finish flange bolts to project a maximum of 1/4 inch beyond outside face of nut after assembly.
 7. Tap holes for cap screws or stud bolts when used.
- D. Lubricant for stainless steel bolts and nuts:
1. Chloride-free.
 2. Manufacturers: One of the following or equal:
 - a. Huskey FG-1800.

2.04 GASKETS

- A. Gaskets for non-steam cleaned ductile iron and steel piping:
1. Suitable for pressures equal and less than 150 pounds per square inch gauge, temperatures equal and less than 250 degrees Fahrenheit, and raw sewage service.
 2. Gasket material:
 - a. Neoprene elastomer with minimum Shore A hardness value of 70.
 - b. Reinforcement: Inserted 13-ounce nylon fabric cloth for pipes 20 inch or larger.
 - c. Thickness: Minimum 3/32-inch thick for less than 10-inch pipe; minimum 1/8 inch thick for 10-inch and larger pipe.
 3. Manufacturers: One of the following or equal:
 - a. Pipe less than 20 inches in diameter:
 - 1) Garlock, Style 7797.
 - 2) John Crane, similar product.
 - b. Pipe 20 inches in diameter and larger:
 - 1) Garlock, Style 8798.
 - 2) John Crane, similar product.
- B. Gaskets for flanged joints in ductile iron or steel water piping:
1. Suitable for hot or cold water, pressures equal and less than 150 pounds per square inch gauge, and temperatures equal and less than 160 degrees Fahrenheit.
 2. Material:
 - a. Neoprene elastomer, compressed, with non-asbestos fiber reinforcement.
 3. Manufacturers: One of the following or equal:
 - a. Garlock, Bluegard 3300.
 - b. John Crane, similar product.
- C. Provide gaskets suitable for the specific fluids and pressure and temperature conditions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of existing conditions:
1. Locate and expose existing structures, piping, conduits, and other facilities and obstructions that may affect construction of underground piping before starting excavation for new underground piping and appurtenances.

2. Verify sizes, elevations, locations, and other relevant features of existing facilities and obstructions. Determine conflicts for the construction of the new underground piping and appurtenances.
3. Make piping location and grade adjustments to resolve conflicts between new piping and existing facilities and obstructions.

3.02 COMMISSIONING REQUIREMENTS

- A. As specified in Section 01756 and this Section.
- B. Manufacturer services:
 1. Provide Manufacturer's Certificate of Source Testing.
 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.
 - a. Functional Testing: for watertight installations only.

3.03 INSTALLATION

- A. General:
 1. Piping drawings:
 - a. Except in details, piping is indicated diagrammatically. Not every offset and fitting, or structural difficulty that may be encountered has been indicated on the Drawings. Sizes and locations are indicated on the Drawings.
 - b. Perform minor modifications to piping alignment where necessary to avoid structural, mechanical, or other type of obstructions that cannot be removed or changed.
 - 1) Modifications are intended to be of minor scope, not involving a change to the design concept or a change to the Contract Price or Contract Times.
 2. Piping alternatives:
 - a. Provide piping as specified in this Section, unless indicated on the Drawings or specified otherwise.
 - b. Alternative pipe ratings:
 - 1) Piping with greater pressure rating than specified may be substituted in lieu of specified piping without changes to the Contract Price.
 - 2) Piping of different material may not be substituted in lieu of specified piping.
 - c. Valves in piping sections: Capable of withstanding specified test pressures for piping sections and fabricated with ends to fit piping.
 - d. For grooved joints, use couplings, flange adapters, and fittings of the same manufacturer.
 - 1) The grooved joint manufacturer's factory trained representative shall provide on-site training for Contractor's field personnel.
 - 2) The representative shall periodically visit the jobsite and review Contractor is following best recommended practices in grooved product installation.
 - 3) A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).
 - e. For flanged joints, where 1 of the joining flanges is raised face type, provide a matching raised face type flange for the other joining flange.

3. Unless otherwise indicated on the Drawings, piping at pipe joints, fittings, couplings, and equipment shall be installed without rotation, angular deflection, vertical offset, or horizontal offset.
- B. Wall and slab penetrations:
1. Provide sleeves for piping penetrations through aboveground masonry and concrete walls, floors, ceilings, roofs, unless specified or otherwise indicated on the Drawings.
 2. For piping 1 inch in nominal diameter and larger, provide sleeves with minimum inside diameters of 1 inch plus outside diameter of piping. For piping smaller than 1 inch in nominal diameter, provide sleeve of minimum twice the outside diameter of piping.
 - a. Arrange sleeves and adjacent joints so piping can be pulled out of sleeves and replaced without disturbing the structure.
 - b. Cut ends of sleeves flush with surfaces of concrete, masonry, or plaster.
 - c. Conceal ends of sleeves with escutcheons where piping runs through floors, walls, or ceilings of finished spaces within buildings.
 - d. Seal spaces between pipes and sleeves with link-type seals when not otherwise specified or indicated on the Drawings.
 - e.
 3. Provide flexibility in piping connecting to structures to accommodate movement due to soil settlement and earthquakes. Provide flexibility using details indicated on the Drawings.
 4. Core drilled openings:
 - a. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without acceptance by Engineer.
 - b. Determine location of reinforcing bars or other obstructions with a non-destructive indicator device.
 - c. Remove dust and debris from hole using compressed air.
- C. Exposed piping:
1. Install exposed piping in straight runs parallel to the axes of structures, unless otherwise indicated on the Drawings:
 - a. Install piping runs plumb and level, unless otherwise indicated on the Drawings.
 - 1) Slope plumbing drain piping with a minimum of 1/4 inch per foot downward in the direction of flow.
 - 2) Slope digester gas piping to drip traps or low-point drains at a minimum of 1/2 inch per foot where condensate flows against the gas, or at a minimum of 1/4 inch per foot where condensate flows with gas.
 2. Install exposed piping after installing equipment and after piping and fitting locations have been determined.
 3. Support piping: As specified in Section 15061:
 - a. Do not transfer pipe loads and strain to equipment.
 4. In addition to the joints indicated on the Drawings, provide unions, flexible couplings, flanged joints, flanged coupling adapters, and other types of joints or means which are compatible with and suitable for the piping system, and necessary to allow ready assembly and disassembly of the piping.

5. Assemble piping without distortion or stresses caused by misalignment:
 - a. Match and properly orient flanges, unions, flexible couplings, and other connections.
 - b. Do not subject piping to bending or other undue stresses when fitting piping.
 - c. Do not correct defective orientation or alignment by distorting flanged joints or subjecting flange bolts to bending or other undue stresses.
 - d. Flange bolts, union halves, flexible connectors, and other connection elements shall slip freely into place.
 - e. Alter piping assembly to fit, when proper fit is not obtained.
 - f. Install eccentric reducers or increasers with the top horizontal for pump suction piping.
- D. Buried piping:
 1. Bury piping with minimum 3-foot cover without air traps, unless otherwise indicated on the Drawings.
 2. Where 2 similar services run parallel to each other, piping for such services may be laid in the same trench.
 - a. Lay piping with sufficient room for assembly and disassembly of joints, for thrust blocks, for other structures, and to meet separation requirements of public health authorities having jurisdiction.
 3. Laying piping:
 - a. Lay piping in finished trenches free from water or debris. Begin at the lowest point with bell ends up slope.
 - b. Place piping with top or bottom markings with markings in proper position.
 - c. Lay piping on an unyielding foundation with uniform bearing under the full length of barrels.
 - d. Where joints require external grouting, banding, or pointing, provide space under and immediately in front of the bell end of each section laid with sufficient shape and size for grouting, banding, or pointing of joints.
 - e. At the end of each day's construction, plug open ends of piping temporarily to prevent entrance of debris or animals.
 4. Concrete encase all buried pipe installed under concrete slabs or structures.
- E. Venting piping under pressure:
 1. Lay piping under pressure flat or at a continuous slope without air traps, unless otherwise indicated on the Drawings.
 2. Install plug valves as air bleeder cocks at high points in piping.
 - a. Provide 1-inch plug valves for water lines, and 2-inch plug valves for sewage and sludge lines, unless otherwise indicated on the Drawings.
 3. Provide additional pipe taps with plug cocks and riser pipes along piping as required for venting during initial filling, disinfecting, and sampling.
 4. Before piping is placed into service, close plug valves and install plugs. Protect plugs and plug valves from corrosion in as specified in Section 09960.
- F. Restraining piping:
 1. Restrain piping at valves and at fittings where piping changes direction, changes sizes, and at ends:
 - a. When piping is underground, use concrete thrust blocks, mechanical restraints, or push-on restraints.
 - b. When piping is aboveground or underwater, use mechanical or structural restraints.

- c. Determine thrust forces by multiplying the nominal cross sectional area of the piping by design test pressure of the piping.
 2. Provide restraints with ample size to withstand thrust forces resulting from test pressures:
 - a. During testing, provide suitable temporary restraints where piping does not require permanent restraints.
 3. Place concrete thrust blocks against undisturbed soil.
 4. Place concrete so piping joints, fittings, and other appurtenances are accessible for assembly and disassembly.
 5. Provide underground mechanical restraints where specified in the Piping Schedule.
- G. Connections to existing piping:
 1. Expose existing piping to which connections are to be made with sufficient time to permit, where necessary, field adjustments in line, grade, or fittings:
 - a. Protect domestic water/potable water supplies from contamination:
 - 1) Make connections between domestic water supply and other water systems in accordance with requirements of public health authorities.
 - 2) Provide devices approved by Owner of domestic water supply system to prevent flow from other sources into the domestic supply system.
 2. Make connections to existing piping and valves after sections of new piping to be connected have been tested and found satisfactory.
 3. Provide sleeves, flanges, nipples, couplings, adapters, and other fittings needed to install or attach new fittings to existing piping and to make connections to existing piping.
 4. For flanged connections, provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.
- H. Connections to in-service piping:
 1. As specified in Section 01030.
- I. Connections between ferrous and nonferrous metals:
 1. Connect ferrous and nonferrous metal piping, tubing, and fittings with dielectric couplings especially designed for the prevention of chemical reactions between dissimilar metals.
 2. Nonferrous metals include aluminum, copper, and copper alloys.
- J. Flanged connections between dissimilar metals such as ductile iron pipe and steel pipe:
 1. Provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.

3.04 CLEANING

- A. Piping cleaning:
 1. Upon completion of installation, clean piping interior of foreign matter and debris.
 2. Perform special cleaning when required by the Contract Documents.
 3. Disassemble and clean valves and equipment that have oil residues before installation.

- B. Cleaning air piping:
1. Perform special cleaning of filtered air piping from the intake clean air plenums to the discharge points and high-pressure air piping.
 - a. Protect surfaces from contamination.
 2. Special cleaning shall include wire brushing, power tool cleaning, wiping down with lint-free cloths, brooming, and vacuuming to remove rust, scale, weld spatter, dust, dirt, oil, and other matter deleterious to operation of the air system:
 - a. Do not sandblast installed piping.
 3. To the greatest extent possible, clean piping immediately prior to final closure of piping systems:
 - a. Enter piping, clean and wipe down surfaces, and vacuum out residue.
 - b. Clean surfaces not accessible to this cleaning operation after installation within 6 hours preceding installation.
 4. Subsequent to cleaning, protect surfaces from contamination by dust, dirt, construction debris, and moisture, including atmospheric moisture:
 - a. Whether or not pipe upstream has been cleaned, temporarily seal openings in partially completed work except when installation is actively in progress.
 - b. When installation is actively in progress, seal openings at the end of each day's construction or when construction is temporarily stopped.
 5. Suspend cleaning and seal openings when inclement weather, including dust storms, is imminent.
 6. Use clean, dry air for testing the piping and other elements of the system.
 7. Prior to introduction of air to the system, blow piping clean.
 - a. Blow with maximum discharge rate possible for minimum 4 hours, using new blowers or compressors and filters.
 8. Clean surfaces that become contaminated prior to acceptance.

3.05 PIPING SCHEDULE

PIPING SCHEDULE											
Process Abbrev.	Service	Nominal Diameter (inches)	Material	Pressure Class Special Thickness Class Schedule Wall Thickness	Pipe Spec. Section	Joints/ Fittings	Test Pressure/ Method	Lining	Coating	Service Conditions	Comments
FM	Underground Sewer Force Main	6-8	DIP	CL 53	15211	Restrained MJ	50 psig/HH	CM	2 Layers PEE	Sewage	
FM	Exposed Force Main in Wetwell and through Vaults	4-6	DIP	CL 53	15211	Restrained MJ or FL where shown	50 psig/HH	CM	2 Layers PEE	Sewage	
SS	Underground Gravity Sewer	8-12	PVC	AWWA C900	15244	B&SP	15 psig/LH	None	None	Sewage	
Vent	Air Vent	1-6	PVC	SCH 80	15245	FL	15 psig/AM	None	None	Air Vent	Above Roof
Vent	Air Vent	6	316 SST	SCH 10S	15286	FL	15 psig/AM	None	None	Air Vent	Through Concrete Roof
D	Drain Underground	0.5-4	PVC	SCH 40	15245	B&SP	15 psig/AM	None	None	Water	

PIPING SCHEDULE											
Process Abbrev.	Service	Nominal Diameter (inches)	Material	Pressure Class Special Thickness Class Schedule Wall Thickness	Pipe Spec. Section	Joints/ Fittings	Test Pressure/ Method	Lining	Coating	Service Conditions	Comments
Abbreviations: 1. The following abbreviations used in the column of test method refer to the respective methods as specified in Section 15956. AM Air method GR Gravity method LH Low head method 2. Abbreviations to designate piping include the following: B&SP Bell and spigot CL Class, followed by the designation CM Cement mortar DIP Ductile iron piping EPP Epoxy polyurethane coating FL Flange GA Gauge, preceded by the designation						GE Grooved end joint GSP Galvanized steel pipe MJ Mechanical joint NPS Nominal pipe size, followed by the number in inches psi pounds per square inch psig pounds per square inch gauge PEE Polyethylene encasement PVC Polyvinyl Chloride SCH Schedule, followed by the designation SST Stainless steel					

END OF SECTION

May 2016

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8231C10

pw:///CarolloDocuments/Client/CA/Sausalito-M/CSD/8231C10/Specifications/15052 (BldSet)

SECTION 15061

PIPE SUPPORTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Supports for pipe, fittings, valves, and appurtenances.
- B. Related sections:
 - a. Section 01410 - Regulatory Requirements.
 - b. Section 01756 - Commissioning.
 - c. Section 05120 - Structural Steel.
 - d. Section 09960 - High-Performance Coatings.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - 3. A967 - Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
- B. Manufacturer's Standardization Society (MSS):
 - 1. SP-58 - Pipe Hangers and Supports - Materials, Design, and Manufacture.

1.03 SUBMITTALS

- A. Shop drawings: Include schedule, indicating where supports will be installed, and drawings of pipe support system components.
- B. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756.
- C. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General:
 - 1. Hot dip galvanized:
 - a. Fabricate as specified in Section 05120.
 - b. Hot dip after fabrication of support in accordance with ASTM A123.
 - c. Repair galvanized surface as specified in Section 05120.
 - 2. Stainless steel.
 - a. Fabricate as specified in Section 05120.

- b. Finish requirements: Remove free iron, heat tint oxides, weld scale, and other impurities, and obtain a passive finished surface.
 - c. At the shop, perform pickling and passivation on all surfaces inside and out in accordance with ASTM A380 or A967.
 - 1) Passivation treatments using citric acid are not allowed.
 - d. Field welding is prohibited unless specifically allowed by the Owner. All field welds shall be passivated.
- B. Outdoor areas: Areas exposed to the natural outdoor environment:
 - 1. Type 316 Stainless Steel.
- C. Indoor areas: Areas exposed to an indoor environment including galleries and tunnels:
 - 1. Type 316 Stainless Steel.
- D. Submerged, 3 feet or less above water level in a structure, or inside a water bearing structure:
 - 1. Type 316 Stainless Steel.
- E. Stainless steel piping system:
 - 1. Type 316 Stainless Steel.
- F. Fasteners:
 - 1. As specified in Section 05120.

2.02 PIPE SUPPORTS

- A. Hanger rods: Sized to match suspended pipe hanger, or as indicated on the Drawings:
 - 1. Manufacturers: One of following or equal:
 - a. For stainless steel piping:
 - 1) Bergen-Power, Figure 133.
 - 2) Nibco-Tolco, Figure 103.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 140.
 - 2) Bergen-Power, Figure 133.
 - 3) Cooper B-Line Systems, Inc., Figure B3205.
- B. Hanger rods, continuously threaded: Sized to match suspended pipe hanger, or as indicated on the Drawings:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Bergen-Power, Figure 94.
 - 2) FM Stainless Fasteners.
 - b. For steel and ductile iron piping:
 - 1) Anvil International, Figure 146.
 - 2) Bergen-Power, Figure 94.
- C. Eye bolts:
 - 1. For stainless steel piping:
 - a. Type 316 stainless steel, welded and rated equal to full load capacity of rod.

2. For all other piping, unless indicated on the Drawings:
 - a. Welded and rated equal to full load capacity of rod.
- D. Welded eyebolt rod:
 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 101.
 - 2) FM Stainless Fasteners.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 278.
 - 2) Bergen-Power, Figure 93.
 - 3) Cooper B-Line Systems, Inc., Figure B3210.
- E. Adjustable ring hangers: MSS SP-58, Type 7 or Type 9 (system dependent):
 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 1C.I.
 - 2) Bergen-Power, Figure 100SS.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 97.
 - 2) Cooper B-Line Systems, Inc., Figure B3172.
- F. Adjustable clevis hangers: MSS SP-58, Type 1:
 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Cooper B-Line Systems, Inc, Figure B3100 or B3102.
 - 2) FM Stainless Fasteners, Figure 60.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 260 or Figure 590.
 - 2) Bergen-Power, Figure 100.
 - 3) Cooper B-Line Systems, Inc., Figure B3100 or B3102.
- G. Adjustable clevis hangers for insulated pipe: Oversize:
 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 1A.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 300.
 - 2) Bergen-Power, Figure 100EL.
 - 3) Cooper B-Line Systems, Inc. Figure B3108.
- H. Single rod hangers for steam pipe: MSS SP-58, Type 43; malleable iron or steel yoke and roller hangers; swivel to allow rotation of yoke on rod:
 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 324.
 - 2) Cooper B-Line Systems, Inc., Figure B3110.
 - 3) FM Fasteners, Figure 81.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 181.
 - 2) Cooper B-Line Systems, Inc., Figure B3110.

- I. Brackets: MSS SP-58, Type 32 with back plate; rated for 1,500 pounds:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 30M.
 - 2) Cooper B-Line Systems, Inc., Figure B3066.
 - 3) FM Stainless Fasteners, Figure 98.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 195.
 - 2) Cooper B-Line Systems, Inc., Figure B3066.
- J. Standard U-bolt: MSS SP-58, Type 24:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 110.
 - 2) Cooper B-Line Systems, Inc., Figure B3188.
 - 3) FM Stainless Fasteners, Figure 37.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 137.
 - 2) Bergen-Power, Figure 283.
 - 3) Cooper B-Line Systems, Inc., Figure B3188.
- K. Riser clamps: MSS SP-58, Type 8:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Cooper B-Line Systems, Inc., Figure B3373.
 - 2) FM Stainless Fasteners, Figure 61.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 261.
 - 2) Bergen-Power, Figure 126.
 - 3) Cooper B-Line Systems, Inc., Figure B3373.
- L. Pipe clamps: MSS SP-58, Type 4:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 4.
 - 2) Cooper B-Line Systems, Inc., Figure 3140.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 212.
 - 2) Bergen-Power, Figure 175.
 - 3) Cooper B-Line Systems, Inc., Figure B3140.
- M. Adjustable offset pipe clamp:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 4.
 - 2) Cooper B-Line Systems, Inc., Figure B3149.
 - 3) FM Stainless Fasteners, Figure 63.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 100.
 - 2) Cooper B-Line Systems, Inc., Figure B3149.

- N. Offset pipe clamp:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 8.
 - 2) Cooper B-Line Systems, Inc., Figure 3148.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 103.
 - 2) Cooper B-Line Systems, Inc., Figure B3148.
- O. Floor stand or stanchion saddles: MSS SP-58, Type 37. Provided with U-bolt hold down yokes:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 318.
 - 2) FM Stainless Fasteners, Figure 59.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 259.
 - 2) Bergen-Power, Figure 125.
 - 3) Cooper B-Line Systems, Inc., Figure B3090.
 - c. Threaded pipe stand support stanchion. Match pipe support material.
 - 1) Anvil International, Figure 63T.
 - 2) Bergen-Power, Figure 138.
 - 3) Cooper B-Line Systems Inc., Figure B3088ST.
- P. Spring hangers:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Bergen-Power, Figure 920.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure B-268, Type G.
 - 2) Bergen-Power, Figure 920.
- Q. One hole pipe clamps:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Not used.
 - b. For all other piping:
 - 1) Anvil International, Figure 126.
 - 2) Carpenter & Paterson, Figure 237S.
- R. Welded beam attachment: MSS SP-58, Type 22:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 304.
 - 2) Cooper B-Line Systems, Inc., Figure 3083.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 66.
 - 2) Bergen-Power, Figure 113A or 113B.
 - 3) Cooper B-Line Systems, Inc., Figure B3083.

- S. Heavy pipe clamp: MSS SP-58, Type 4:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 4H.
 - b. For all other piping, unless called out otherwise on the Drawings:
 - 1) Anvil International, Figure 216.
 - 2) Bergen-Power, Figure 298.
- T. PTFE pipe slide assembly: MSS SP-58, Type 35 with lateral and vertical restraint:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 426.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 257, Type 3.
 - 2) Cooper B-Line Systems, Inc., Figure B3893.
- U. Anchor bolts, concrete anchors, concrete inserts, powder-actuated fasteners, and sleeve anchors: As specified in Section 05120.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Support, suspend, or anchor exposed pipe, fittings, valves, and appurtenances to prevent sagging, overstressing, or movement of piping; and to prevent thrusts or loads on or against connected pumps, blowers, and other equipment.
- B. Field verify support location, orientation, and configuration to eliminate interferences prior to fabrication of supports.
- C. Carefully determine locations of inserts. Anchor to formwork prior to placing concrete.
- D. Use flush shells only where indicated on the Drawings.
- E. Do not use anchors relying on deformation of lead alloy.
- F. Do not use powder-actuated fasteners for securing metallic conduit or steel pipe larger than 1 inch to concrete, masonry, or wood.
- G. Suspend pipe hangers from hanger rods and secure with double nuts.
- H. Install continuously threaded hanger rods only where indicated on the Drawings.
- I. Use adjustable ring hangers or adjustable clevis hangers, for 4 inch and smaller diameter pipe.
- J. Use adjustable clevis hangers for pipe larger than 4 inches in diameter.
- K. Secure pipes with double nutted U-bolts or suspend pipes from hanger rods and hangers.
 - 1. For stainless steel piping, use stainless steel U-bolts.

2. For all other piping, use galvanized U-bolts.
- L. Support spacing:
1. Support 2-inch and smaller piping on horizontal and vertical runs at maximum 5 feet on center, unless otherwise specified.
 2. Support larger than 2-inch piping on horizontal and vertical runs at maximum 10 feet on center, unless otherwise specified.
 3. Support exposed polyvinyl chloride and other plastic pipes at maximum 5 feet on center, regardless of size.
 4. Support tubing, PVC pipe 1-inch and smaller, copper pipe and tubing, fiber-reinforced plastic pipe or duct, and rubber hose and tubing at intervals close enough to prevent sagging greater than 1/4 inch between supports.
 5. Do not suspend or support valves, pipe and fittings from another pipe or conduit.
- M. Install supports at:
1. Any change in direction.
 2. Both sides of flexible pipe connections.
 3. Base of risers.
 4. Floor penetrations.
 5. Connections to pumps, blowers, and other equipment.
 6. Valves and appurtenances.
- N. Securely anchor plastic pipe, valves, and headers to prevent movement during operation of valves.
- O. Anchor plastic pipe between expansion loops and direction changes to prevent axial movement through anchors.
- P. Provide elbows or tees supported from floors with base fittings where indicated on the Drawings.
- Q. Support base fittings with metal supports or when indicated on the Drawings support on concrete piers.
- R. Do not use chains, plumbers' straps, wire, or similar devices for permanently suspending, supporting, or restraining pipes.
- S. Support plumbing drainage and vents in accordance with plumbing code as specified in Section 01410.
- T. Supports, clamps, brackets, and portions of support system bearing against copper pipe: Copper plated, copper throughout, or isolated with neoprene or polyvinyl chloride tape.
- U. Where pipe is insulated, install over-sized supports and hangers.
- V. Install insulation shield in accordance with MSS SP-58, Type 40. Shield shall be galvanized steel unless otherwise specified or indicated on the Drawings.
- W. Install riser clamps at floor penetrations and where indicated on the Drawings.
- X. Coat support system components as specified in Section 09960.

3.02 COMMISSIONING REQUIREMENTS

- A. Manufacturer services for each type of pipe support:
 - 1. Provide Manufacturer's Certificate of Source Testing.
 - 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.

END OF SECTION

SECTION 15075

EQUIPMENT IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Equipment nameplates.
 - 2. Special items.
- B. Related sections:
 - 1. Section 01300 - Submittals.
 - 2. Section 01605 - Product Requirements.
 - 3. Section 01756 - Commissioning.
 - 4. Section 01700 - Contract Closeout.
 - 5. Section 09960 - High-Performance Coatings.

1.02 SUBMITTAL

- A. Submit as specified in Section 01300.
- B. Shop Drawings:
 - 1. Product data.
 - 2. Installation instructions.
- C. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756.
- D. Samples.
- E. Submit following as specified in Section 01700:
 - 1. Warranty.

PART 2 PRODUCTS

2.01 EQUIPMENT NAMEPLATES

- A. Material and fabrication:
 - 1. Stainless steel sheet engraved or stamped with text, holes drilled, or punch for fasteners.
- B. Fasteners:
 - 1. Number 4 or larger oval head stainless steel screws or drive pins.
- C. Text:
 - 1. Manufacturer's name, equipment model number and serial number, identification tag number; and when appropriate, drive speed, motor horsepower with rated capacity, pump rated total dynamic head, and impeller size.

2.02 SPECIAL ITEMS

- A. In addition, special coating of following items will be required:

Item	Color
Hoist hooks and blocks	Yellow and black stripes
Steel guard posts	In accordance with standard details

- B. Paint minimum 2 inches high numbers on or adjacent to accessible valves, pumps, flowmeters, and other items of equipment which are indicated on the Drawings or in Specifications by number.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify satisfactory conditions of substrate for applying identification.
- B. Verify that conditions are satisfactory for installation and application of products as specified in Section 01605.

3.02 PREPARATION

- A. Prepare and coat surfaces of special items as specified in Section 09960.
- B. Prepare surface in accordance with product manufacturer's instructions.

3.03 COMMISSIONING AND PROCESS START-UP REQUIREMENTS

- A. As specified in Section 01756 and this Section.
- B. Manufacturer services:
1. Provide Manufacturer's Certificate of Source Testing.

			Manufacturer Rep Onsite					
Source Testing (Witnessed or Non-witnessed)	Training Requirements		Installation Testing		Functional Testing		Process Operational Period	
	Maintenance (hrs per session)	Operation (hrs per session)	Trips	Days (each trip)	Trips	Days (each trip)	Trips	Days (each trip)
Witnessed	Not Required		Not Required		Not Required		Not Required	

END OF SECTION

SECTION 15076

PIPE IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Pipe identification including the following:
 - 1. Pipe identification by color and legend.
 - 2. Underground warning tape.
 - 3. Tracer wire.
 - 4. Valve identification.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 01300 - Submittals.
 - b. Section 01605 - Product Requirements.
 - c. Section 01700 - Contract Closeout.
 - d. Section 09960 - High-Performance Coatings.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

- A. Submit as specified in Section 01300.
- B. Submit following:
 - 1. Product data.
 - 2. Samples.
 - 3. Manufacturer's installation instructions.
 - 4. Submit following as specified in Section 01700:
 - a. Operation and Maintenance Data.
 - b. Warranty.

PART 2 PRODUCTS

2.01 ABOVE GROUND AND IN-CHASE PIPE IDENTIFICATION

A. Manufacturers:

1. One of the following or equal:
 - a. Seton, Opti Code Pipe Markers.
 - b. Lab Safety Supply.
 - c. Marking Services, Inc.

B. Materials:

1. Pipe markers: Self-adhesive vinyl, suitable for outdoor application from -40 degrees to 180 degrees Fahrenheit; in accordance with ASME A13.1 requirements.
 - a. Lettering:

Nominal Pipe Diameter	Lettering Size
Less than 1.5	1/2 inch
1.5 inches to 2 inches	3/4 inch
2.5 inches to 6 inches	1-1/4 inches
8 inches to 10 inches	2-1/2 inches
Over 10 inches	3-1/2 inches

b. Marker colors:

Service	Lettering	Background
Flammables, chemicals, toxics	Black	Yellow
Water, nontoxic solutions or low hazard liquids	White	Green
Nonflammable or nontoxic gases	White	Blue
Fire quenching fluids (foam, fire water, CO ₂ Halon)	White	Red

2. Coating: As specified in Section 09960.
3. Pipe identification tags: Aluminum or stainless steel with stamped-in 1/4 inch high identifying lettering.
4. Pipe identification tag chains: Aluminum or stainless steel.
5. Snap-on markers: Markers with 3/4 inch high letters for 3/4 to 4 inch pipe or covering, or 5 inch high letters for 5 inch or larger pipe or cover, as manufactured by one of following:
 - a. Brady Bradysnap-On B-915.
 - b. Seton Setmark.

2.02 BURIED PIPELINE IDENTIFICATION

A. Underground warning tape:

1. Manufacturer: One of the following or equal:
 - a. Seton Name Plate Company, Branford, CT.
 - b. T. Christy Enterprises, Inc.
2. Material:
 - a. Polyethylene tape for prolonged underground use.

- b. Minimum tape thickness: 4 mils.
 - c. Overall tape width: 6 inches.
 - d. Message: "CAUTION" with the name of the service followed by "LINE BURIED BELOW." in black lettering on colored background in accordance with approved APWA colors.
 - 1) Water: Blue.
 - 2) Sewer: Green.
 - 3) Telephone: Orange.
 - 4) Gas and other services: Yellow.
 - e. Aluminum backing or solid aluminum core.
- B. Tracer wire:
- 1. Manufacturers: One of the following or equal:
 - a. Kris-Tech Wire.
 - b. Corpro.
 - 2. Materials: One of the following or equal:
 - a. Solid copper conductor with 30 mil HMWPE.
 - b. 10 gauge or thicker wire.
 - c. Match insulation color to the color of the pipe being installed.

2.03 VALVE IDENTIFICATION

- A. The Contractor shall furnish and install tags for all valves and gates required for the Work.
- 1. Tags shall be 2-in diameter round, stainless steel or brass for buried applications.
 - 2. Tags shall be furnished with a non-corrosive metal wire suitable for attaching the tag to the operator base.
 - 3. Tags shall be stamped in 1/4-inch high letter
 - a. Tags shall not be attached in such a way as to inhibit the operation of the valve or gate.
 - 4. Buried valve tags shall be secured to concrete s with the specified valve or gate number.
 - 5. Submit 2 samples of the type of tag proposed and the manufacturer's standard color chart and letter styles to the Engineer for review.
 - 6. Manufacturer: The following or equal:
 - a. Seton Name Plate Company, Branford, CT.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify satisfactory conditions of substrate for applying identification.
- B. Verify that conditions are satisfactory for installation and application of products as specified in Section 01605.

3.02 PREPARATION

- A. Prepare and coat surfaces as specified in Section 09960.
- B. Prepare surface in accordance with product manufacturer's instructions.

3.03 ABOVE GROUND AND IN-CHASE PIPING IDENTIFICATION

- A. Identify exposed piping, valves, and accessories with lettering or tags designating service of each piping system with flow directional arrows and color code.
- B. Color code:
 - 1. Paint all piping with colors as scheduled in Piping Color Code and Marker Schedule.
- C. Lettering and flow direction arrows:
 - 1. Stencil lettering on painted bands or use snap-on markers on pipe to identify pipe. When stenciling, stencil 3/4 inch high letters on 3/4 through 4-inch pipe or coverings, or 5-inch high letters on 5-inch and larger pipe or coverings.
 - 2. Provide lettering and flow direction arrows near equipment served, adjacent to valves, both sides of walls and floors where pipe passes through, at each branch or tee, and at intervals of not more than 50 feet in straight runs of pipe.
- D. Where scheduled, space 6-inch wide bands along stainless steel pipe at 10-foot intervals and other pipe at 5-foot intervals.
- E. Label chemical tank fill pipelines at locations which are visible from chemical fill stations.
- F. Metal tags:
 - 1. Where outside diameter of pipe or pipe covering is 5/8 inch or smaller, provide metal pipe identification tags instead of lettering.
 - 2. Fasten pipe identification tags to pipe with chain.
 - 3. Where tags are used, color code pipe as scheduled.

3.04 BURIED PIPING IDENTIFICATION

- A. Underground warning tape:
 - 1. Place continuous run of warning tape in pipe trench, 12 inches above the pipe.
- B. Tracer wire:
 - 1. Install on all non-metallic pipe.
 - 2. Install an electrically continuous run of tracer wire along the entire length of the pipe with wire terminations in valve boxes, vaults, or structures.
 - 3. Install tracer wire on top of the pipe and secure to pipe with tape a minimum of every 10 feet.
 - 4. Where approved by the Engineer, splice sections of wire together using approved direct bury wire nuts.
 - a. Twisting the wires together is not acceptable.

3.05 APPLICATION

- A. Identify piping with legend markers, directional arrow markers, and number markers; use self-adhesive arrow roll tape to secure ends of piping markers and indicate flow direction.
- B. Provide legend markers, directional arrow markers, and number markers where piping passes through walls or floors, at piping intersections and at maximum 15 foot spacing on piping runs.

- C. Provide piping marker letters and colors as scheduled.
- D. Place markers on piping so they are visible from operator's position in walkway or working platform near piping. Locate markers along horizontal centerline of pipe, unless better visibility is achieved elsewhere.

3.06 PIPING COLOR CODE AND MARKER SCHEDULE

Service Fluid	Pipe Color	Marker Legend
Cooling Water	Blue	COOLING WATER
Domestic Cold Water	Light Blue	DOMESTIC COLD WATER
Drain	Charcoal	DRAIN
Exhaust Gas	Yellow	EXHAUST GAS
Engine Jacket Water	Dark Blue	ENGINE JACKET WATER
Fuel Oil	Orange	FUEL OIL
Instrumental Air	Purple	INSTRUMENTATION AIR
Engine Lube Oil	Red	ENGINE LUBE OIL
Pumped Drain	Charcoal	PUMPED DRAIN
Process Water	Dark Blue	PROCESS WATER
Raw Wastewater	Buff	NONE USED
Return Water	Silver/Grey	RETURN WATER
Sanitary Drain	Charcoal	SANITARY DRAIN
Service Air	Green	SERVICE AIR
Vent Pipe	Yellow	VENT PIPE

Letters	Color of Pipe	Color of Bands	Color of Letters
Finished or Potable (cold)	Light blue	None	Black
Nonpotable or Raw	Light blue	Dark Gray	Black
Service Water (lines downstream from backflow prevention unit)	Dark Blue	White	Red
Sewage	Light Gray	None	Black
Drain	Dark Gray	None	White

END OF SECTION

SECTION 15110

COMMON WORK RESULTS FOR VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Basic requirements for valves.
- B. Related sections:
 - 1. Section 01300 - Submittals.
 - 2. Section 01756 - Commissioning.
 - 3. Section 01730 - Operation and Maintenance Data.
 - 4. Section 09960 - High-Performance Coatings.
 - 5. Section 15211 - Ductile Iron Pipe: AWWA C151.

1.02 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. C111/A21.11 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe Fittings.
- B. ASTM International (ASTM):
 - 1. A126 - Standard Specification for Gray Iron Casting for Valves, Flanges, and Pipe Fittings.
 - 2. A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - 3. A536 - Standard Specification for Ductile Iron Castings.
- C. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.
- D. Society for Protective Coatings (SSPC):
 - 1. SP 7 - Brush-Off Blast Cleaning.
 - 2. SP 10 - Near-White Blast Cleaning.

1.03 DESIGN REQUIREMENTS

- A. Pressure rating:
 - 1. Suitable for service under minimum working pressures of 150 pounds per square inch gauge.
 - 2. When a piping system is specified in the Piping Schedule to be tested at a pressure greater than 150 pounds per square inch gauge, provide valves for that piping system with design working pressure which is sufficient to withstand the test pressure.
- B. Valve to piping connections:
 - 1. Valves 3 inch nominal size and larger: Flanged ends.
 - 2. Valves less than 3 inch nominal size: Screwed ends.

3. Plastic valves in plastic piping:
 - a. Up to 2.5 inches: Provide solvent or heat welded unions.
 - b. 3 inches and above: Provide solvent or heat welded flanges.

1.04 SUBMITTALS

- A. Submit as specified in Section 01300.
- B. Product data:
 1. Submit the following information for each valve:
 - a. Valve type, size, pressure rating, Cv factor.
 - b. Coatings.
 - c. Manual valve actuators:
 - 1) Information on valve actuator including size, manufacturer, model number.
 - d. Certified drawings with description of component parts, dimensions, weights, and materials of construction.
 - e. Certifications of reference standard compliance:
 - 1) Submit certification that the valves and coatings are suitable in potable water applications in accordance with NSF 61.
 - f. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.
- C. Provide vendor operation and maintenance manual as specified in Section 01730.
 1. Furnish bound sets of installation, operation, and maintenance instructions for each type of manual valve 4 inch in nominal size and larger, and all non-manual valves. Include information on valve operators.
- D. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756.
- E. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756.

1.05 QUALITY ASSURANCE

- A. Manufacturer qualifications:
 1. Valves manufactured by manufacturers whose valves have had successful operational experience in comparable service.

1.06 DELIVERY STORAGE AND HANDLING

- A. Protect valves and protective coatings from damage during handling and installation; repair coating where damaged.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Stainless steel: In accordance with ASTM A167, Type 316, or Type 304, UNS Alloy S31600 or S30400.

- B. Valve and operator bolts and nuts:
 - 1. Fabricated of stainless steel for the following installation conditions:
 - a. Submerged in sewage or water.
 - b. In an enclosed space above sewage or water.
 - c. In structures containing sewage or water, below top of walls.
 - d. At openings in concrete or metal decks.
 - 2. Where dissimilar metals are being bolted, use stainless steel bolts with isolation bushings and washers.
 - 3. Underground bolts: Low-alloy steel in accordance with AWWA C111/A21.11.
- C. Bronze and brass alloys: Use bronze and brass alloys with not more than 6 percent zinc and not more than 2 percent aluminum in the manufacture of valve parts; UNS Alloy C83600 or C92200 unless specified otherwise.
- D. Valve bodies: Cast iron in accordance with ASTM A126, Class 30 minimum or ductile iron in accordance with ASTM A536, Grade 65-45-12 minimum unless specified otherwise.

2.02 INTERIOR PROTECTIVE LINING

- A. When specified in the particular valve specification, provide valves with type of protective lining specified in the particular valve Specification.
- B. Apply protective lining to interior, non-working surfaces, except stainless steel surfaces.
- C. Lining types:
 - 1. Fusion bonded epoxy:
 - a. Manufacturers: One of the following or equal:
 - 1) 3-M Company, ScotchKote 134; certified to NSF 61 for drinking water use.
 - b. Clean surfaces in accordance with SSPC SP 7 or SP 10, as recommended by epoxy manufacturer.
 - c. Apply in accordance with manufacturer's published instructions.
 - d. Lining thickness: 0.010 to 0.012 inches except that:
 - 1) Lining thickness in grooves for gaskets: 0.005 inches.
 - 2) Do not coat seat grooves in valves with bonded seat.
 - e. Quality control:
 - 1) Lining thickness: Measured with a non-destructive magnetic type thickness gauge.
 - 2) Verify lining integrity with a wet sponge-testing unit operating at approximately 60 volts, or as recommended by the lining manufacturer.
 - 3) Consider tests successful when lining thickness meets specified requirements and when no pinholes are found.
 - 4) Correct defective lining disclosed by unsuccessful tests, and repeat test.
 - 5) Repair pinholes with liquid epoxy recommended by manufacturer of the epoxy used for lining.
 - 2. High solids epoxy:
 - a. Product equivalent to high solids epoxy specified in Section 09960.
 - 1) Certified in accordance with NSF 61 for drinking water use.

- 2) Interior: Coat valve interior with manufacturer's equivalent high performance high solids epoxy coating system with a certifiable performance history for the service conditions and as approved by the Engineer. Manufacturer shall provide for approval, coating information sufficient to allow Engineer to assess equivalence to the specified high solids epoxy coating specified in Section 09960.
- b. Clean surfaces to meet SP-7 or SP-10, or as recommended by coating manufacturer.
- c. Quality control: After coating is cured, check coated surface for porosity with a holiday detector set at 1,800 volts, or as recommended by coating manufacturer.
 - 1) Repair holidays and other irregularities and retest coating.
 - 2) Repeat procedure until holidays and other irregularities are corrected.

2.03 UNDERGROUND VALVES

- A. Provide underground valves with flanged, mechanical, or other type of joint required for the type of pipe to which the valve is to be connected.
- B. Coating and wrapping:
 - 1. Prior to installation, coat buried valves with 2 coats of protective coal tar epoxy as specified in Section 09960.
 - 2. After installation, encase valves in 2 layers of polyethylene wrap as specified for ductile iron piping in Section 15211.
 - a. Ascertain that polyethylene wrapping does not affect operation of valve.

2.04 FIELD APPLIED COATING OF VALVE EXTERIOR

- A. Match color and be compatible with manufacturer's coating system and as specified in Section 09960.
 - 1. When shop applied finish coating matches field applied coating on adjacent piping, touch up shop coating in damaged areas in accordance with instructions recommended by the paint manufacturer.
 - 2. When shop applied coating does not match field coating on adjacent piping, or when damage has occurred to the shop applied coating that requires more than touchup, blast clean valve surfaces or utilize other surface preparation recommended by the manufacturer of the coating material and apply the coating system used for coating adjacent piping.

2.05 STEAM VALVES

- A. Valves in steam or steam condensate piping: Ductile iron body in accordance with ASTM A536, Grade 65-45-12 minimum or cast steel or forged steel.

2.06 VALVE BOXES

- A. Provide cast-iron valve boxes at each buried valve to access valve and valve operators.
- B. Do not support boxes on valve, valve operator, or pipe.

- C. Boxes:
 - 1. 2-piece, fabricated of cast iron; provide cover, with asphalt varnish or enamel protective coating.
 - 2. Adjustable to grade, install centered around the upper portions of the valve and valve operator.
- D. Manufacturers: One of the following or equal:
 - 1. Tyler Pipe Industries, Inc.
 - 2. Neenah Foundry Company.

2.07 VALVE OPERATORS

- A. Valve operator "Open" direction: Open counterclockwise.
- B. Provide valves located below operating level or deck with extensions for key operation or floor stands and handwheels.
- C. Provide manually operated valves located not more than 6 feet above the operating level with tee handles, wrenches, or handwheels.
 - 1. Make the valve operator more conveniently accessible by rolling valves, located more than 5 feet but less than 6 feet above the operating level, toward the operating side.
 - 2. Secure tee handles and wrenches to the valve head or stem, except where a handle or wrench so secured constitutes a hazard to personnel; in which case, stow handle or wrench immediately adjacent to the valve on or in a suitable hanger, bracket, or receptacle.
- D. Fit valves located more than 6 feet above operating level with chain operated handles or valve wheels.
 - 1. Chains: Sufficient length to reach approximately 4 feet above the operating level.
 - 2. Where chains constitute a nuisance or hazard to operating personnel, provide holdbacks or other means for keeping the chains out of the way.
- E. Provide an operator shaft extension from valve or valve operator to finished grade or deck level when buried valves, and other valves located below the operating deck or level, are specified or indicated on the Drawings to be key operated; provide 2 inch square AWWA operating nut, and box and cover as specified, or a cover where a box is not required.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Preparation prior to installation:
 - 1. Install valves after the required submittal on installation has been accepted.
 - 2. Determine after flanged valves and flanged check valves are selected, the face-to-face dimensions of flanged valves and flanged check valves.
- B. Fabricate piping to lengths taking into account the dimensions of flanged valves and flanged check valves.

3.02 INSTALLATION

- A. Provide incidental work and materials necessary for installation of valves including flange gaskets, flange bolts and nuts, valve boxes and covers, concrete bases, blocking, and protective coating.
- B. Where needed, furnish and install additional valves for proper operation and maintenance of equipment and plant facilities under the following circumstances:
 - 1. Where such additional valves are required for operation and maintenance of the particular equipment furnished by Contractor.
 - 2. Where such additional valves are required as a result of a substitution or change initiated by Contractor.
- C. Install valves with their stems in vertical position above the pipe, except as follows:
 - 1. Butterfly valves, gate valves aboveground, globe valves, ball valves, and angle valves may be installed with their stems in the horizontal position.
 - 2. Install buried plug valves with geared operators with their stems in a horizontal position.
- D. Install valves so that handles clear obstructions when the valves are operated from fully open to fully closed.
- E. Place top of valve boxes flush with finished grade or as otherwise indicated on the Drawings.
- F. Valves with threaded connections:
 - 1. Install valves by applying wrench on end of valve nearest the joint to prevent distortion of the valve body.
 - 2. Apply pipe joint compound or Teflon tape on external (male) threads to prevent forcing compound into valve seat area.
- G. Valves with flanged connections:
 - 1. Align flanges and gasket carefully before tightening flange bolts.
 - 2. When flanges are aligned, install bolts and hand tighten.
 - 3. Tighten nuts opposite each other with equal tension before moving to next pair of nuts.
- H. Valves with soldered connections:
 - 1. Do not overheat connection to prevent damage to resilient seats and metal seat rings.
 - 2. Position valves in full open position before starting soldering procedure.
 - 3. Apply heat to piping rather than to valve body.

3.03 COMMISSIONING REQUIREMENTS

- A. As specified in Section 01756 and this Section.
- B. Manufacturer services from each manufacturer for all valves supplied:
 - 1. Provide Manufacturer's Certificate of Source Testing.
 - 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.

- C. As specified elsewhere for specific valve types, sizes or actuators.
 - 1. Source testing.
 - 2. Manufacturers on site services for Owner Training, Installation Testing, Functional Testing, and during the Process Operational Period.

END OF SECTION

SECTION 15114

CHECK VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Swing.
- B. Related sections:
 - 1. Section 01756 - Commissioning.
 - 2. Section 15110 - Common Work Results for Valves.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Inch Standard.
- B. American Water Works Association (AWWA):
 - 1. C508 - Standard for Swing-Check Valves for Waterworks Service 2 Inch Through 24 Inch (50-mm Through 600-mm) NPS.
- C. ASTM International (ASTM):
 - 1. A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. A313 - Standard Specification for Stainless Steel Spring Wire.
 - 3. A536 - Standard Specification for Ductile Iron Castings.
 - 4. B582 - Standard Specification for Nickel-Chromium-Iron-Molybdenum-Copper Alloy Plate, Sheet, and Strip.
 - 5. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

1.03 SYSTEM DESCRIPTION

- A. Design requirements:
 - 1. Check valves: When not otherwise specified as indicated on the Drawings, provide check valves suitable for service as follows:
 - a. In either horizontal or vertical position.
 - b. Suitable for service working pressures up to 150 pounds per square inch gauge.

1.04 SUBMITTALS

- A. As specified in Section 15110.

PART 2 PRODUCTS

2.01 FIELD APPLIED COATING OF VALVE EXTERIOR

- A. Match color and be compatible with manufacturer's coating system and as specified in Section 09960.
 - 1. When shop applied finish coating matches field applied coating on adjacent piping, touch up shop coating in damaged areas in accordance with instructions recommended by the paint manufacturer.
 - 2. When shop applied coating does not match field coating on adjacent piping, or when damage has occurred to the shop applied coating that requires more than touchup, blast clean valve surfaces or utilize other surface preparation recommended by the manufacturer of the coating material and apply the coating system used for coating adjacent piping.

2.02 SWING CHECK VALVES

- A. Valves 4 inch through 24 inch:
 - 1. Manufacturers: One of the following or equal:
 - a. Kennedy, Figure 106LW or M&H, Model 159.
 - b. Mueller Company, Model A-2600.
 - c. APCO Model 250.
 - d. Crispin SWL Series.
 - 2. Valve design:
 - a. In accordance with AWWA C508.
 - b. Constructed to permit top entry and removal of internal components without removing the valve.
 - c. Equipped with outside lever and weight.
 - 3. Materials:
 - a. Body: Cast iron, ASTM A126 Class B or ASTM A536 Gr. 65-45-12 Ductile Iron.
 - b. Disc:
 - 1) Valve disc shall be ASTM A126 cast iron, ASTM A536 ductile iron or ASTM B584 bronze.
 - 2) 4-inch valves: Bronze or stainless steel rings and seats.
 - 3) 6 inches and larger valves: Bronze faced or stainless steel rings and seats.
 - 4) Rubber seat Buna-N or EPDM.
 - c. Hinge pins: Stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install valves as specified in Section 15110 and the manufacturer's instructions.
- B. Flapper type check valves:
 - 1. Install with proper orientation of flow direction arrow on valve body.
 - 2. When installed in horizontal pipelines, mount with shaft on vertical locations.
 - 3. When mounted in a vertical pipeline, directly downstream of an elbow, mount with the shaft perpendicular to the outermost portion of the elbow.

4. Mount on downstream side of discharge silencer when used on positive displacement and centrifugal blowers.

3.02 COMMISSIONING AND PROCESS START-UP REQUIREMENTS

- A. As specified in Section 01756 and this Section.
- B. Manufacturer services from each manufacturer for all valves supplied:
 1. As specified in Section 15110.

3.03 ADJUSTING

- A. Adjust cushioned swing check valves in the field by means of external adjustment devices to minimize pressure surges.
- B. Adjust weight on swing check valves to affect proper closing action on equipment shutdown.

END OF SECTION

SECTION 15115

GATE VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Gate valves.
- B. Related sections:
 - 1. Section 01756 - Commissioning and Process Start-Up.
 - 2. Section 09960 - High Performance Coatings.
 - 3. Section 15110 - Common Work Results for Valves.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (AMSE).
- B. American Water Works Association (AWWA):
 - 1. C515 - Standard for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Services.
 - 2. C 550 - Protective Interior Coatings for Valves and Hydrants.
- C. ASTM International (ASTM):
 - 1. B98 - Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.

1.03 SUBMITTALS

- A. As specified in Section 15110.
- B. Interior epoxy coatings: Affidavit of compliance attesting that epoxy coatings applied to interior surfaces of valves comply in accordance with all provisions of AWWA C550.

PART 2 PRODUCTS

2.01 FIELD APPLIED COATING OF VALVE EXTERIOR

- A. Match color and be compatible with manufacturer's coating system and as specified in Section 09960.
 - 1. When shop applied finish coating matches field applied coating on adjacent piping, touch up shop coating in damaged areas in accordance with instructions recommended by the paint manufacturer.
 - 2. When shop applied coating does not match field coating on adjacent piping, or when damage has occurred to the shop applied coating that requires more than touchup, blast clean valve surfaces or utilize other surface preparation recommended by the manufacturer of the coating material and apply the coating system used for coating adjacent piping.

2.02 GATE VALVES

- A. Gate valves underground:
1. Manufacturers: One of the following or equal:
 - a. M&H/Kennedy Valve Company.
 - b. Mueller Company.
 - c. American Flow Control.
 2. Design:
 - a. Size, material, configuration: Indicated on the Drawings.
 - b. Resilient wedge type in accordance with AWWA C515.
 - c. Stem:
 - 1) Iron body, resilient seat, non-rising stem, double O-ring stem seal.
 - 2) Rising stem configuration with handwheel diameter sized to allow opening of valve with no more than a 40-pound pull.
 - d. Ductile or cast iron wedge encapsulated in nitrile rubber and capable of sealing in either flow direction.
 - e. Bronze stem with double or triple O-ring or braided packing stem seals.
 - f. Coat interior and exterior surfaces of valve body and bonnet with fusion-bonded epoxy in accordance with AWWA C550.
 - g. Valve operator: Provide standard AWWA 2-inch operating nut, matching valve key, and valve box for operating stem.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install valves as specified in Section 15110 and manufacturer's instructions.

3.02 COMMISSIONING AND PROCESS START-UP REQUIREMENTS

- A. As specified in Section 01756 and this Section.
- B. Manufacturer services from each manufacturer for all valves supplied,
1. As specified in Section 15110.
 2. On site services.

Manufacturer Rep Onsite							
Training Requirements		Installation Testing		Functional Testing		Process Operational Period	
Maintenance (hrs per session)	Operation (hrs per session)	Trips	Days (each trip)	Trips	Days (each trip)	Trips	Days (each trip)
X	X	X	X	X	X	X	

3. Source testing.

END OF SECTION

SECTION 15116

PLUG VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Non-lubricated plug valves.
- B. Related sections:
 - 1. Section 01756 - Commissioning.
 - 2. Section 09960 - High-Performance Coatings.
 - 3. Section 15110 - Common Work Results for Valves.

1.02 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. C606 - Grooved and Shouldered Joints.
 - 2. C517 - Resilient-Seated Cast Iron Eccentric Plug Valves.
- B. ASTM International (ASTM):
 - 1. A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. A536 - Standard Specification for Ductile Iron Castings.

1.03 SUBMITTALS

- A. As specified in Section 15110.

PART 2 PRODUCTS

2.01 NON-LUBRICATED PLUG VALVES

- A. Manufacturers: One of the following or equal:
 - 1. DeZurik, "PEC".
 - 2. Milliken.
- B. Design:
 - 1. Type: Non-lubricated eccentric type, in accordance with AWWA C517.
 - 2. Plug face: Resilient material that operates satisfactorily at a temperature of 180 degrees Fahrenheit continuous and 215 degrees Fahrenheit intermittent.
 - 3. Compression washer: Provide flat compression washer made of Teflon, or of a material having equal physical characteristics on valve stem between plug and bonnet.
 - 4. Stem seals: Provide stem seals serviceable without unbolting the valve bonnet assembly.
 - 5. Grit excluders: Provide PTFE grit excluders at upper plug journals to prevent entry of foreign solids in bearing area.

6. Clearly mark valves to indicate their open and closed positions.
 7. Provide valves with ends as required by piping details indicated on the Drawings.
- C. Materials:
1. Body and plug: ASTM A126, Class B, cast-iron, with plug face of EPDM material suitable for the intended service as specified under paragraph "Design" above.
 2. Body seats in valves 3 inch size and larger: Provide with overlay of not less than 90-percent nickel and minimum thickness of 1/8 inch on surfaces contacting the plug face.
 3. Stem bearing and bottom bearing: Type 316 stainless steel.
 4. Internal parts, except the body and plug: Type 316 stainless steel.
 5. Exposed nuts, bolts, and washers: Zinc plated. Exception: Exposed nuts, bolts, and washers for buried service: Stainless steel.

2.02 VALVE OPERATORS

- A. Furnish valves with an operating wrench or worm gear operator:
1. Equip valves 4 inch nominal size and smaller with a lever operator.
 2. Equip valves 6 inch nominal size and larger with a worm gear operator.

2.03 COATING

- A. Coat interior metal surfaces as specified in Section 15110.
- B. Coat exterior metal surfaces as specified in Section 09960.
- C. Field applied coating of valve exterior:
1. Match color and be compatible with manufacturer's coating system and as specified in Section 09960.
 - a. When shop applied finish coating matches field applied coating on adjacent piping, touch up shop coating in damaged areas in accordance with instructions recommended by the paint manufacturer.
 - b. When shop applied coating does not match field coating on adjacent piping, or when damage has occurred to the shop applied coating that requires more than touchup, blast clean valve surfaces or utilize other surface preparation recommended by the manufacturer of the coating material and apply the coating system used for coating adjacent piping.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install valves as specified in Section 15110 and the manufacturer's instructions.
- B. Install valves so that in the closed position the pressure in the pipeline applies a seating head on the valves.
- C. Lubrication: Lubricate plug valves and fill extended lubricant pipes with lubricant suitable for service intended.

- D. Install valves so that in the open position the plug is located in the top half of the valve body.

3.02 COMMISSIONING REQUIREMENTS

- A. As specified in Section 01756 and this Section.
- B. Manufacturer services from each manufacturer for all valves supplied,
 - 1. As specified in Section 15110.

END OF SECTION

SECTION 15119

AIR AND VACUUM RELIEF VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Air release valves, air and vacuum valves, and air vents.
- B. Related sections:
 - 1. Section 01756 - Commissioning.
 - 2. Section 15110 - Common Work Results for Valves.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME).
 - 1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
- B. American Water Works Association (AWWA).
- C. ASTM International (ASTM):
 - 1. A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 3. A270 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Sanitary Tubing.
 - 4. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
- D. SSPC: The Society for Protective Coatings (SSPC).
 - 1. SP 5 - White Metal Blast Cleaning.
 - 2. SP 10 - Near-White Metal Blast Cleaning.

1.03 SUBMITTALS

- A. As specified in Section 15110.

PART 2 PRODUCTS

2.01 FIELD APPLIED COATING OF VALVE EXTERIOR

- A. Match color and be compatible with manufacturer's coating system and as specified in Section 09960.
 - 1. When shop applied finish coating matches field applied coating on adjacent piping, touch up shop coating in damaged areas in accordance with instructions recommended by the manufacturer.
 - 2. When shop applied coating does not match field coating on adjacent piping, or when damage has occurred to the shop applied coating that requires more than touchup, remove existing coating by abrasive blast cleaning and apply the coating system used for coating adjacent piping in accordance with Section 09960.
 - a. Submerged valves: SP-5 White Metal Blast cleaning.
 - b. Other valves: SP-10 Near-white blast cleaning.

2.02 COMBINATION AIR VALVES - SEWAGE SERVICE

- A. Manufacturers: One of the following or equal:
 - 1. Valve and Primer Corporation, DeZurik/APCO, Series 440.
 - 2. Multiplex Manufacturing Company, Crispin Series US.
- B. Design:
 - 1. Operation: Automatic exhaust and intake of large quantities of air during filling and draining of pipelines, respectively, and release of accumulated air while pipeline is under pressure.
 - 2. Design: Utilize compound lever system in conjunction with large and small orifices.
 - 3. Internal parts removable through top cover without removing valve from pipeline.
 - 4. Pressure rating: 150 pounds per square inch.
 - 5. Connections: 2-inch threaded inlet and 1-inch threaded outlet.
 - 6. Accessories:
 - a. Inlet shutoff valve.
 - b. 2 blowoff valves for backflushing.
 - c. 10 feet of hose with quick disconnect couplings.
- C. Materials:
 - 1. Body: Cast iron.
 - 2. Float: Type 316 stainless steel.
 - 3. Needle: EPDM.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install as specified in Section 15110 and manufacturer's instructions.
- B. Install air release valves and air and vacuum valves with suitable discharge lines to nearest drainage system.

3.02 COMMISSIONING REQUIREMENTS

- A. As specified in Section 01756 and this Section.
- B. Manufacturer services from each manufacturer for all valves supplied,
 - 1. As specified in Section 15110.
 - 2. Source testing.

END OF SECTION

SECTION 15120

PIPING SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Piping specialties including:
 - 1. Flexible rubber connections.
 - 2. Bellows type expansion joints.
 - 3. Slip type expansion joints.
 - 4. Rubber expansion joints.
 - 5. Vibration control joints.
 - 6. Transition fittings.
 - 7. Pipe saddles.
 - 8. Tapping sleeves.
 - 9. Pressure gauges.
 - 10. Annular pressure seals/isolator rings.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 13000 - Instrument and Control System.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24.
- B. American Water Works Association (AWWA):
 - 1. C110 - Standard for Ductile-Iron and Gray-Iron Fittings.
 - 2. C151 - Standard for Ductile-Iron Pipe, Centrifugally Cast.
- C. ASTM International (ASTM).
 - 1. A 148 - Standard Specification for Steel Castings, High-Strength, for Structural Purposes.
 - 2. A 536 - Standard Specification for Ductile Iron Castings.

1.03 SUBMITTALS

- A. Product data:
 - 1. Manufacturer's certificate attesting successful performance of specified tests.
 - 2. Shop drawings detailing dimensions and materials.

3. Manufacturer's published installation instructions.
4. Operation and maintenance manuals.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Bellows type expansion joints and vibration control joints:
 1. Protect joints against damage during packing, shipping, and installation, and also during pressure test.
 2. Lock expansion joints against movement until pressure tests are completed.
 3. Replace damaged expansion joints with new and undamaged expansion joints.

PART 2 PRODUCTS

2.01 FLEXIBLE RUBBER CONNECTIONS

- A. Manufacturers: One of the following or equal:
 1. Mercer Rubber Company, Type 150 Vibraflex.
 2. Red Valve Company, Inc., Part Number P-5.
- B. Provide flexible rubber connections with 3/8 inch thick neoprene or EPDM rubber tube with full-faced flanged ends suitable to withstand a pressure of 150 pounds per square inch gauge.
- C. Provide complete flexible rubber connections, including galvanized retaining rings and control rods.

2.02 BELLOWS TYPE EXPANSION JOINTS

- A. Expansion joints for general service:
 1. Expansion joints: Flexible bellows type with equalizing rings, except as otherwise specified or indicated on the Drawings.
 2. Manufacturers:
 - a. Expansion joints: One of the following or equal:
 - 1) Flexonics, Inc., Controlled Flexing Expansion Joint.
 - 2) Flex-Weld, Inc., Keflex, Series 308.
 - b. Pipe alignment guides: One of the following or equal:
 - 1) Flexonics, Inc.
 - 2) Flex-Weld, Inc.
 - c. Intermediate supports: Provide with protective saddles. One of the following or equal:
 - 1) Unistrut Corporation, Roller-type.
 - 2) Bergen-Paterson Pipe Support Corp.
 3. Design:
 - a. Expansion joint rating: 150 pounds per square inch gauge, at 400 degrees Fahrenheit.
 - b. Bellows: Laminated stainless steel, equipped with a self-draining liner guide.
 - c. Axial travel of expansion joints: Not less than 1.50 inches.
 - d. Ends: 150 pound ASME flanges, or plain suitable for welding connections, as required for piping in which installed.

2.03 SLIP TYPE EXPANSION JOINTS

- A. PVC expansion joints:
 - 1. Manufacturers: One of the following or equal:
 - a. Flo Control, Flo-Span.
 - b. Chemtrol.
 - 2. Materials: PVC with EPDM O-ring.
 - 3. Design:
 - a. 150 pound per square inch pressure rating.
 - b. Double O-ring seal.
 - c. Axial travel: Not less than 1.5 inches.
 - d. Ends: 150 pound ASME flanges, or plain end suitable for solvent welding connections.

2.04 RUBBER EXPANSION JOINTS

- A. Manufacturers: One of the following or equal:
 - 1. Mercer Rubber Company, Style 500 or 700.
 - 2. Red Valve Company, Inc., Type J-1.
- B. Provide rubber expansion joints complete with control units and split retaining rings.
- C. Design:
 - 1. Material: Neoprene rubber, reinforced with embedded steel rings, and a strong synthetic fabric.
 - 2. Expansion rings, suitable for pressures of at least 125 pounds per square inch gauge, except as follows:
 - a. Expansion joints in pump suction piping and where indicated on the Drawings suitable for minimum 110 pounds per square inch gauge pressure, and minimum 30 inches mercury vacuum.
 - b. Split retaining rings, galvanized.
 - c. Ends of expansion joints, 150 pound ASME flanges with drilling to match that of the piping.

2.05 VIBRATION CONTROL JOINTS

- A. Manufacturers:
 - 1. Braided bronze flexible vibration joints 2 inches and less in size: One of the following or equal:
 - a. Flexonics, Inc., Type Vibra Sorber.
 - b. Flex-Weld, Inc., Keflex, Type KFCB.
 - 2. Flexible vibration joints larger than 2 inches: One of the following or equal:
 - a. Flexonics, Inc., Type TCS.
 - b. Flex-Weld, Inc., Keflex, Series 151-TR-1215.
 - 3. Corrugated stainless steel with stainless steel braid flexible vibration joints: One of the following or equal:
 - a. Flexonics, Inc., Type FCS.
 - b. Flex-Weld, Inc., Keflex, Type USFNSS-31.
- B. Design:
 - 1. Flexible vibration joints 2 inches and smaller: Braided bronze, suitable for pressures of not less than 250 pounds per square inch gauge.

2. Flexible vibration joints larger than 2 inches: Flexible bellows type, suitable for pressures of not less than 150 pounds per square inch gauge, at 70 degrees Fahrenheit, except as follows:
 - a. Provide vibration joints in piping subject to test pressures higher than 150 pounds per square inch gauge, suitable for such higher pressures.
 - b. Bellows: Stainless steel, equipped with a stainless steel liner.
 - c. Ends: ASME Class 150 flanges.
 3. Vibration joints in high-pressure air piping and in digester gas piping: Corrugated Type 316 stainless steel with stainless steel braid, suitable for pressures of not less than 150 pounds per square inch gauge.
 - a. Ends: ASME Class 150 flanges.
- C. Protection: Protect vibration absorbers against end loading and torsional stresses by anchoring attached piping.

2.06 TRANSITION FITTINGS

- A. Manufacturers: One of the following or equal:
1. Spears.
- B. Materials:
1. Slip socket: Schedule 80 PVC.
 2. Collar: Type 316 stainless steel.
 3. Threaded insert: Brass or Type 316 stainless steel.

2.07 PIPE SADDLES

- A. Manufacturers: One of the following or equal:
1. BTR Inc./Smith-Blair, Inc., Style 317.
 2. Romac Industries, Inc., Style 202S.
- B. Materials:
1. Pipe saddles: Ductile iron.
 2. Straps, bolts, and nuts: Type 304 stainless steel with Teflon coating on nuts.
 3. Gaskets: Rubber or EPDM.

2.08 TAPPING SLEEVES

- A. Manufacturers: One of the following or equal:
1. BTR, Inc./Smith-Blair, Inc., Style 622.
 2. Romac Industries, Inc., Style FTS 420.
- B. Materials:
1. Tapping sleeves: Steel construction.
 2. Bolts and nuts: Type 304 stainless steel.
 3. Nuts: Teflon coated.
 4. Gaskets: Rubber or EPDM.
 5. Size of tapped boss: As indicated on the Drawings.

2.09 PRESSURE GAUGES

A. Design:

1. Provide dual-range, liquid filled gauges with ranges as indicated on the Drawings and in the Pressure Gauge Schedule.
2. Size: As follows, unless otherwise indicated on the Drawings or specified:
 - a. For 1-Inch Pipe and Larger: 4-1/2 inch diameter.
 - b. For Smaller than 1-Inch Pipe: 2-1/2 inch diameter.
3. Provide gauges with Type 316 stainless steel, wetted parts, back flanged aluminum cases with threaded ring, except for panel mounting, in which case provide gauge with front flanged aluminum case with threaded ring. Apply black epoxy coating to cases.
4. Provide case fitted with a rupture disc which shall relieve out the back of the case.
5. Window: Shatterproof glass or high temperature acrylic.
6. Provide gauges with Type 316 stainless steel socket and bellows or bourdon tube, depending on pressure range:
 - a. Where the maximum pressure is less than or equal to 15 pounds per square inch, the gauge shall use bellows as the measuring element.
 - b. Where the maximum pressure is greater than 15 pounds per square inch, the measuring element shall be a bourdon tube.
7. Socket Tips:
 - a. Socket Tips for Bellows and Bourdon Tube: Type 316 Stainless steel.
 - b. Size: 1/2 inch for 4-1/2 inch diameter gauges, 1/4 inch for 2-1/2 inch diameter gauges.
8. Mount gauges on diaphragm seals where indicated on the Drawings:
 - a. Housing: Provide diaphragm seals with Type 316 stainless steel top housing, bottom housing and bolt assemblies.
 - b. Flush Connection: Fit bottom housing with a 1/4 inch flushing connection with Type 316 stainless steel nipple and shutoff cock
 - c. Diaphragm Seal: Removable:
 - 1) For pressure less than or equal to 15 pounds per square inch, provide Viton diaphragm seal.
 - 2) For pressures greater than 15 pounds per square inch, provide Type 316 stainless steel diaphragm seal.
 - d. Snubber:
 - 1) Fit diaphragm seal gauge assembly with a snubber:
 - 2) Porous metal disc sized to dampen pressure fluctuations in the filled system. Size filter disc shall to prevent the gauge from pulsating.
 - 3) Material: Stainless steel.
 - e. Provide diaphragm seal gauge assemblies filled with silicon, except as follows:
 - 1) For chlorine gas under vacuum, sodium hypochlorite, chlorine solution, ferric chloride, sodium hydroxide, and hydrochloric acid, provide diaphragm seal gauge assemblies filled with halocarbon.
9. Pressure gauges, except gauges with diaphragm seals, shall have pulsation dampeners installed between the gauge and the shut-off valve:
 - a. Pulsation Dampeners: Stainless steel.

- B. Manufacturers:
 - 1. Pressure Gauges: One of the following or equal:
 - a. U.S. Gauge Division of Ametek, Inc., Solfrunt Gauges, Figure Number 1931T.
 - b. Dresser Industries, Inc., Ashcroft Figure Number 1379.
 - 2. Diaphragm Seal: One of the following or equal:
 - a. For pressure less than or equal to 15 pounds per square inch:
 - 1) Ashcroft, Type 301.
 - 2) Mansfield and Green, Type LG.
 - b. For pressures greater than 15 pounds per square inch:
 - 1) Ashcroft, Type 101.
 - 2) Mansfield and Green, Type RG.
 - 3. Snubber: One of the following or equal:
 - a. Ashcroft.
 - b. Chemiquip.
 - 4. Pulsation Dampeners: One of the following or equal:
 - a. Dresser Industries, Inc., Ashcroft Figure Number 1106S.
 - b. Operation and Maintenance Specialties, Charlotte, N.C., Ray Pressure Snubbers.

2.10 ANNULAR PRESSURE SEALS/ISOLATOR RINGS

- A. Manufacturers: One of the following or equal:
 - 1. Dresser Industrial Valve and Instrument, Ashcroft Iso-Spool or Iso-Ring.
 - 2. Red Valve Company, Series 40 or Series 42, as applicable.
- B. Features and Characteristics:
 - 1. Body: Carbon steel, unless otherwise noted.
 - 2. Flanges: Carbon steel, unless otherwise noted.
 - 3. Flexible Liner: Buna N, unless otherwise noted.
 - 4. Sensing Fluid: Glycerin or 50 percent ethylene glycol and water, unless otherwise noted.
 - 5. Factory Filled System: Locked-in and sealed sensing fluid which is factory filled and assembled to the pressure device(s).
 - 6. Instrument Connection: 1/2-inch National Pipe Thread, unless otherwise noted.
 - 7. Pipe Size: As noted on the drawings and in the Instrument Index.
 - 8. Pressure Rating: Annular seal shall have a pressure rating equivalent to the ANSI flanges.
- C. Maximum number of instruments per annular seal: 2.
- D. Inside diameter of annular seal shall provide uninterrupted flow. There shall be no dead ends or crevices and process flow shall be sufficient to make the device self-cleaning.
- E. The pressure sensing piping shall measure pressure for 360 degrees around the full inside circumference of the pipeline.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Expansion control joints:
 - 1. Install bellows type expansion control joints at piping connections to mechanical equipment to prevent damaging stresses due to normal expansion and contraction with temperature changes in piping and connected equipment.
 - 2. Install bellows type expansion joints so as to allow 2-1/4 inch expansion per 100 linear feet of piping.
 - 3. Install expansion joints adjacent to an anchor, and provide 1 concentric guide on piping within 12 pipe diameters, but not more than 5 feet, from the end of the joint opposite the anchor.
 - a. Locate a similar guide approximately 30 diameters but not more than 10 feet from the first.
 - 4. For expansion joints not installed adjacent to an anchor provide 2 concentric guides similarly located at each end of the joint.
 - 5. Provide control rods and additional guides where indicated on the Drawings, but at no greater intervals than recommended by the joint manufacturer in published instructions.
 - 6. Space intermediate supports a minimum of 10 feet, and tack weld the protective saddles to the pipe.
- B. Vibration control joints:
 - 1. Install vibration control joints at piping connections to or from mechanical equipment to prevent transmitting equipment vibration through the piping system.
- C. Transition couplings:
 - 1. Application:
 - a. Use transition couplings with function and design similar to flexible couplings and flanged coupling adapters for connecting piping having different outside diameters.
 - 2. Install transition-coupling products specifically designed and manufactured for that application.
- D. Pipe saddles:
 - 1. Coat threads on bolts with anti-gall coating prior to installation.
- E. Tapping sleeves:
 - 1. Coat threads on bolts with anti-gall coating prior to installation.
- F. Pressure Gauges:
 - 1. Install pressure and compound gauges as indicated on the Drawings, in the Pressure Gauge Schedule, and as specified.
 - 2. Install gauges as specified, and as recommended by the manufacturer in published instructions.

3.02 FIELD QUALITY CONTROL

- A. Testing: Field test gauges with a calibrated test gauge, in the presence of ENGINEER.

3.03 PRESSURE GAUGE SCHEDULE

- A. The Pressure Gauge Schedule is not a take-off list. CONTRACTOR shall provide additional pressure gauge installation assemblies as required by specifications and drawings.

MARK	QUANTITY	DRAWING	LOCATION	SERVICE	GAUGE TYPE	TYPICAL DETAIL	DIAPHRAGM	GAUGE STAND	RANGE	NOTES
1	1	M01	Pump Combined Discharge	FM	Pressure	M-294	Yes	No	0 to 100 psig	-
Notes:										

END OF SECTION

SECTION 15121

PIPE COUPLINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Pipe couplings for ductile iron piping.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 01300 - Submittals.
 - b. Section 01756 - Commissioning.
 - c. Section 01730 - Operation and Maintenance Data.
 - d. Section 09960 - High-Performance Coatings.
 - e. Section 15052 - Common Work Results for General Piping.
 - f. Section 15956 - Piping Systems Testing.

1.02 REFERENCES

- A. American National Standards Institute (ANSI).
- B. American Society of Mechanical Engineers (ASME):
 - 1. B31.1 - Power Piping.
 - 2. B31.9 - Building Services Piping.
- C. American Water Works Association (AWWA):
 - 1. C111 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 2. C207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In.
 - 3. C606 – Standard for Grooved and Shouldered Joints.
- D. ASTM International (ASTM):
 - 1. A 36 - Standard Specification for Carbon Structural Steel.
 - 2. A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 3. A 193 - Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.

4. A 351 - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
5. A 449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/9 ksi Minimum Tensile Strength, General Use.
6. A 536 - Standard Specification for Ductile Iron Castings.
7. A 576 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
8. F 593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

1.03 SUBMITTALS

- A. Submit as specified in Section 01300.
- B. Product data:
 1. Shop drawings, detailing dimensions, and materials.
 2. Piping layout drawings: Coordinate preparation of required piping layout drawings to show coupling sizes.
- C. Provide vendor operation and maintenance manual as specified in Section 01730.
 1. Furnish bound sets of installation, operation, and maintenance instructions for each type of manual valve 4 inch in nominal size and larger, and all non-manual valves. Include information on valve operators.
- D. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756.
- E. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756.

PART 2 PRODUCTS

2.01 GENERAL

- A. Known acceptable manufacturers are listed by specific products.
- B. Provide references as specified in this Section by specific product.
- C. Manufacturer's representatives requirements as specified in Section 01756 and this Section by specific product.
- D. Gaskets for flexible couplings and flanged coupling adapters:
 1. Provide gasket materials for piping applications as follows:
 - a. Low-pressure and high-pressure air, steam, hot water: EPDM.
 - b. All other piping applications: EPDM.
- E. Exterior coatings for underground and submerged applications:
 1. Manufacturers: One of the following or equal:
 - a. Tapecoat Company, Inc., T.C. Mastic.
 - b. Kop-Coat Company, Inc., Bitumastic Number 50.
 2. Thickness: Minimum 0.040 inch.

2.02 PIPE COUPLINGS FOR DUCTILE IRON PIPING

- A. Dismantling joints:
 - 1. Manufacturers: One of the following or equal:
 - a. Romac Industries, Inc., Style DJ400.
 - b. Smith-Blair, Inc., Series 975.
 - 2. Materials:
 - a. Flanged spool:
 - 1) AWWA C207 steel pipe:
 - a) ASTM A 53 for sizes 3 inches to 12 inches.
 - b) ASTM A 36 for sizes 14 inches to 72 inches.
 - b. End ring and body:
 - 1) For sizes 3 inches to 12 inches, ductile iron in accordance with ASTM A 536.
 - 2) For sizes 14 inches to 72 inches, steel in accordance with ASTM A 36 or A 53.
 - c. Follower ring: Ductile iron in accordance with ASTM A 536.
 - d. Bolts and hex nuts:
 - 1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
 - 2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F 593.
 - e. Tie rods: High tensile steel in accordance with ASTM A 193 Grade B7.
 - 3. Flange design: Class D steel ring flange in accordance with AWWA C207, compatible with ANSI Class 125 and 150 bolt circles.
 - 4. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.
- B. Flanged coupling adapters: 12-inch size and smaller:
 - 1. Manufacturers: One of the following or equal:
 - a. Dresser, Inc., Style 227.
 - b. Romac Industries, Inc., Style FCA501.
 - c. Smith-Blair, Inc., Series 912.
 - 2. Materials:
 - a. Flanged body: Ductile iron in accordance with ASTM A 536.
 - b. Follower ring: Ductile iron in accordance with ASTM A 536.
 - c. Bolts and hex nuts:
 - 1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
 - 2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F 593.
 - 3. Flange design: Class D steel ring flange in accordance with AWWA C207 compatible with ANSI Class 125 and 150 bolt circles.
 - 4. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.
- C. Flexible couplings:
 - 1. Manufacturers: One of the following or equal:
 - a. Dresser, Inc., Style 253.
 - b. Romac Industries, Inc., Style 501.
 - c. Smith-Blair, Inc., Series 441.

2. Materials:
 - a. Center rings: Ductile iron in accordance with ASTM A 536.
 - b. Follower rings: Ductile iron in accordance with ASTM A 536.
 - c. Bolts and hex nuts:
 - 1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
 - 2) Buried and underwater: Type 316 stainless steel in accordance with ASTM F 593.
3. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.
4. Center sleeve dimensions: Provide center sleeves with lengths in accordance with following table:

Nominal Pipe Size	Sleeve Length
3 inch and smaller	Manufacturer's standard
4 inch through 8 inch	7 inches
10 inch through 14 inch	12 inches
Greater than 16 inch	Use steel flexible coupling per Pipe Couplings for Steel Piping

- D. Restrained flange coupling adapter:
 1. Manufacturers: One of the following or equal:
 - a. Romac Industries, Inc., Style RFCA.
 - b. Star Pipe Products, 3200 StarFlange.
 2. Materials:
 - a. Flange and flanged body: Ductile iron in accordance with ASTM A 536.
 - b. Follower ring: Lug type restraint system.
 - 1) Follower ring: Ductile iron in accordance with ASTM A 536.
 - 2) Restraining lugs: Ductile iron in accordance with ASTM A 536.
 - a) Designed to contact the pipe and apply forces evenly.
 - 3) Restraining bolts:
 - a) Ductile iron in accordance with ASTM A 536.
 - b) Bolt heads shall be designed to twist off when the proper torque has been applied.
 - c. Bolts and hex nuts:
 - 1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
 - 2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F 593.
 3. Flange design: Class D steel ring flange in accordance with AWWA C207 compatible with ANSI Class 125 and 150 bolt circles.
 4. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.
 5. Angular deflection: Restrained flange coupling adapter must allow angular deflection after assembly.
- E. Grooved joint couplings:
 1. Manufacturers:
 - a. Victaulic Company, Series 31 or equal.

2. Materials:
 - a. Housings: Ductile iron in accordance with ASTM A 536.
 - b. Gasket:
 - 1) FlushSeal® type, or equal. Elastomer in accordance with ASTM D 2000.
 - 2) EPDM.
 - c. Bolts and nuts: Electroplated steel in accordance with ASTM A 449.
 - d. Coating: As specified in Section 09960.
3. For use with rigid or flexible radius grooved components in accordance with AWWA C606.
4. For connection to IPS steel pipe sizes, Victaulic Style 307.

PART 3 EXECUTION

3.01 INSTALLATION

- A. In underground and underwater installations, coat the exterior of coupling with a protective coating in accordance with manufacturer's instructions.
- B. Joints and flexible connections shall be installed centered with no angular deflection unless otherwise indicated on the Drawings.
- C. Flexible couplings and flange coupling adapters: Install with gap between pipe ends in accordance with the following table unless a greater gap is indicated on the Drawings. Maximum gap tolerance shall be within 1/8 inch.
 1. Install flexible coupling with pipe gap located in middle of center sleeve.
 2. Install flanged coupling adapter with end of plain end pipe in middle of flanged coupling body.

Center Ring Length	Gap Dimension and Tolerance
4 inch through 6 inch	3/8 inch
7 inch	5/8 inch
10 inch and greater	7/8 inch

- D. Provide harnesses (tie-downs) for flexible couplings unless otherwise indicated on the Drawings with a written note.
 1. Design harnesses (tie-downs) for the test pressures as specified in the Piping Schedule in Section 15052.
- E. Grooved joint couplings:
 1. Grooved ends: Clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
 2. Gaskets: Elastomer grade suitable for the intended service, and molded and produced by the coupling manufacturer.
 3. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756.
- F. Bolted, split-sleeve couplings:
 1. Inspect each coupling to insure that there are no damaged portions of the coupling.
 - a. Pay particular attention to the sealing pad/sealing plate area.

- b. Before installation, thoroughly clean each coupling of any foreign substance which may have collected thereon and shall be kept clean at all time.
 2. Wrenches:
 - a. Conform to manufacturer instructions.
 - b. Bolts and studs shall be tightened so as to secure a uniform gasket compression between the coupling and the body of the pipe with all bolts or studs tightened approximately the same amount.
 - c. Final tightening shall be done by hand (no air impact wrenches) and is complete when the coupling is in uniform contact with the outside surface of the pipe all around the circumference of the pipe.
 3. No joint shall be misfit in any plane.
 4. On the fixed ends of bolted, split-sleeve couplings, the shoulders shall bear on the restraint rings all around with no visible gap.
 5. Ends of piping where coupler are installed shall be smooth and free of defects.
 - a. Remove weld splatter and grind smooth.
 - b. Grind pipe seam welds flush with pipe wall and smooth.

3.02 COMMISSIONING AND PROCESS START-UP REQUIREMENTS

- A. As specified in Section 01756 and this Section.
- B. Manufacturer(each) services for each type of pipe coupling:
 1. Provide Manufacturer's Certificate of Source Testing.
 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.

Source Testing (Witnessed or Non-witnessed)	Manufacturer Rep Onsite							
	Training Requirements		Installation Testing		Functional Testing		Process Operational Period	
	Maintenanc e (hrs per session)	Operati on (hrs per session)	Trips	Days (each trip)	Trips	Days (each trip)	Trips	Days (each trip)
Non-Witnessed	4	2	1	2	1	1	Not Required	

- C. Functional Testing:
 1. Pressure testing as specified in Sections 15052 and 15956.

END OF SECTION

SECTION 15211

DUCTILE IRON PIPE: AWWA C151

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Ductile iron pipe, joints, fittings, gaskets, and pipe linings and coatings.
- B. Related sections:
 - 1. Section 01300 - Submittals.
 - 2. Section 01756 - Commissioning.
 - 3. Section 02318 - Trenching.
 - 4. Section 09960 - High-Performance Coatings.
 - 5. Section 15052 - Common Work Results for General Process Piping.
 - 6. Section 15121 - Pipe Couplings.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- B. American Water Works Association (AWWA):
 - 1. C104 - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - 2. C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - 3. C110 - Standard for Ductile-Iron and Gray-Iron Fittings.
 - 4. C111 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 5. C115 - Flanged Ductile Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - 6. C150 - Standard for Thickness Design of Ductile-Iron Pipe.
 - 7. C151 - Standard for Ductile-Iron Pipe, Centrifugally Cast.
 - 8. C600 - Installation of Ductile Iron Water Mains and Their Appurtenances.
 - 9. C606 - Standard for Grooved and Shouldered Joints.
- C. American Welding Society (AWS):
 - 1. D11.2 - Guide for Welding Iron Castings.
- D. ASTM International (ASTM):
 - 1. A47 - Standard Specifications for Ferritic Malleable Iron Castings.
 - 2. A183 - Standard Specifications for Carbon Steel Track Bolts and Nuts.
 - 3. A536 - Standard Specifications for Ductile Iron Castings.
 - 4. C283 - Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
 - 5. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

- E. Ductile Iron Pipe Research Association (DIPRA):
 - 1. Thrust Restraint Design Manual.
- F. NACE International (NACE):
 - 1. SP0188 - Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
- G. National Association of Pipe Fabricators, Inc. (NAPF):
 - 1. 500-03 - Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings.
- H. Society for Protective Coatings (SSPC):
 - 1. PA-2 - Measurement of Dry Coating Thickness With Magnetic Gages.

1.03 SYSTEM DESCRIPTION

- A. Thrust restraint system design:
 - 1. Design restrained joint thrust restraint system.
 - 2. Determine the length of pipe that must be restrained on each side of the focus of a thrust load in accordance with the procedures and criteria established by the DIPRA Thrust Restraint Design Manual as specified in Piping Schedule in Section 15052 and the following additional criteria:
 - a. Design pressure: Test pressure.
 - b. Laying condition: Type 5 in accordance with AWWA C150.
 - c. Soil designation: Silt 1 as defined by DIPRA.
 - d. Unit friction resistance: Based upon polyethylene encasement of pipe.
 - e. Safety factor: 1.5 (for thrust restraint calculations only).

1.04 SUBMITTALS

- A. Submit as specified in Section 01300.
- B. Shop Drawings:
 - 1. Detailed layout drawings showing alignment of pipes, location of valves, fittings, and appurtenances, types of joints, connections to structures, and thrust restraint system layouts.
 - 2. Thrust restraint systems: Calculations and layout for restrained joint thrust restraint systems.
 - 3. Photographs, drawings, and descriptions of fittings, gaskets, couplings, grooving of pipe and fittings, pipe linings, and coatings.
- C. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Lining manufacturers: For piping specified to receive glass or epoxy lining, use only a lining manufacturer having a minimum of 5 years' experience supplying this type of product to the wastewater and water industry.

2. Welded on outlets: The pipe manufacturer shall have a minimum of 5 years' experience in the fabrication and testing of outlets of similar size and configuration similar to those used on the Project.
- B. Pre-installation meeting:
1. Arrange for Coating Manufacturer's Technical Representative to attend preconstruction conferences, and to make periodic visits to factory or shop to inspect surface preparation of pipe, fittings, and accessories; and to inspect application of linings to interior and coatings to exterior of pipe, fittings, and accessories.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Block piping and associated fittings for shipment to prevent damage to coatings and linings.
- B. Carefully handle piping and associated fittings during loading, unloading, and installation.
1. Do not drop piping material from cars or trucks.
 2. Lower piping by mechanical means.
 3. Do not drop or pound pipe to fit grade.
- C. Protect gaskets and polyethylene encasement from long-term exposure to sunlight.
- D. Store piping, fittings, and other accessories such that they do not accumulate and hold rainwater, dirt, and debris.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Ductile iron piping:
1. Typical type:
 - a. In accordance with AWWA C150 and AWWA C151.
 - b. Pressure class or special thickness class as indicated in the Piping Schedule provided in Section 15052.
 - c. Manufactured from greater than 90 percent recycled material.
 2. Type with screw-on flanges:
 - a. In accordance with AWWA C115 with minimum special thickness Class 53 wall thickness as required for screw-on flanges.
 - b. Special thickness class as indicated in the Piping Schedule as specified in Section 15052.
 - c. Manufactured from greater than 90 percent recycled material.
 3. Type with grooved couplings:
 - a. Special thickness class as indicated in the Piping Schedule as specified in Section 15052.
 - b. Manufactured from greater than 90 percent recycled material.

B. Joints:

1. Flanged joints:
 - a. Screw-on flanges: Comply with the diameter, thickness, drilling, and other characteristics in accordance with ASME B16.1. In addition, comply with the following requirements:
 - 1) Ductile iron.
 - 2) Long hub, threaded, and specially designed for ductile iron pipe.
 - 3) After attaching to pipe, machine flange face to make pipe end and flange even and perpendicular to the axis of the pipe.
 - b. Bolt holes on flanges: 2-holed and aligned at both ends of pipe.
 - c. Cap screw or stud bolt holes: Tapped.
 - d. Bolts and nuts: As specified in Section 15052.
 - e. Gaskets: Standard styrene butadiene copolymer (SBR).
2. Grooved joints: In accordance with AWWA C606, as complemented and modified below, radius-cut type, with following components:
 - a. Couplings: Rigid type, cast from ductile iron in accordance with ASTM A536, Grade 65-45-12, or malleable iron in accordance with ASTM A47, Grade 32510.
 - b. Bolts and nuts: In accordance with ASTM A183, Grade 2.
 - c. Gaskets: Capable of being applied on surface of piping with cavities to provide for an improved seal with the internal piping pressure. Material to be used for following services:
 - 1) For liquid service: SBR.
 - d. Fittings: In accordance with AWWA C606, rigid radius-cut groove:
 - 1) Center-to-center dimensions: In accordance with AWWA C110.
 - 2) Wall thickness and other characteristics: In accordance with AWWA C606.
 - e. Flanged unit connections: Flanged to grooved joint adapters or a long enough spool with one end flanged and the other end grooved to prevent interference with the operation of adjacent valves, pumps, or other items.
3. Mechanical joints: In accordance with AWWA C111.
4. Push-on rubber gasket joints: In accordance with AWWA C111.
5. Mechanical wedge action joint restraints:
 - a. Manufacturers: One of the following or equal:
 - 1) EBAA Iron, Inc., Megalug Series 1100.
 - 2) Star Pipe Products, Split Stargrip Series 3000.
 - b. Materials:
 - 1) Gland body: Ductile iron in accordance with ASTM A536.
 - 2) Wedges and wedge actuating components: Ductile iron in accordance with ASTM A536.
 - a) Wedges shall be heat treated to a minimum of 370 BHN.
 - 3) Actuating bolts and nuts: Ductile iron in accordance with ASTM A536.
 - a) Provide torque-limiting twist off components to ensure proper installation.
 - c. Coatings:
 - 1) Provide manufacturer applied coating system.
 - 2) Manufacturers: One of the following or equal:
 - a) EBAA Iron Inc., Mega-Bond.
 - b) Star Pipe Products, Star-Bond.
 - d. Working pressure:
 - 1) Shall include a minimum safety factor of 2:1.

- 2) For sizes 3- through 16-inch: 350 pounds per square inch.
- 3) For sizes 18- through 48-inch: 250 pounds per square inch.
- e. Restraint shall consist of multiple gripping wedges incorporated into a follower gland meeting the requirements of AWWA C111.
- f. Restraint shall allow post assembly angular deflection that is a minimum of 50 percent of the angular deflection allowed by the mechanical joint.
- g. Restraint must be in accordance with applicable requirements of AWWA C110 and AWWA C111 for mechanical joints.

C. Fittings:

- 1. Ductile iron in accordance with AWWA C110.
- 2. Joint type: Same as that of the associated piping as specified in Section 15052.
- 3. Plain end-to-flanged joint connectors using setscrews are not acceptable.

D. Pipe linings:

- 1. Cement-mortar lining:
 - a. In accordance with AWWA C104, apply cement-mortar on clean bare metal surfaces. Extend to faces of flanges, ends of spigots, and shoulders of hubs.
 - b. Minimum lining thickness: Standard in accordance with AWWA C104.
 - c. Type of cement: Type II.
- 2. Asphaltic seal coat:
 - a. Apply over cement mortar linings and to outside surface of pipes that will not receive another coating. Apply in accordance with AWWA C151.

E. Coatings:

- 1. Asphalt varnish: Factory applied.
- 2. Primer:
 - a. Factory applied for field coating.
 - b. Compatible with materials as specified in Section 09960.

2.02 POLYETHYLENE ENCASEMENT

A. General:

- 1. Polyethylene encasement shall be supplied by the pipe manufacturer.

B. Materials: Supply one of the following polyethylene encasements:

- 1. 2 layers of linear low-density polyethylene (LLDPE) film, minimum thickness of 8 mils in accordance with AWWA C105; or
- 2. Single layer of high-density, cross-laminated polyethylene (HDCLPE) film, minimum thickness of 4 mils in accordance with AWWA C105.
- 3. Single layer of V-Bio[®] enhanced polyethylene encasement (3 layers of co-extruded LLDPE film with anti-microbial additive and volatile corrosion inhibitor infused on the inside surface), meeting all requirements of AWWA C105.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
1. Install ductile iron piping in accordance with AWWA C600, modified as specified in Section 15052.
 2. For underground piping, the trenching, backfill, and compaction: As specified in Section 02318.
- B. Polyethylene encasement:
1. Wrap all buried ductile iron pipe and fittings in 2 layers of loose low density polyethylene wrap or a single layer of high-density polyethylene wrap in accordance with AWWA C105.
 2. Polyethylene encasement shall be continuous and terminated neatly at connections to below grade equipment or structures.
 3. At wall penetrations, extend encasement to the wall and neatly terminate.
 4. At slab penetrations, extend encasement to 2 inches below the top of slab and neatly terminate.
 5. When rising vertically in unimproved areas, extend encasement 6 inches above existing grade and neatly terminate.
 6. Repair tears and make joints with 2 layers of plastic tape.
 7. All work shall be inspected prior to backfilling of pipe and associated items.
- C. Joints:
1. Install types of joints as specified in the piping schedule provided in Section 15052.
 2. Mechanical joints are not acceptable in above ground applications.
 3. Field closure for restrained push-on pipe:
 - a. Locate field closures in areas where thrust calculations demonstrate restraint is not required.
 4. Grooved joints:
 - a. Install piping with grooved joints where specified in the piping schedule as specified in Section 15052 or indicated on the Drawings.
 - b. Assemble grooved joints in accordance with manufacturer's published instructions.
 - c. Support grooved-end pipe in accordance with manufacturer's published instructions.
 - 1) Install at least 1 support between consecutive couplings.
- D. Tapping ductile iron pipe:
1. Direct tapping of ductile iron pipe may be performed but is limited to the following conditions:
 - a. Maximum allowable tap diameter by pipe diameter and pressure class:

Pipe Size (inches)	Pressure Class				
	150	200	250	300	350
	Maximum Allowable Direct Tap Size (inches)				
3	-	-	-	-	3/4
4	-	-	-	-	3/4

Pipe Size (inches)	Pressure Class				
	150	200	250	300	350
	Maximum Allowable Direct Tap Size (inches)				
6	-	-	-	-	1
8	-	-	-	-	1
10	-	-	-	-	1
12	-	-	-	-	1-1/4
14	-	-	1-1/4	1-1/2	1-1/2
16	-	-	1-1/2	2	2
18	-	-	2	2	2
20	-	-	2	2	2
24	-	2	2	2	2

- b. The maximum allowable tap diameter for pipelines greater than 24 inches is 2 inches.
 - c. Two layers of 3-mil thread sealant are required to minimize the torque required to effect a watertight connection.
2. Direct tapping of glass lined ductile iron pipe may be performed only when approved in writing by the Engineer. Direct tapping of glass lined pipe shall be performed in accordance with the above conditions for tapping ductile iron pipe in addition to the following conditions:
 - a. Drilling and tapping shall be performed using a hole saw.
 - 1) Use of a large drill bit is not acceptable.
 - b. As the hole saw approaches the glass lining, lessen the inward pressure to avoid excess chipping or cracking of the lining.
 - c. Minor chipping or spalling of the glass lining shall be repaired using an epoxy resin "glass repair kit" provided by the fabricator.
 - 1) Manufacturers: One of the following or equal:
 - a) Devoe - Devran 224 HS.
 - b) Sherwin-Williams Co. – Sher-Tile High Solids Epoxy.
 - 2) Repair kit use is only allowed for areas of damage less than 1/2 inch in diameter.
 - a) Larger areas of damage will require replacement.
 - 3) Surface shall be prepared and repair kit shall be applied in accordance with manufacturer and/or fabricator's instructions.

3.02 FIELD QUALITY CONTROL

- A. Testing ductile iron piping:
 1. Test as specified in Section 15052.
 2. Do not test sections longer than 1/2 mile in total pipe length.
- B. Repair damaged cement mortar lining to match quality, thickness, and bonding of original lining in accordance with AWWA C104.
 1. When lining cannot be repaired or repairs are defective, replace defective piping with undamaged piping.

- C. Verify that interior surfaces of glass lined pipe and fittings have continuous coverage:
1. Verify with low voltage wet sponge holiday detector in accordance with NACE SP0188.
 2. Discard glass lined ductile iron piping and fittings with voids or casting anomalies. that exceed the maximum non-visible pinholes allowances below:

Diameter	Maximum Pinholes	
	Fittings	Pipe (per 20-foot length of pipe)
4- to 8-inch	3-5	10-12
10- to 18-inch	5-8	18-20
20-inch and Larger	8-10	25-28

3. Discard lined piping and fittings found to have pinholes, crazing, or fish scales, which expose the metal substrate.

3.03 COMMISSIONING REQUIREMENTS

- A. As specified in Section 01756 and this Section.
- B. Manufacturer services:
1. Provide Manufacturer's Certificate of Source Testing.
 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.

			Manufacturer Rep Onsite					
Source Testing (Witnessed or Non-witnessed)	Training Requirements		Installation Testing		Functional Testing		Process Operational Period	
	Maintenanc e (hrs per session)	Operatio n (hrs per session)	Trips	Days (each trip)	Trips	Days (each trip)	Trips	Days (each trip)
Non-witnessed	Not required		Not required		Not required		Not required	

END OF SECTION

SECTION 15244

POLYVINYL CHLORIDE (PVC) PIPE: AWWA C900

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. AWWA C900 PVC pipe and fittings.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 01300 - Submittals.
 - b. Section 01756 - Commissioning.
 - c. Section 15052 - Common Work Results for General Piping.
 - d. Section 15076 - Pipe Identification.
 - e. Section 15120 - Piping Specialties.
 - f. Section 15211 - Ductile Iron Pipe: AWWA C151.
 - g. Section 15956 - Piping Systems Testing.

1.02 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. C111 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 2. C605 - Standard for Underground Installation of PVC and PVCO Pressure Pipe and Fittings for Water.
 - 3. C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 Inches to 12 Inches, for Water Transmission Distribution.
 - 4. M23 – PVC Pipe – Design and Installation Manual.
- B. ASTM International (ASTM):
 - 1. A 536 - Standard Specification for Ductile Iron Castings.
 - 2. D 1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - 3. D 3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 - 4. F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - 5. F 645 - Standard Guide for Selection, Design and Installation of Thermoplastic Water-Pressure Piping Systems.

- C. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.

1.03 ABBREVIATIONS

- A. DR: Dimension ratio.
- B. NPS: Nominal pipe size followed by the size designation.

1.04 SUBMITTALS

- A. Submit as specified in Section 01300.
- B. Shop Drawings:
 - 1. Describe materials, pipe, fittings, and gaskets.
 - 2. Manufacturer's product handling and installation instructions.
- C. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756.
 - 1. Include date of manufacture for each lot delivered.
- D. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756.

1.05 QUALITY ASSURANCE

- A. Pipe in potable water applications: Provide pipe bearing NSF 61 seal.
- B. Mark plastic pipe with date of extrusion, nominal size, class, manufacturer and all markings required in accordance with ASTM and AWWA standards.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect from sunlight, scoring, and distortion.
- B. Do not allow surface temperatures to exceed 120 degrees Fahrenheit.
- C. Deliver, offload, handle, and store pipe in accordance with manufacturer's or pipe supplier's recommendations and best practices provided by AWWA M23 and AWWA C605, including compliance with minimum recommended bending radius and maximum safe pulling forces for each specific pipe.

PART 2 PRODUCTS

2.01 PIPE

- A. General:
 - 1. Extruding and molding material: Virgin material containing no scrap, regrind, or rework material except where permitted in the referenced standards.
 - 2. In accordance with AWWA C900.
 - 3. Made from a PVC compound conforming to cell classification 12454 in accordance with ASTM D 1784.

- B. Pipe:
 - 1. Bell and spigot:
 - a. Pipe with integral bell.
 - b. Pressure Class as scheduled in Section 15052 with a minimum DR of 18.
 - c. Manufacturers:
 - 1) Diamond Plastics Corporation.
 - 2) CertainTeed.
 - 3) North American Pipe Corporation.

2.02 _FITTINGS

- A. Material:
 - 1. Cast or ductile iron fittings as specified in Section 15211, sized for the dimensions of the pipe being used.
- B. Equal to or greater pressure rating than the pipe.

2.03 JOINTS

- A. Bell and spigot joints:
 - 1. Push-on or mechanical joint type as identified in the Piping Schedule in Section 15052.
 - 2. Gasketed joint assembly: Meet or exceed the requirements in accordance with ASTM D 3139.
 - 3. Factory installed gaskets: EPDM in accordance with ASTM F 477.
 - 4. Joint restraint at fittings:
 - a. Mechanical wedge action joint restraints:
 - 1) Manufacturers: One of the following or approved equal:
 - a) EBAA Iron, Inc.:
 - (1) For pipes 3 to 36-inch: Series 2000PV.
 - (2) For pipes 42 and 48-inch: Series 2200.
 - b) Star Pipe Products, Series 4000.
 - 2) Materials:
 - a) Gland body: Ductile iron in accordance with ASTM A 536.
 - b) Wedge and wedge actuating components: Ductile iron in accordance with ASTM A 536.
 - (1) Wedges: Heat-treated to a minimum of 370 BHN.
 - c) Actuating bolts and nuts: Ductile iron in accordance with ASTM A 536.
 - (1) Provide torque-limiting twist off components to ensure proper installation.
 - 3) Coatings:
 - a) Provide a manufacturer applied coating system.
 - b) Manufacturers: One of the following or equal:
 - (1) EBAA Iron Inc., Mega-Bond.
 - (2) Star Pipe Products, Star-Bond.
 - 4) Consist of multiple gripping wedges incorporated into a follower gland meeting the requirements in accordance with AWWA C111.
 - 5) Allow post assembly angular deflection that is a minimum of 50 percent of the angular deflection allowed by the mechanical joint.
 - 6) Pressure rating equal to or greater than that of the pipe on which it is being used and a minimum safety factor of 2:1 for all sizes.

- b. Push-on joint restraint harnesses:
 - 1) Manufacturers: One of the following or approved equal:
 - a) EBAA Iron, Inc.:
 - (1) For pipes 4 to 12-inch: Series 1500.
 - (2) For pipes 14 to 48-inch: Series 2800.
 - b) Star Pipe Products, Series 4100P.
 - 2) Materials:
 - a) Restraint and backup rings: Ductile iron in accordance with ASTM A 536.
 - b) Wedge and wedge actuating components: Ductile iron in accordance with ASTM A 536.
 - c) Tie rods: Low alloy steel in accordance with AWWA C111.
 - 3) Coatings:
 - a) Provide manufacturer applied coating system.
 - b) Manufacturers: One of the following or equal:
 - (1) EBAA Iron Inc., Mega-Bond.
 - (2) Star Pipe Products, Star-Bond.
 - 4) Consist of a backup ring behind the PVC bell and a restraint ring consisting of multiple gripping wedges connected with number and type of tie rods as recommended by the manufacturer.
 - 5) Allow post assembly angular deflection that is a minimum of 50 percent of the angular deflection allowed by the push-on joint.
 - 6) Pressure rating equal to or greater than that of the pipe on which it is being used and a minimum safety factor of 2:1 for all sizes.]

2.04 SOURCE QUALITY CONTROL

- A. Bell and spigot piping:
 - 1. Hydrostatic proof testing in accordance with AWWA C900: Test pipe and integral bell to withstand, without failure, 2 times the pressure class of the pipe for a minimum of 5 seconds.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Install piping in accordance with ASTM F 645, AWWA C605, the Appendix of AWWA C900 and manufacturer's or pipe supplier's published installation instructions.
 - 2. For open cut installations, install underground warning tape as specified in Section 15076.
 - 3. Install pipe with tracer wire as specified in Section 15076.
- B. Tapping:
 - 1. Direct tapping:
 - a. Direct taps are allowed for AWWA C900 Class 235 and Class 305 pipe, NPS 6-inch through 12-inch only.
 - b. 1-inch is the maximum allowable outlet size for performing a direct tap.
 - 2. Saddle tapping:
 - a. Saddle taps are allowable on all sizes and classes of AWWA C900 pipe.
 - b. 2-inch is the maximum allowable outlet size for performing a saddle tap.

- c. As specified in Section 15120 for allowable service saddles.
- 3. Tapping sleeves:
 - a. Tapping sleeves are allowable on all sizes and classes of PVC AWWA C900.
 - b. As specified in Section 15120 for allowable tapping sleeves.

3.02 FIELD QUALITY CONTROL

A. Leakage test for piping:

- 1. Subject to visible leak test and pressure test with maximum leakage allowance, as specified in Section 15956.
- 2. Pressure test with maximum leakage allowance.
 - a. Perform test after placing sufficient backfill.
 - b. In areas requiring immediate backfill, test prior to placement of permanent surfacing.
 - c. Test pressure: As specified in the Piping Schedule in Section 15052.
 - d. Maximum leakage allowance for bell and spigot pipe is as follows, where the value for leakage is in gallons per 50 joints per hour.

Test Pressure (psi)	Nominal Pipe Size (inches)									
	4	6	8	10	12	14	16	18	20	24
50	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.96	1.15
75	0.23	0.35	0.47	0.59	0.70	0.82	0.94	1.05	1.17	1.40
100	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62
125	0.3	0.45	0.6	0.76	0.91	1.06	1.21	1.36	1.51	1.81
150	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99
175	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15
200	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29
225	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43
250	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56
275	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69
300	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81

3.03 COMMISSIONING REQUIREMENTS

A. As specified in Section 01756 and this Section.

B. Manufacturer services:

- 1. Provide Manufacturer's Certificate of Source Testing.
- 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.

Source Testing (Witnessed or Non-witnessed)	Manufacturer Rep Onsite							
	Training Requirements		Installation Testing		Functional Testing		Process Operational Period	
	Maintenance (hrs per session)	Operation (hrs per session)	Trips	Days (each trip)	Trips	Days (each trip)	Trips	Days (each trip)

			Manufacturer Rep Onsite					
Source Testing (Witnessed or Non-witnessed)	Training Requirements		Installation Testing		Functional Testing		Process Operational Period	
	Maintenanc e (hrs per session)	Operati on (hrs per session)	Trips	Days (each trip)	Trips	Days (each trip)	Trips	Days (each trip)
Non-witnessed	Not required		Not required		Not required		Not required	

END OF SECTION

SECTION 15245

DRAIN, WASTE, AND VENT PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Plastic drain, waste, and vent pipe and fittings.
- B. Related sections:
 - 1. Section 01300 - Submittals.
 - 2. Section 01756 - Commissioning.
 - 3. Section 15052 - Common Work Results for General Piping.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.12 - Cast Iron Threaded Drainage Fittings.
- B. International (ASTM):
 - 1. B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 2. D396 - Standard for Fuel Oils.
 - 3. D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
 - 4. D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.-
 - 5. D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - 6. D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - 7. D2235 - Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
 - 8. D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 9. D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
 - 10. D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
 - 11. D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - 12. D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
 - 13. D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
 - 14. D2661 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.
 - 15. D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
 - 16. D2683 -Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

17. D2843 - Standard Test Method for Density of Smoke from the Burning of Decomposition of Plastics.
18. D2863 - Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index).
19. D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride)(PVC) Pipe and Fittings.
20. D3138 - Standard Specification for Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components.
21. D3222-Standard Specification for Unmodified Poly(Vinylidene Fluoride)(PVDF) Molding Extrusion and Coating Materials.
22. D3261 -Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
23. D3350 - Standard Specification for Polyethylene Plastic Pipes and Fittings Materials.
24. D3965 - Specification for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Materials for Pipe and Fittings.
25. D4101 – Standard Specification for Polypropylene Injection and Extrusion Materials.
26. D6713 - Standard Specification for Extruded and Compression Molded Shapes Made from Poly(Vinylidene Fluoride) (PVDF).
27. E84 - Standard Test Method for Surface Burning Characteristics of Building.
28. F402 - 05 Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
29. F628 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core.
30. F645 - Standard Guide for Selection, Design, and Installation of Thermoplastic Water-Pressure Piping Systems.
31. F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
32. F1055 - Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
33. F1056 - Standard Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings.
34. F1290 - Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings.
35. F1412 - Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems.
36. F1673 - Standard Specification for Polyvinylidene Fluoride (PVDF) Corrosive Waste Drainage Systems.
37. F1668 - Standard Guide for Construction Procedures for Buried Plastic Pipe.
38. F2620 - Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.

C. National Science Foundation International (NSF).

D. Plastics Pipe Institute (PPI):

1. TR 31 - Underground Installation of Polyolefin Piping.

1.03 ABBREVIATIONS

A. DR: Dimension ratio.

- B. DWV: Drain, waste, and vent.
- C. ID: Inside diameter of piping or tubing.
- D. NPS: Nominal pipe size followed by the size designation.
- E. NS: Nominal SIZE of piping or tubing.
- F. PVC: Polyvinyl chloride.

1.04 SUBMITTALS

- A. Submit as specified in Section 01300.
- B. Shop Drawings:
 - 1. Describe materials, pipe, fittings, gaskets, and solvent cement.
 - 2. Installation instructions.
- C. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756. Include as applicable:
 - 1. Date of manufacture of plastic pipe and tubing for each lot delivered.
 - 2. Copies of solvent cement manufacturer's report and certification in accordance with ASTM D2564 for PVC piping.
- D. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756.

1.05 QUALITY ASSURANCE

- A. Install drain system in accordance with all local and national plumbing codes.
- B. Plastic pipe in potable water applications: Provide pipe and tubing bearing NSF 61 seal.
 - 1. Mark plastic pipe with nominal size, type, class, schedule, or pressure rating, manufacturer and all markings required in accordance with ASTM standards.

1.06 SOURCE QUALITY CONTROL

- A. PVC piping, Schedule Type:
 - 1. Mark pipe and fittings in accordance with ASTM D1785.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping materials from sunlight, scoring, and distortion.
- B. Do not allow surface temperatures on pipe and fittings to exceed 120 degrees Fahrenheit.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Extruding and molding material: Virgin material containing no scrap, regrind, or rework material except where permitted in the referenced standards.
- B. Fittings: Same material as the pipe.
- C. Unions 2-1/2 inches and smaller: Socket end screwed unions. Make unions 3 inches and larger of socket flanges with 1/8-inch full-face soft EPDM gasket.

2.02 PVC PIPING

- A. Materials:
 - 1. PVC Pipe: Designation PVC 1120 in accordance with ASTM D1785 and appendices:
 - a. Pipe and fittings: Extruded from Type I, Grade 1, Class 12454-B material in accordance with ASTM D1784.
 - b. PVC Pipe: Schedule 40 unless otherwise indicated on the Drawings.
 - 2. Fittings:
 - a. Supplied by pipe manufacturer.
 - b. Pressure fittings: In accordance with ASTM D2466 or ASTM D2467.
 - c. DWV fittings: In accordance with ASTM D2665.
 - 3. Solvent cement: In accordance with ASTM D2564:
 - a. Chemical service: For CPVC or PVC pipe in chemical service, provide the following primer and cement, or equal:
 - 1) Primer: IPS Corp Type P-70™.
 - 2) Cement: IPS Corp Type 724™ cement or cement certified by the manufacturer for chemical service.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Where not otherwise specified, install piping in accordance with ASTM F645, or manufacturer's published instructions for installation of piping, as applicable to the particular type of piping.
 - 2. Provide molded transition fittings for transitions from plastic to metal or IPS pipe. Do not thread plastic pipe.
 - 3. Locate unions where indicated on the Drawings, and elsewhere where required for adequate access and assembly of the piping system.
 - 4. Provide serrated nipples for transition from plastic pipe to rubber hose.
 - 5. Heat fusion joining shall be in accordance with ASTM D2657.
 - 6. Underground installation shall be installed in accordance with ASTM D2321 and ASTM F1668.
 - 7. Solvent cements shall be handled in accordance with ASTM F402.

- B. Installation of PVC piping, Schedule Type:
 - 1. Solvent weld joints in accordance with ASTM D2855:
 - a. For PVC pipe in chemical service use IPS Corp. Type 724™ cement in accordance with manufacturer's instructions.
 - 2. Install piping in accordance with manufacturer's published instructions.

3.02 FIELD QUALITY CONTROL

- A. Test all piping as specified in Section 15052.

3.03 COMMISSIONING

- A. As specified in Section 01756 and this Section.
- B. Manufacturer services:
 - 1. Provide Manufacturer's Certificate of Source Testing.
 - 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.

			Manufacturer Rep Onsite					
Source Testing (Witnessed or Non-witnessed)	Training Requirements		Installation Testing		Functional Testing		Process Operational Period	
	Maintenance (hrs per session)	Operation (hrs per session)	Trips	Days (each trip)	Trips	Days (each trip)	Trips	Days (each trip)
Non-witnessed	Not required		Not required		Not required		Not required	

END OF SECTION

SECTION 15286

STAINLESS STEEL PIPE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Stainless steel piping and tubing.
- B. Related sections:
 - 1. Section 01300 - Submittals.
 - 2. Section 01756 - Commissioning.
 - 3. Section 15052 - Common Work Results for General Piping.
 - 4. Section 15121 - Pipe Couplings.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
 - 2. B16.11 - Forged Fittings, Socket-Welded and Threaded.
 - 3. B31.3 - Process Piping.
 - 4. B36.19 - Stainless Steel Pipe.
- B. American Welding Society (AWS):
 - 1. D1.6 - Structural Welding Code - Stainless Steel.
- C. ASTM International (ASTM):
 - 1. A182 - Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - 2. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - 3. A194 - Standard Specification for Carbon and Alloy Steel Nuts and Bolts for High Pressure or High Temperature Service, or Both.
 - 4. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 5. A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - 6. A276 - Standard Specification for Stainless Steel Bars and Shapes.
 - 7. A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - 8. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - 9. A403 - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
 - 10. A744 - Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.

11. A774 - Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Services at Low and Moderate Temperatures.
12. A778 - Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
13. A790 - Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe.
14. A928 - Standard Specification for Ferritic/Austenitic (Duplex) Stainless Steel Pipe Electric Fusion Welded with Addition of Filler Metal.
15. A967 - Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.

1.03 DESIGN REQUIREMENTS

- A. Shop fabrication: Fabricate piping sections in the shop and pickle and passivate at point of manufacture.
- B. Field assembly:
 1. Field welding is prohibited.
 2. Assemble shop-fabricated piping in the field using the joints designed into the piping layout or by using flexible couplings.

1.04 SUBMITTALS

- A. Submit as specified in Section 01300.
- B. Shop drawings:
 1. Thickness and dimensions of fittings and gaskets.
 2. Material specifications for pipe, gaskets, fittings, and couplings.
 3. Data on joint types and components used in the system including stub ends, backing flanges, flanged joints, grooved joint couplings and screwed joints.
- C. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756.
- D. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756.

PART 2 PRODUCTS

2.01 STAINLESS STEEL PIPE

- A. General:
 1. Pipe sizes specified in the Specifications and indicated on the Drawings are nominal.
- B. Wall thickness:
 1. Piping 3 inches in nominal diameter and greater:
 - a. For general service applications with pressures less than 250 pounds per square inch gauge, pipe diameter 24-inches or less, minimum wall thickness corresponding to Schedule 10S.

C. Piping material and manufacturing:

1. Comply with the requirements outlined in the following table:

Service	Stainless Steel Grade	Pipe Manufacturing Process
For low chloride water service with chloride concentrates below 200 parts per million and/or free chlorine less than 2 parts per million at ambient temperatures.		
Piping 3 inches in nominal diameter and larger	Type 304L stainless steel in accordance with ASTM A240	In accordance with ASTM A778
Piping less than 3 inches in nominal diameter	Type 304L stainless steel in accordance with ASTM A240	In accordance with ASTM A312

UNS #	ALLOY	Cr%	Mo%	N%	Other	PREN
N10276	C-276	14.5-16	15-17	-	W 3-4.5	64
S32750	Alloy 2507	24-26	6-8	0.24-0.32	-	48
S32654	654SMO	24-25	7-8	-	-	47
N06625	Alloy 625	20-23	8-10	-	Cb 3.25-4.15	46
N08366	AL6XN	20-22	6-7	-	-	40
N06985	Alloy G	21-23.5	5.5-7.5	-	-	39
S32760	Zeron 100	24-26	3-4	0.2-0.3	W 0.5-1.0	37
S32205	Alloy 2205	22-23	3-3.5	0.14-0.20	-	34
N08904	904L	19-23	4-5	-	-	32
S31726	317LNM	17-20	4-5	0.1-0.2	-	32
N08825	Alloy 825	19-23.5	2.5-3.5	-	-	27
S32101	LDX-2101	21.5	0.3	0.22	-	26
S31603	316L	16-18	2-3	-	-	23
S30403	304L	18-20	-	-	-	18

D. Fittings for piping 3 inches in nominal diameter and greater:

1. Material: In accordance with ASTM A240 stainless steel, grade to match the pipe.
2. Manufacturing standard: In accordance with ASTM A774.
3. Wall thickness of fitting: In accordance with ASME B36.19 for the schedule of pipe specified.
4. End configuration: As needed to comply with specified type of joint.
5. Dimensional standards:

- a. Fittings with flanged ends: In accordance with ASME B16.5, Class 150.
- E. Piping joints:
 - 1. Flanged joints: Conforming to the requirements in accordance with ASME B16.5, Class 150.
 - 2. Flanges for Schedule 40S and Schedule 80S pipe:
 - a. Provide forged stainless steel (type matching piping system) welding neck flanges or slip-on flanges in accordance with ASME B16.5 Class 150.
 - b. Material: In accordance with ASTM A182.
- F. Gaskets: EPDM, nitrile, or other materials compatible with the process fluid.
- G. Bolts for flanges and stub end/backing flanges:
 - 1. Bolts and nuts: Type 316 stainless steel in accordance with ASTM A193 heavy hex head.
 - a. Bolt length such that after installation, end of bolt projects 1/8-inch to 3/8-inch beyond outer face of nut.
 - b. Nuts: In accordance with ASTM A194 heavy hex pattern.
- H. Fabrication of pipe sections:
 - 1. Welding: Weld in accordance with ASME B31.3.
 - 2. Weld seams:
 - a. Full penetration welds, free of oxidation, crevices, pits and cracks, and without undercuts.
 - b. Provide weld crowns of 1/16 inch with tolerance of plus 1/16 inch and minus 1/32 inch.
 - c. Where internal weld seams are not accessible, use gas tungsten-arc procedures with internal gas purge.
 - d. Where internal weld seams are accessible, weld seams inside and outside using manual shielded metal-arc procedures.
- I. Cleaning (pickling) and passivation:
 - 1. Following shop fabrication of pipe sections, straight spools, fittings, and other piping components, clean (pickle) and passivate fabricated pieces.
 - 2. Clean (pickle) and passivate in accordance with ASTM A380 or A967.
 - a. If degreasing is required before cleaning to remove scale or iron oxide, cleaning (pickling) treatments with citric acid are permissible.
 - 1) However, these treatments must be followed by inorganic cleaners such as nitric acid/hydrofluoric acid.
 - b. Passivation treatments with citric acid are not allowed.
 - 3. Finish requirements: Remove free iron, heat tint oxides, weld scale, and other impurities, and obtain a passive finished surface.

2.02 SOURCE QUALITY CONTROL

- A. Visually inspect pipe for welding defects such as crevices, pits, cracks, protrusions, and oxidation deposits.
- B. Provide written certification that the pipe as supplied are in accordance with ASTM A778. Supplemental testing is not required.
- C. Provide written certification that the fittings as supplied are in accordance with ASTM A774.

1. Supplementary testing is not required.
- D. Thoroughly clean any equipment before use in cleaning or fabrication of stainless steel.
- E. Storage: Segregate location of stainless steel piping from fabrication of any other piping materials.
- F. Shipment to site:
 1. Protect all flanges and pipe ends by encapsulating in dense foam.
 2. Securely strap all elements to pallets with nylon straps. Use of metallic straps is prohibited.
 3. Cap ends of tube, piping, pipe spools, fittings, and valves with non-metallic plugs.
 4. Load pallets so no tube, piping, pipe spools, fittings, or valves bear the weight of pallets above.
 5. Notify Engineer when deliveries arrive so Engineer may inspect the shipping conditions.
 6. Engineer may reject material due to improper shipping methods or damage during shipment.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install piping in such a manner as not to impart strain to connected equipment.

3.02 FIELD ASSEMBLY OF SHOP-FABRICATED PIPING SECTIONS

- A. Join shop-fabricated piping sections together using backing flanges, flexible couplings, flanged coupling adapters, grooved couplings, or flanges.

3.03 FIELD QUALITY CONTROL

- A. Test piping to pressure and by method as specified in Section 15052.
 1. If pressure testing is accomplished with water:
 - a. Use only potable quality water.
 - b. Piping: Thoroughly drained and dried or place immediately into service.
- B. Visually inspect pipe for welding defects such as crevices, pits, cracks, protrusions, and oxidation deposits.

3.04 PROTECTION

- A. Preserve appearance and finish of stainless steel piping by providing suitable protection during handling and installation and until final acceptance of the Work.
 1. Use handling methods and equipment to prevent damage to the coating, include the use of wide canvas slings and wide padded skids.
 2. Do not use bare cables, chains, hooks, metal bars, or narrow skids.
 3. Store stainless steel piping and fittings away from any other piping or metals. Storage in contact with ground or outside without protection from bad weather is prohibited.

4. Protect stainless steel piping and fittings from carbon steel projections (when grinding carbon steel assemblies in proximity) and carbon steel contamination (do not contact stainless steel with carbon steel wire brush or other carbon steel tool).

3.05 COMMISSIONING

- A. As specified in Section 01756 and this Section.
- B. Manufacturer services:
 1. Provide Manufacturer's Certificate of Source Testing.
 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.

			Manufacturer Rep Onsite					
Source Testing (Witnessed or Non-witnessed)	Training Requirements		Installation Testing		Functional Testing		Process Operational Period	
	Maintenance (hrs per session)	Operation (hrs per session)	Trips	Days (each trip)	Trips	Days (each trip)	Trips	Days (each trip)
Non-witnessed	Not required		Not required		Not required		Not required	

END OF SECTION

SECTION 15956

PIPING SYSTEMS TESTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Test requirements for piping systems.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 01300 - Submittals.
 - b. Section 01410 - Regulatory Requirements.
 - c. Section 01500 - Temporary Facilities and Controls.
 - d. Section 15052 - Common Work Results for General Piping.

1.02 REFERENCES

- A. National Fuel Gas Code (NFGC).
- B. American Society of Mechanical Engineers (ASME):
 - 1. B31.1 - Power Piping.
 - 2. B31.3 - Process Piping.
 - 3. B31.8 - Gas Transmission and Distribution Piping Systems.
- C. Underwriters Laboratories Inc. (UL).

1.03 TESTING REQUIREMENTS

- A. General requirements:
 - 1. Testing requirements are stipulated in Laws and Regulations; are included in the Piping Schedule in Section 15052; are specified in the specifications covering the various types of piping; and are specified in this Section.
 - 2. Requirements in Laws and Regulations supersede other requirements of Contract Documents, except where requirements of Contract Documents are more stringent, including higher test pressures, longer test times, and lower leakage allowances.
 - 3. Test plumbing piping in accordance with Laws and Regulations, the plumbing code, as specified in Section 01410, and UL requirements.

4. When testing with water, the specified test pressure is considered to be the pressure at the lowest point of the piping section under test.
 - a. Lower test pressure as necessary (based on elevation) if testing is performed at higher point of the pipe section.
- B. Furnish necessary personnel, materials, and equipment, including bulkheads, restraints, anchors, temporary connections, pumps, water, pressure gauges, and other means and facilities required to perform tests.
- C. Water for testing, cleaning, and disinfecting:
 1. Water for testing, cleaning, and disinfecting will be provided as specified in Section 01500.
- D. Pipes to be tested: Test only those portions of pipes that have been installed as part of this Contract. Test new pipe sections prior to making final connections to existing piping. Furnish and install test plugs, bulkheads, and restraints required to isolate new pipe sections. Do not use existing valves as test plug or bulkhead.
- E. Unsuccessful tests:
 1. Where tests are not successful, correct defects or remove defective piping and appurtenances and install piping and appurtenances that comply with the specified requirements.
 2. Repeat testing until tests are successful.
- F. Test completion: Drain and leave piping clean after successful testing.
- G. Test water disposal: Dispose of testing water in sanitary sewer at pump station site in accordance with requirements of federal, state, county, and city regulations governing disposal of wastes in the location of the Project and disposal site. Water shall meet the SMCSD permit requirements as shown in Appendix B.

1.04 SUBMITTALS

- A. Submit as specified in Section 01300.
- B. Schedule and notification of tests:
 1. Submit a list of scheduled piping tests by noon of the working day preceding the date of the scheduled tests.
 2. Notification of readiness to test: Immediately before testing, notify Engineer in writing of readiness, not just intention, to test piping.
 3. Have personnel, materials, and equipment specified in place before submitting notification of readiness.

1.05 SEQUENCE

- A. Clean piping before pressure or leak tests.
- B. Test gravity piping underground, including sanitary sewers, for visible leaks before backfilling and compacting.
- C. Underground pressure piping may be tested before or after backfilling when not indicated or specified otherwise.

- D. Backfill and compact trench, or provide blocking that prevents pipe movement before testing underground piping with a maximum leakage allowance.
- E. Test underground piping before encasing piping in concrete or covering piping with slab, structure, or permanent improvement.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 TESTING ALIGNMENT, GRADE, AND DEFLECTION

- A. Alignment and grade:
 - 1. Visually inspect the interior of gravity piping with artificial light, reflected light, or laser beam.
 - 2. Consider inspection complete when no broken or collapsed piping, no open or poorly made joints, no grade changes that affect the piping capacity, or no other defects are observed.
- B. Deflection test:
 - 1. Pull a mandrel through the clean piping section under test.
 - 2. Perform the test not sooner than 30 days after installation and not later than 60 days after installation.
 - 3. Use a 9-rod mandrel with a contact length of not less than the nominal diameter of the pipe within 1 percent plus or minus.
 - 4. Consider test complete when the mandrel can be pulled through the piping with reasonable effort by 1 person, without the aid of mechanical equipment.

3.02 AIR TESTING METHOD FOR PRESSURE PIPING

- A. Air test piping, indicated with "AM" in the Piping Schedule, with air or another nonflammable or inert gas.
- B. Test gas, air, liquefied petroleum gas, liquid chlorine, and chlorine gas piping by the air test method:
 - 1. Test chlorine piping with dry air or nitrogen having a dew point of minus 40 degrees Fahrenheit or less. Supply temporary air dryers as necessary.
- C. Test at pressure as specified in Piping Schedule in Section 15052:
 - 1. Provide temporary pressure relief valve for piping under test:
 - a. Set at the lesser of 110 percent of the test pressure or 50 pounds per square inch gauge over the test pressure.
 - 2. Air method test pressures shall not exceed 110 percent of the piping maximum allowable working pressure calculated in accordance with the most stringent of ASME B31.1, ASME B31.3, ASE B31.8, or the pipe manufacturer's stated maximum working pressure.
 - 3. Gradually increase test pressure to an initial test pressure equal to the lesser of 1/2 the test pressure or 25 pounds per square inch gauge.
 - 4. Perform initial check of joints and fittings for leakage.

5. Gradually increase test pressure in steps no larger than the initial pressure. Check for leakage at each step increase until test pressure reached.
6. At each step in the pressure, examine and test piping being air tested for leaks with soap solution.
7. Consider examination complete when piping section under test holds the test pressure for 15 minutes without losses.

3.03 TESTING GRAVITY FLOW PIPING

- A. Test gravity flow piping indicated with "GR" in the Piping Schedule, as follows:
 1. Unless specified otherwise, subject gravity flow piping to the following tests:
 - a. Alignment and grade.
 - b. For plastic piping test for deflection.
 - c. Visible leaks and pressure with maximum leakage allowance, except for storm drains and culverts.
 2. Inspect piping for visible leaks before backfilling.
 3. Provide temporary restraints when needed to prevent movement of piping.
 4. Pressure test piping with maximum leakage allowance after backfilling.
 5. With the lower end plugged, fill piping slowly with water while allowing air to escape from high points. Keep piping full under a slight head for the water at least 24 hours:
 - a. Examine piping for visible leaks. Consider examination complete when no visible leaks are observed.
 - b. Maintain piping with water, or allow a new water absorption period of 24 hours for the performance of the pressure test with maximum leakage allowance.
 - c. After successful completion of the test for visible leaks and after the piping has been restrained and backfilled, subject piping to the test pressure for minimum of 4 hours while accurately measuring the volume of water added to maintain the test pressure:
 - 1) For polyvinyl chloride (PVC) gravity sewer pipe: 25 gallons per day per inch diameter per mile of piping under test:
 - a) Consider the test complete when leakage is equal to or less than the following maximum leakage allowances:
 - (1) For concrete piping with rubber gasket joints: 80 gallons per day per inch of diameter per mile of piping under test:
 - (a) Advise manufacturer of concrete piping with rubber gasket joints of more stringent than normal maximum leakage allowance.
 - (2) For vitrified claypiping: 500 gallons per day per inch of diameter per mile of piping under test.
 - (3) For other piping: 80 gallons per day per inch diameter per mile of piping under test.

3.04 TESTING HIGH-HEAD PRESSURE PIPING

- A. Test piping for which the specified test pressure in the Piping Schedule is 20 pounds per square inch gauge or greater, by the high head pressure test method, indicated "HH" in the Piping Schedule.

B. General:

1. Test connections, hydrants, valves, blowoffs, and closure pieces with the piping.
2. Do not use installed valves for shutoff when the specified test pressure exceeds the valve's maximum allowable seat differential pressure. Provide blinds or other means to isolate test sections.
3. Do not include valves, equipment, or piping specialties in test sections if test pressure exceeds the valve, equipment, or piping specialty safe test pressure allowed by the item's manufacturer.
4. During the performance of the tests, test pressure shall not vary more than plus or minus 5 pounds per square inch gauge with respect to the specified test pressure.
5. Select the limits of testing to sections of piping. Select sections that have the same piping material and test pressure.
6. When test results indicate failure of selected sections, limit tests to piping:
 - a. Between valves.
 - b. Between a valve and the end of the piping.
 - c. Less than 500 feet long.
7. Test piping for minimum 2 hours for visible leaks test and minimum 2 hours for the pressure test with maximum leakage allowance.

C. Testing procedures:

1. Fill piping section under test slowly with water while venting air:
 - a. Use potable water for all potable waterlines and where noted on the Piping Schedule.
2. Before pressurizing for the tests, retain water in piping under slight pressure for a water absorption period of minimum 24 hours.
3. Raise pressure to the specified test pressure and inspect piping visually for leaks:
 - a. Consider visible leakage testing complete when no visible leaks are observed.

D. Pressure test with maximum leakage allowance:

1. Leakage allowance is zero for piping systems using flanged, National Pipe Thread threaded and welded joints.
2. Pressure test piping after completion of visible leaks test.
3. For piping systems using joint designs other than flanged, threaded, or welded joints, accurately measure the makeup water necessary to maintain the pressure in the piping section under test during the pressure test period:
 - a. Consider the pressure test to be complete when makeup water added is less than the allowable leakage and no damage to piping and appurtenances has occurred.
 - b. Successful completion of the pressure test with maximum leakage allowance shall have been achieved when the observed leakage during the test period is equal or less than the allowable leakage and no damage to piping and appurtenances has occurred.
 - c. When leakage is allowed, calculate the allowable leakage by the following formula:

$$L = S \times D \times P^{1/2} \times 133,200^{-1}$$

wherein the terms shall mean:

L = Allowable leakage in gallons per hour.

S = Length of the test section in feet.

D = Nominal diameter of the piping in inches.

P = Average observed test pressure in pounds per square inches gauge, at the lowest point of the test section, corrected for elevation of the pressure gauge.

x = The multiplication symbol.

3.05 TESTING LOW-HEAD PRESSURE PIPING

- A. Test piping for which the specified test pressure is less than 20 pounds per square inch gauge, by the low head pressure test method, indicated "LH" in the Piping Schedule.
- B. General:
 - 1. Test pressures shall be as scheduled in Section 15052.
 - 2. During the performance of the tests, test pressure shall not vary more than plus or minus 2 pounds per square inch gauge with respect to the specified test pressure.
 - 3. Test connections, blowoffs, vents, closure pieces, and joints into structures, including existing bell rings and other appurtenances, with the piping.
 - 4. Test piping for minimum 2 hours for visible leaks test and minimum 2 hours for the pressure test with maximum leakage allowance.
- C. Visible leaks test:
 - 1. Subject piping under test to the specified pressure measured at the lowest end.
 - 2. Fill piping section under test slowly with water while venting air:
 - a. Use potable water for all potable waterlines and where noted on the Piping Schedule.
 - 3. Before pressurizing for the tests, retain water in piping under slight pressure for the water absorption period of minimum 24 hours.
 - 4. Raise pressure to the specified test pressure and inspect piping visually for leaks. Consider testing complete when no visible leaks are observed.
- D. Pressure test with maximum leakage allowance:
 - 1. Pressure test piping after completion of visible leaks test.
 - 2. Accurately measure the makeup water necessary to maintain the pressure in the piping section under test during the pressure test period:
 - a. Consider the pressure test to be complete when makeup water added is less than the allowable leakage of 80 gallons per inch of nominal diameter, per mile of piping section under test after 24 hours, and no damage to piping and appurtenances has occurred.
 - b. Successful completion of the leakage test shall have been achieved when the observed leakage is equal or less than the allowable leakage and no damage to piping and appurtenances has occurred.

- E. Optional joint test:
1. When joint testing is allowed by note in the Piping Schedule, the procedure shall be as follows:
 - a. Joint testing will be allowed only for low head pressure piping.
 - b. Joint testing does not replace and is not in lieu of any testing of the piping system or trust restraints.
 2. Joint testing may be performed with water or air.
 3. Joint test piping after completion of backfill and compaction to the top of the trench.
 4. Joint testing with water:
 - a. Measure test pressure at the invert of the pipe. Apply pressure of 4 feet plus the inside diameter of the pipe in water column within 0.20 feet in water column.
 - b. Maintain test pressure for 1 minute.
 - c. Base the allowable leakage per joint on 80 gallons per inch nominal diameter, per mile of piping, per 24 hours equally distributed to the actual number of joints per mile for the type of piping.
 - d. Consider the pressure test to be complete when makeup water added is less than the allowable leakage.
 - e. Successful completion of the joint test with water shall have been achieved when the observed leakage is equal or less than the allowable leakage.
 5. Joint testing with air:
 - a. Apply test pressure of 3 pounds per square inch gauge with a maximum variation of plus 0.20 and minus 0.00 pounds per square inch.
 - b. Maintain test pressure for 2 minutes.
 - c. Consider the pressure test to be complete when the test pressure does not drop below 2.7 pounds per square inch for the duration of the test.

END OF SECTION

SECTION 15958

MECHANICAL EQUIPMENT TESTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Testing of mechanical equipment and systems.
- B. Related sections:
 - 1. Section 01756 - Commissioning.
 - 2. Section 02318 - Trenching.
 - 3. Section 15956 - Piping Systems Testing.
 - 4. Section 16222 - Motors.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. S1.4 Specification for Sound Level Meters.
- B. Hydraulic Institute (HI).
- C. National Institute of Standards and Technology (NIST).

1.03 SUBMITTALS

- A. Schedule of source (factory) tests, Owner training, installation testing, functional testing, clean water facility testing, closeout documentation, process start-up and process operational period as specified in this Section and in Section 01756 and equipment sections.
- B. Test instrumentation calibration data:
- C. Operation and maintenance manual:
 - 1. Include motor rotor bar pass frequencies for motors larger than 500 horsepower.
- D. Commissioning and Process Start-up Plan: As specified in Section 01756.
- E. Test plan as specified in Section 01756 and equipment sections.
- F. Test reports as specified in this Section and in Section 01756 and equipment sections.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 GENERAL

- A. Commissioning and process start-up of equipment as specified in:
 - 1. This section.
 - 2. Section 01756.
 - 3. Equipment sections.
 - a. If testing requirements are not specified, provide Level 1 Tests.
- B. Comply with latest version of applicable standards.
- C. Test and prepare piping as specified in Sections 02318 and 15956.
- D. Provide necessary test instrumentation that has been calibrated within 1 year from date of test to recognized test standards traceable to the NIST or approved source.
 - 1. Properly calibrated field instrumentation permanently installed as a part of the Work may be utilized for tests.
 - 2. Prior to testing, provide signed and dated certificates of calibration for test instrumentation and equipment.
- E. Test measurement and result accuracy:
 - 1. Use test instruments with accuracies as recommended in the appropriate referenced standards. When no accuracy is recommended in the referenced standard, use 1 percent or better accuracy test instruments.
 - a. Improved (lower error tolerance) accuracies specified elsewhere prevail over this general requirement.
 - 2. Do not adjust results of tests for instrumentation accuracy.
 - a. Measured values and values directly calculated from measured values shall be the basis for comparing actual equipment performance to specified requirements.
- F. Report features:
 - 1. Report results in a bound document in generally accepted engineering format with title page, written summary of results compared to specified requirements, and appropriate curves or plots of significant variables in English units.
 - 2. Include appendix with a copy of raw, unmodified test data sheets indicating test value, date and time of reading, and initials of person taking the data.
 - 3. Include appendix with sample calculations for adjustments to raw test data and for calculated results.
 - 4. Include appendix with the make, model, and last calibration date of instrumentation used for test measurements.
 - 5. Include in body of report a drawing or sketch of the test system layout showing location and orientation of the test instruments relative to the tested equipment features.
- G. Provide necessary fluids, utilities, temporary piping, temporary supports, temporary access platforms or access means and other temporary facilities and labor necessary to safely operate the equipment and accomplish the specified testing.
 - 1. With Owner's permission, some utilities may be provided by fully tested permanently installed utilities that are part of the Work.
- H. Prepare and submit test reports as specified.

- I. Testing levels:
 - 1. Level 1 Tests:
 - a. Level 1 General Equipment Performance Test:
 - 1) For equipment, operate, rotate, or otherwise functionally test for 15 minutes minimum after components reach normal operating temperatures.
 - 2) Operate at rated design load conditions.
 - 3) Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
 - b. Level 1 Pump Performance Test:
 - 1) Measure flow and head while operating at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.
 - 2) Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 16222 or the applicable equipment section. Use actual driver for field tests.
 - 3) Record measured flow, suction pressure, discharge pressure, and make observations on bearing temperatures and noise levels.
 - c. Level 1 Vibration Test:
 - 1) Test requirement:
 - a) Measure filtered vibration spectra versus frequency in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component.
 - b) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.
 - 2) Equipment operating condition: Test at specified maximum speed.
 - d. Level 1 Noise Test:
 - 1) Measure unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment and at a mid-point of the equipment height.
 - 2. Level 2 Tests:
 - a. Level 2 General Performance Test:
 - 1) For equipment, operate, rotate, or otherwise functionally test for at least 2 hours after components reach normal operating temperatures.
 - 2) Operate at rated design load conditions.
 - 3) Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
 - b. Level 2 Pump Performance Test:
 - 1) Test 2 hours minimum for flow and head at the rated condition; for factory testing, testing may be at a reduced speeds with flow and

- head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.
- 2) Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 16222. Use actual driver for field tests.
 - 3) Test for flow and head at 2 additional conditions; 1 at 25 percent below the rated flow and 1 at 10 percent above the rated flow.
 - 4) Record measured flow, suction pressure, discharge pressure, and observations on bearing temperatures and noise levels at each condition.
- c. Level 2 Vibration Test:
- 1) Test requirement:
 - a) Measure filtered vibration spectra versus frequency and measure vibration phase in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component; measure actual rotational speeds for each vibration spectra measured using photometric or other tachometer input connected directly to the vibration data collector.
 - b) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.
 - 2) Equipment operating condition: Repeat test requirements at design specified maximum speed and at minimum speed for variable speed equipment.
 - 3) Natural frequency test of field installed equipment:
 - a) Excite the installed equipment and support system in 3 perpendicular planes, use same planes as operating vibration measurement planes, and determine the as-installed natural resonant frequency of the driven equipment, the driver, gears and supports.
 - b) Perform test at each bearing housing, at each support pedestal, and for pumps on the suction and discharge piping.
 - c) Perform with equipment and attached piping full of intended service or process fluid.
- d. Level 2 Noise Test:
- 1) Measure filtered A-weighted overall sound pressure level in dBA for each of 8 octave band mid-points beginning at 63 hertz measured at 3 feet horizontally from the surface of the equipment at mid-point height of the noise source.
3. Level 3 Tests:
- a. Level 3 General Equipment Performance Tests:
 - 1) For equipment, operate, rotate, or otherwise functionally test for at least 4 hours after components reach normal operating temperatures.
 - 2) Operate at rated design load conditions for 1/2 the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.
 - 3) Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration or temperatures are observed.

- 4) Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.
 - 5) Bearing temperatures: During maximum speed or capacity performance testing, measure and record the exterior surface temperature of each bearing versus time.
- b. Level 3 Pump Performance Test:
- 1) Test 4 hours minimum for flow and head at or near the rated condition; for factory testing, testing may be at a reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.
 - 2) Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 16222. Use actual driver for field tests.
 - 3) Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 15 minutes; for factory testing, test at other speeds may be omitted if test driver at reduced speeds is used for rated condition testing.
 - 4) Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices are not required by the equipment section) and record observations on noise levels.
- c. Level 3 Vibration Test:
- 1) Requirements: Same as Level 2 vibration test except data taken at each operating condition tested and with additional requirements below.
 - 2) Perform High Frequency Enveloping Analysis for gears and bearings.
 - a) Measure bearing element vibration directly on each bearing cap in a location close as possible to the bearing load zone that provides a smooth surface and direct path to the bearing to detect bearing defects.
 - b) Report results in units of acceleration versus frequency in cycles per minute.
 - 3) Perform Time Wave Form analysis for gears, low speed equipment and reciprocating equipment; plot true peak amplitude velocity and displacement versus time and label the period between peaks with the likely cause of the periodic peaks (relate the period to a cause).
 - 4) Plot vibration spectra on 3 different plots; peak displacement versus frequency, peak acceleration versus frequency and peak velocity versus frequency.
- d. Level 3 Noise Test: Measure filtered, un-weighted overall sound pressure level in dB at 3 feet horizontally from the surface of the equipment at mid-point height and at 4 locations approximately 90 degrees apart in plain view; report results for each of 8 octave band mid-points beginning at 63 hertz.

4. Level 4 Tests:
- a. Level 4 General Equipment Performance Test:
 - 1) For equipment, operate, rotate, or otherwise functionally test for at least 8 hours after components reach normal operating temperatures.
 - 2) Operate at rated design load conditions for 1/2 the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.
 - 3) Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration or temperatures are observed.
 - 4) Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.
 - 5) Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.
 - b. Level 4 Pump Performance Test:
 - 1) Test 8 hours minimum for flow and head; begin tests at or near the rated condition; for factory and field-testing, test with furnished motor at full speed.
 - 2) Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 20 minutes or longer as necessary to measure required performance, vibration and noise data at each test condition.
 - 3) Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices not required by the equipment section) and record observations on noise levels.
 - 4) Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.
 - 5) Perform efficiency and/or Net Positive Suction Head Required (NPSHr) and/or priming time tests when specified in the equipment section in accordance with the appropriate HI standard and as follows:
 - a) Perform NPSHr testing at maximum rated design speed, head and flow with test fluids at ambient conditions; at maximum rated speed, test at 15 percent above rated design flow, and 25 percent below rated design flow.
 - b) Perform efficiency testing with test fluids at maximum rated speed.
 - c) Perform priming time testing with test fluids at maximum rated speed.
 - c. Level 4 Vibration Test: Same as Level 3 vibration test.
 - d. Level 4 Noise Test: Same as Level 3 Noise Test except with data taken at each operating condition tested.

- J. Pump tests, all levels of testing:
1. Test in accordance with the following:
 - a. Applicable HI Standards.
 - b. This Section.
 - c. Equipment sections.
 2. Test tolerances: In accordance with appropriate HI Standards, except the following modified tolerances apply:
 - a. From 0 to plus 5 percent of head at the rated design point flow.
 - b. From 0 to plus 5 percent of flow at the rated design point head.
 - c. No negative tolerance for the efficiency at the specified flows rated design point.
 - d. No positive tolerance for vibration limits. Vibration limits and test methods in HI Standards do not apply, use limits and methods specified in this or other Sections of the Specifications.
- K. Drivers tests:
1. Test motors as specified in Section 16222.
 2. Test other drivers as specified in the equipment section.
- L. Noise requirements and control:
1. Perform noise tests in conjunction with vibration test analysis.
 2. Make measurements in relation to reference pressure of 0.0002 microbar.
 3. Make measurements of emitted noise levels on sound level meter meeting or exceeding ANSI S1.4, Type II.
 4. Set sound level meter to slow response.
 5. Unless otherwise specified, maximum free field noise level not to exceed 85 dBA measured as sound pressure level at 3 feet from the equipment.
- M. Pressure testing:
1. Hydrostatically pressure test pressure containing parts at the appropriate standard or code required level above the equipment component specified design pressure or operating pressure, whichever is higher.
- N. Inspection and balancing:
1. Statically and dynamically balance each of the individual rotating parts as required to achieve the required field vibration limits.
 2. Statically and dynamically balance the completed equipment rotating assembly and drive shaft components.
 3. Furnish copies of material and component inspection reports including balancing reports for equipment system components and for the completed rotating assembly.
- O. Critical speed of rotating equipment:
1. Satisfy the following:
 - a. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered rigid such as horizontal pumps, all non-clog pumps, blowers, air compressors, and engines shall be at least 25 percent above the equipment's maximum operating speed.
 - b. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered flexible or flexibly mounted such as vertical pumps (vertical in-line and vertical non-clog pumps

excluded) and fans shall at least 25 percent below the equipment's lowest operating speed.

- c. The second lateral and torsional critical speed of all constant, variable, and 2-speed equipment that is considered flexible or flexibly mounted shall be at least 25 percent above the maximum operating speed.

P. Vibration tests:

1. Definitions:

- a. Root mean square: for pumps operating at speeds greater than 600 rpm, the vibration measurement shall be measured as the overall velocity in inches per second root mean square (RMS).
- b. Peak-to-peak displacement: The root mean squared average of the peak-to-peak displacement multiplied by the square root of 2.
- c. Peak velocity: The root mean squared average of the peak velocity multiplied by the square root of 2.
- d. Peak acceleration: The root mean squared average of the peak acceleration multiplied by the square root of 2.
- e. High frequency enveloping: A process to extract very low amplitude time domain signals associated with impact or impulse events such as bearing or gear tooth defects and display them in a frequency spectrum of acceleration versus frequency.
 - 1) Manufacturers: One of the following or equal:
 - a) Rockwell Automation, Entek Group, "Spike Energy" analysis.
 - b) CSI, "PeakVue."
- f. Low speed equipment: Equipment or components of equipment rotating at less than 600 revolutions per minute.
- g. High speed equipment: Equipment and equipment components operating at or above 600 revolutions per minute.
- h. Preferred operating range: Manufacturer's defined preferred operating range (POR) for the equipment.
- i. Allowable operating range: Manufacturer's defined allowable operating range (AOR) for the equipment.

2. Vibration instrumentation requirements:

- a. Analyzers: Use digital type analyzers or data collectors with anti-aliasing filter, 12 bit A/D converter, fast fourier transform circuitry, phase measurement capability, time wave form data storage, high frequency enveloping capabilities, 35 frequency ranges from 21 to 1,500,000 cycles per minute, adjustable fast fourier transform resolution from 400 to 6,400 lines, storage for up to one hundred 3,200 line frequency spectra, data output port, circuitry for integration of acceleration data to velocity or double integration to displacement.
 - 1) Manufacturers: One of the following or equal:
 - a) Computational Systems Inc., (CSI) Division of Emerson Process Management, Model 2120A, Data Collector/analyzer with applicable analysis software.
 - b) Pruftechnik, VIBXPERT II.
- b. Analyzer settings:
 - 1) Units: English, inches/second, mils, and gravitational forces.
 - 2) Fast fourier transform lines: Most equipment 1,600 minimum; for motors, enough lines as required to distinguish motor current frequencies from rotational frequencies, use 3,200 lines for motors with a nominal speed of 3,600 revolutions per minute; 3,200 lines

- minimum for High Frequency Enveloping; 1,600 lines minimum for low speed equipment.
- 3) Sample averages: 4 minimum.
 - 4) Maximum frequency (Fmax): 40 times rotational frequency for rolling element bearings, 10 times rotational frequency for sleeve bearings.
 - 5) Amplitude range: Auto select but full scale not more than twice the acceptance criteria or the highest peak, whichever is lower.
 - 6) Fast fourier transform windowing: Hanning Window.
 - 7) High pass filter: Minus 3 dB at 120 cycles per minute for high speed equipment. Minus 3 dB at 21 cycles per minute for low speed equipment.
- c. Accelerometers:
- 1) For low speed equipment: Low frequency, shear mode accelerometer, 500 millivolts per gravitational force sensitivity, 10 gravitational force range, plus/minus 5 percent frequency response from 0.5 hertz to 850 hertz, magnetic mount.
 - a) Manufacturers: One of the following or equal:
 - (1) Wilcoxon Research, Model 797L.
 - (2) PCB, Model 393C.
 - 2) For high speed equipment: General purpose accelerometer, 100 millivolts per gravitational force sensitivity, 50 gravitational force range, plus/minus 3dB frequency response range from 2 hertz to 12,000 hertz when stud mounted, with magnetic mount holder.
 - a) Manufacturers: One of the following or equal:
 - (1) Wilcoxon Research, Model 793.
 - (2) Entek-IRD Model 943.
3. Accelerometer mounting:
- a. Use magnetic mounting or stud mounting.
 - b. Mount on bearing housing in location with best available direct path to bearing and shaft vibration.
 - c. Remove paint and mount transducer on flat metal surface or epoxy mount for High Frequency Enveloping measurements.
4. Vibration acceptance criteria:
- a. Testing of rotating mechanical equipment: Tests are to be performed by an experienced, factory trained, and independent authorized vibration analysis expert.
 - b. Vibration displacement limits: Unless otherwise specified, equipment operating at speeds 600 revolutions per minute or less is not to exhibit unfiltered readings in excess of following:

Operating Conditions & Application Data	Overall Peak-to-Peak Displacement	
	Field, mils	Factory, mils
Operation within the POR	3.0	4.0
Operation within the AOR	4.0	5.0
Additive value when measurement location is greater than 5 feet above foundation.	2.0	2.0
Additive value for solids-handling pumps	2.0	N/A
Additive value for slurry pumps	2.0	N/A

- c. Vibration velocity limits: Unless otherwise specified, equipment operating at speeds greater than 600 revolutions per minute is not to exceed the following peak velocity limits:

HI Pump Type	Horsepower	Field Test	Factory Test
		Overall RMS	Overall RMS
Horizontal Solids Handling Centrifugal Pumps	Below 33 HP	0.25	0.28
Horizontal and Vertical In-Line Centrifugal Pumps (other than Non-Clog type) Vertical Solids Handling Centrifugal Pumps	Between 33 and 100 HP	0.28	0.31
	100 HP and above	0.31	0.34
	Below 33 HP	0.30	0.33
Gear Reducers, Radial	268 HP and above	0.17	
Motors		See Applicable Motor Specification	See Applicable Motor Specification
Gear Reducers, Radial		Not to exceed AGMA 6000-B96 limits	Not to exceed AGMA 6000-B96 limits
Other Reducers, Axial		0.1	N/A

- d. Equipment operation: Measurements are to be obtained with equipment installed and operating within capacity ranges specified and without duplicate equipment running.
- e. Additional criteria:
- 1) No narrow band spectral vibration amplitude components, whether sub-rotational, higher harmonic, or synchronous multiple of running speed, are to exceed 40 percent of synchronous vibration amplitude component without manufacturer's detailed verification of origin and ultimate effect of such excitation.
 - 2) The presence of discernable vibration amplitude peaks in Test Level 2 or 3 vibration spectra at bearing inner or outer race frequencies shall be cause for rejection of the equipment.
 - 3) For motors, the following shall be cause for rejection:
 - a) Stator eccentricity evidenced by a spectral peak at 2 times electrical line frequency that are more than 40 percent of the peak at rotational frequency.
 - b) Rotor eccentricity evidenced by a spectral peak at 2 times electrical line frequency with spectra side bands at the pole pass frequency around the 2 times line frequency peak.
 - c) Other rotor problems evidenced by pole pass frequency side bands around operating speed harmonic peaks or 2 times line frequency side bands around rotor bar pass frequency or around 2 times the rotor bar pass frequency.
 - d) Phasing problems evidenced by 1/3 line frequency side band spectral peaks around the 2 times electrical line frequency peak.

- 4) The presence of peaks in a High Frequency Enveloping spectra plot corresponding to bearing, gear or motor rotor bar frequencies or harmonics of these frequencies shall be cause for rejection of the equipment; since inadequate lubrication of some equipment may be a cause of these peaks, lubrication shall be checked, corrected as necessary and the high frequency envelope analysis repeated.
5. Vibration testing results presentation:
 - a. Provide equipment drawing with location and orientation of measurement points indicated.
 - b. For each vibration measurement take and include appropriate data on equipment operating conditions at the time vibration data is taken; for pumps, compressors, and blowers record suction pressure, discharge pressure, and flow.
 - c. When Vibration Spectra Data required:
 - 1) Plot peak vibration velocity versus frequency in cycles per minute.
 - 2) Label plots showing actual shaft or part rotation frequency, bearing inner and outer race ball pass frequencies, gear mesh frequencies and relevant equipment excitation frequencies on the plot; label probable cause of vibration peaks whether in excess of specification limits or not.
 - 3) Label plots with equipment identification and operating conditions such as tag number, capacity, pressure, driver horsepower, and point of vibration measurement.
 - 4) Plot motor spectra on a log amplitude scale versus frequency.
 - d. For low speed equipment, plot peak vibration displacement versus frequency as well as velocity versus frequency.
 - e. Provide name of manufacturer and model number of the vibration instrumentation used, including analyzer and accelerometer used together with mounting type.

3.02 PLANNING PHASE

- A. Submit test plans as specified in Section 01756 and this Section.
 1. Indicate test start time and duration, equipment to be tested, other equipment involved or required; temporary facilities required, number and skill or trade of personnel involved; safety issues and planned safety contingencies; anticipated effect on Owner's existing equipment and other information relevant to the test.
 2. Provide locations of all instruments to be used for testing. Provide calibration records for all instrumentation.

3.03 COMMISSIONING PHASE

- A. Source testing:
 1. Witnessing not required unless specified otherwise in equipment section.
 2. Witnessed tests: Schedule test date and notify Engineer at least 30 days prior to start of test.
 3. Test equipment as specified in Section 01756 and equipment sections.
 4. Test fluids as specified in Section 01756.
 5. Submit reports as specified in Section 01756

- B. Installation testing:
 - 1. Test equipment as specified in Section 01756 and equipment sections.
- C. Functional testing:
 - 1. Witnessing required as specified in Section 01756.
 - 2. Schedule test date and notify Engineer at least 7 days prior to start of test.
 - 3. Test equipment as specified in equipment sections. Test fluids as specified in Section 01756.
 - 4. Submit reports as specified in Section 01756.
- D. Clean Water Facility Testing:
 - 1. Test equipment as specified in Section 01756 and equipment sections.
- E. Closeout documentation:
 - 1. Provide closeout documentation as specified in Section 01756 and equipment sections.

3.04 PROCESS START-UP PHASE

- A. Process start-up:
 - 1. Process start-up equipment as specified in Section 01756 and equipment sections.
- B. Process Operational Period:
 - 1. Operate equipment as specified in Section 01756 and equipment sections.
 - 2. Test fluids as specified in Section 01756.

END OF SECTION

**SECTION 16000
REQUIREMENTS FOR ELECTRICAL WORK****PART 1 GENERAL****1.1 DESCRIPTION**

- A. This section specifies electrical work including labor, electrical material, equipment, and installation and testing requirements for complete operating system. Electrical work shall also include demolition and or relocation and modifications of existing electrical equipment as shown and specified in these specifications. All equipment requiring power and or control shall include equipment furnished under this section and other sections of the specifications. The electrical drawings included in this project document are diagrammatic only and functional in nature and do not specify exact locations of equipment or equipment terminations. The scope of this project also includes all required work for a temporary 240 three-phase power to continue service to the existing pump station during construction of the new pump station with new 480V three-phase electric service.

1.2 QUALITY ASSURANCE

- A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI A58.1	Minimum Design Loads for Building and Other Structures
IEEE 81	Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C57.12.01	General Requirements for Dry-Type Distribution and Power Transformers
NEMA 250	Enclosures for Electrical Equipment (1000 Volt Maximum)
NEMA ICS 1	General Standards for Industrial Controls and Systems

Reference	Title
NEMA ICS 2	Industrial Control Devices, Controllers, and Assemblies
NEMA ICS 6	Enclosures for Industrial Controls and Systems
NEMA ST20	Dry-Type Transformers for General Application
NEMA WD 1	General Requirements for Wiring Devices
NFPA 70	National Electrical Code (NEC)
CBC	California Building Code
UL 50	Enclosures for Electrical Equipment
UL 62	Flexible Cords and Cables
UL 67	Panelboards
UL 489	Molded-Case Circuit Breakers and Circuit Breaker Enclosures
UL 506	Specialty Transformers
UL 508A	Standard for Industrial Control Panel

- C. Identification of Listed Products: Electrical equipment and materials shall be listed by an independent testing laboratory for the purpose for which they are to be used. Three such organizations are Underwriters Laboratories, Inc. (UL), Canadian Standards Association (CSA), and Electrical Testing Laboratories (ETL). The independent testing laboratory shall be acceptable to the inspection authority having jurisdiction.

1.3 SUBMITTALS

- A. The following specific submittal requirements for the switchgear, switchboard, motors, transformers, power distribution panels and starters or VFD's shall be followed:
1. Contractor shall formally place an order with equipment manufacturer within thirty days of the award of the contract. The order shall include all relevant drawings and specs including any addendum items associated with the equipment.
 2. Contractor shall submit shop drawings to the District as soon as possible or within 6 weeks of the order being placed for long lead items such as standby generator.
 3. Contractor shall forward review comments to equipment manufacturer within two days after receipt of the comments by the District.
 4. Contractor shall provide the release for manufacturing to equipment manufacturer within 3 business days of receiving a favorably reviewed submittal and shall provide the District with the shipping date.

5. Prior to shipment, a factory test of the equipment witnessed by the District shall occur.
- B. The following information shall be provided for all electrical equipment and materials in accordance with Section 01300:
1. Verification of fault withstands and interrupting ratings of all applicable power equipment and devices.
 2. Interconnection diagrams -The Contractor shall prepare interconnection diagrams depicting all cable requirements together with their actual terminations as specified below.

Interconnection diagrams shall be drawn to reflect actual, physical relationship between equipment and or components as shown on the drawings. The interconnection diagram shall indicate wiring between panels, terminal boxes, remotely mounted devices, and motor starters. The diagrams shall interface with the manufacturer's internal connection diagrams for panels. The diagrams shall indicate the terminations to terminal blocks of field devices at each end of the cable, the number of conductors in the cable, the size of wire, and the number of spare conductors. For each termination, the diagrams shall indicate the terminal number, wire color, and wire number as it appears on the wire marker. All terminal blocks, including spares, shall be indicated on the diagrams. Interconnection diagrams shall be provided for review and approval prior to installation of equipment.
 3. Catalog-cuts including technical specifications, application information, ratings, and other information required to verify the equipment and/or material meets the requirements of this specification.
 4. A copy of this specification section with addenda updates, and all referenced sections with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.

1.4 PROJECT/SITE CONDITIONS

- A. General: Unless otherwise specified, equipment and material shall be sized and rated for an ambient temperature of 40 degrees C at an elevation ranging from sea level to 100 feet without exceeding the manufacturer's stated ratings.
- B. Seismic: All electrical equipment and supports shall be braced in accordance with latest California Building Code.
- C. Classified Hazardous locations: The sewage wet well shall be Class 1 Division I hazardous location as defined by current NEC. The flow metering vault shall be Class 1 Division 2 hazardous location as defined by current NEC. All electrical and or devices located in such locations shall be classified and suitable for use in such classified locations. All conduits entering or leaving the hazardous locations shall be provided with eys seals per NEC.

1.5 ELECTRIC SERVICE

Electric service for this facility is new and provided by Pacific Gas and Electric Company. A new service request and application has been submitted to PG&E. Contractor, however, shall be responsible for coordinating this work with PG&E and the DISTRICT to ensure a timely installation of the service. Contractor shall be responsible for trenching, furnishing and installation of underground service conduits as detailed on the drawings. Coordination with the District's staff and with PG&E is required.

The Contractor shall also be responsible for providing temporary 240V three-phase power to maintain existing pump station operations. This can be accomplished by either diesel driven pump or rental, portable generator. (The Contractor shall not be allowed to utilize existing standby generator unit during switchover because of limited allowed running hours from the Air Board. After successful switch-over to new pump station electric service, all temporary service equipment and existing unused electric equipment shall be disconnected and removed by the Contractor.

Refer to Section 01140- Work Restrictions for general sequence of work and project constraints. General electrical sequence of work is part of the general sequence and is as shown on the drawings.

PART 2 PRODUCTS

2.1 GENERAL

Equipment and materials shall be new and free from defects. All equipment of the same or similar type shall be of the same manufacturer throughout the work. Standard production materials shall be used wherever possible.

2.2 RACEWAY, FITTINGS, AND SUPPORTS

A. General: Conduit shall be provided for power, control, instrumentation, grounding, lighting, receptacles, and signaling systems.

B. Raceway:

1. All exposed conduit and outdoor conduit shall be threaded, PVC-coated galvanized, rigid steel conduit. All conduit accessories such as couplings, elbows, junction boxes etc. shall also be PVC-coated galvanized steel. Minimum size of conduit shall be 3/4 inch. Bushings shall be galvanized, malleable iron with insulating collars. Grounding bushings shall be locking type with a feed through compression lug. Unions shall be galvanized, ferrous alloy type. Threadless fittings are not acceptable. Running threads shall not be used in lieu of conduit nipples. Threaded hubs shall be used to terminate conduits entering boxes. PVC-coated RGS conduit shall be manufactured by Robroy Industries, Perma-Cote Industries, or equal.

For conduit installed internally to the MCC auxiliary enclosure, conduit and accessories may be RGS as manufactured by Allied Tube and Conduit, Appleton, PWC Inc. or equal.

2. Liquidtight, flexible steel conduit shall be formed from spirally wound, galvanized steel strip with successive convolutions securely interlocked and jacketed with liquidtight, plastic cover. Minimum size shall be 3/4 inch. Fittings for liquidtight conduit shall have cadmium-plated, malleable iron body and gland nut with cast-in lug, brass grounding ferrule threaded to engage conduit spiral and O-ring seals around the conduit and box connection and insulated throat. Forty-five and 90-degree fittings shall be used where applicable.
 3. Embedded or encased conduit shall be Schedule 40, high impact, polyvinyl chloride (PVC). Minimum size shall be 1 inch.
 4. Fittings for PVC conduit shall be solvent welded type.
- C. Boxes:
1. Boxes for use outdoors and in process areas shall be hot-dip, galvanized cast ferrous alloy type FD with integrally cast-threaded hubs for conduit entry. Boxes larger than FD boxes shall be welded steel and hot-dip galvanized after fabrication.
 2. Boxes installed in areas where electrical metallic tubing is specified shall be standard UL approved electrogalvanized sheet steel, 4-inch square or octagon minimum trade size.
 3. Conduit bodies shall be ferrous alloy type with screw taps for fastening covers. Gaskets shall be made of neoprene.
 4. Boxes for hazardous locations as indicated on the drawings shall be suitable for Class 1 Div I hazardous location. They shall be corrosive resistant, high tensile strength malleable iron and with threaded aluminum cover. They shall be manufactured by Crouse-Hinds, Appleton Electric, or equal.
- D. Raceway Supports: Hot-dip galvanized framing channel shall be used to support groups of conduit. Individual conduit supports shall be one-hole galvanized malleable iron pipe straps with galvanized iron clamp backs and nesting backs where required. Ceiling hangers shall be adjustable, galvanized carbon steel rod hangers. Straps or plumbers tape are not acceptable. Hanger rods shall be 1/2-inch all thread rod.
- E. Concrete Pull Boxes: Provide and install pre-cast concrete pull boxes in locations indicated on the Drawings and as required by NEC. Pull boxes shall be:
1. Designed for heavy traffic conditions, with pull box and cover designed for heavy traffic bridge loading H-20
 2. Minimum 2 feet by 3 feet by 3 feet depth with 3/4 inch diameter pulling irons located at each end. Concrete material shall be reinforced Class A.
 3. Provided with engraved "Electrical" or "Instrumentation" or "Telephone" as applicable on the top side of the covers.

- F. Pull Boxes: Provide and install pre-cast concrete pull boxes in locations indicated on the Drawings and as required by NEC. Pull boxes shall be:

1. Designed for heavy traffic conditions, with pull box and cover designed for heavy traffic bridge loading H-20

2.3 CONDUCTORS, WIRE, AND CABLE

- A. General: Conductors, wires, and cable shall be provided for power, control, lighting, receptacles, instrumentation, grounding and signal circuits. The quantity and size of conductors shall be as specified.
- B. Power and Control Conductors: Power and control conductors shall be single conductor, stranded, annealed copper with 600-volt THWN/THHN polyvinyl chloride (PVC) insulation, Okonite, Okoseal-N; CABLEC; or equal.
- C. Lighting and Receptacle Circuit Conductors: Conductors for lighting and receptacle circuits shall be single conductor, annealed copper with 600-volt THWN/THHN PVC insulation. Conductor sizes No. 10 AWG and larger shall be stranded. No. 12 AWG shall be solid conductor. Minimum conductor size shall be No. 12 AWG. Conductors shall be Okonite, Okoseal-N; CABLEC; or equal.
- D. Grounding Conductors: Grounding conductors shall be as specified in paragraph 16000-2.7 A.
- E. Instrumentation and Signal Cable: Cable for instrumentation and signal circuit shall be twisted shielded pair or triad as specified, No. 16 AWG 7-strand copper with 600-volt PVC insulation, 100 percent aluminum-Mylar tape shield, No. 18 AWG tinned copper drain wire and overall PVC jacket, Okonite, Okoseal-N type P-OS, CABLEC, or equal.
- F. Splicing and Terminating Materials:
1. Connectors: Connectors for stranded conductors shall be tool applied tin-plated copper, compression type of the correct size and UL approved for the application.

Connectors for wire sizes No. 10 AWG and smaller shall be nylon self-insulated, ring tongue or locking-spade terminals. Connectors for wire sizes No. 8 AWG and larger shall be one-hole lugs up to size No. 3/0 AWG and two-hole or four-hole for size 4/0 AWG and larger. Mechanical clamp, dimple, or screw-type connectors are not acceptable.

480-volt motor terminations shall be made using bolt connected lugged connectors and factory engineered kits consisting of heat shrinkable, polymeric insulating material with high dielectric strength mastic sealant.

Termination of solenoid valves, 120-volt motors, and other devices furnished with pigtail leads shall be made using self-insulating, tubular compression connectors.
 2. Terminal Blocks: Terminal blocks shall be provided for external control and power wires size 10 AWG and smaller. Terminal blocks shall be 600 volts, heavy-duty, rated 20 amperes for control and 30 amperes for power.

- G. Wire Markers: Wire markers shall be yellow or white shrink tubing, Thermofit Marker System (TMS) by Raychem Co., Thomas and Betts equivalent, or equal for conductors No. 10 AWG and smaller and locking tab cable markers, W.H. Brady Co., Thomas and Betts, or equal, for conductors No. 8 and larger. Letters and numbers identifying each conductor shall be machine printed in permanent black ink.

2.4 WIRING DEVICES

- A. General: Receptacles, plugs, switches, and appurtenances shall be provided as specified on the drawings. Wiring devices shall be UL approved for the current and voltage specified and shall comply with NEMA WD-1. Receptacles and switches shall be premium, specification grade. GFI type in weather proof cover/box shall be provided for all outdoor receptacles.
- B. Receptacles: Receptacles shall be 20A, 120V, and grounding type. Receptacles for use outdoors and in wet process areas shall be corrosion resistant, GFI type, marine duty with polycarbonate weatherproof lift covers, Hubbell 53CM62/ 53CM21, General Electric, or equal.
- C. Switches: Switches for use outdoors and in wet process areas shall be 20 amp, press-switch type with weatherproof, corrosion-resistant neoprene plate, Hubbell, Arrow-Hart, or equal. Switches located in classified hazardous locations shall be suitable for installation in such locations. They shall be made by Killard Hazloc Series, Appleton, Crouse-Hinds, or equal.

2.5 INDIVIDUAL MOTOR STARTERS

- A. General: Unless otherwise specified, individual motor starters shall be combination type with molded case motor circuit protector, 3-pole, 600-volt AC contactor, and three overload relays, NEMA size 1 minimum. Each motor starter shall be individually enclosed. Starters shall be manufactured by Cutler-Hammer, Allen-Bradley, General Electric, or equal.
- B. Enclosures: The door of the motor starter enclosure shall be interlocked with an externally operated disconnect handle, lockable in the open position. Enclosures shall be NEMA 12 for dry indoor areas and NEMA 4X for outdoor and wet process areas.
- C. Motor Branch Circuit Protection: Molded case motor circuit protectors shall be magnetic only with trip settings adjustable over a range of 700 to 1300 percent of the full load current of the motor served. The motor circuit protector, in conjunction with the starter, shall be rated to interrupt 42,000 amperes (symmetrical) unless otherwise specified.
- D. Overload Relay: Overload relays shall be bimetallic type with separate heaters for each of the three poles. Reset shall be accomplished with a reset pushbutton located on the unit door exterior. Trip setting shall be adjustable from 85 to 115 percent of the motor full load rating.
- E. Control Circuits: Control power transformers, fuses, and control devices shall be provided as specified. Two control transformer primary fuses, rated to interrupt 200,000 amperes at 600 volts, shall be provided on all motor starters. Each motor starter shall be provided

with one control circuit secondary fuse rated to interrupt 10,000 amperes at 250 volts and sized at 125 percent of the control circuit full load current. Control circuit shall be 120 V with grounded leg.

- F. Wiring: Conductors shall be switchboard type and rated 90 degrees C above ambient temperature. Conductor shall be identified with tag numbers as specified.
- G. Manual Starters: Manual starters shall be provided as indicated on the drawings. Manual starters shall consist of a horsepower rated quick-make, quick-break toggle mechanism together with one or two overloads as specified. Voltage shall be as specified. Indoor and dry location shall be NEMA 12. For outdoor and wet process area, they shall be NEMA 4X corrosive resistant. For classified hazardous locations, they shall be rated for such locations and shall be manufactured by Square D, General Electric, or equal.

2.6 ELECTRICAL CONTROL DEVICES

A. Control Devices:

1. PUSHBUTTONS: Pushbuttons shall be flush head, heavy-duty, 600 volts, 10 amperes, continuous with NEMA rating to match enclosure types. Pushbutton operators shall be red for stop functions and black for all other functions. Escutcheon plates shall be as specified on the drawings. For field mounted pushbuttons, each stop pushbutton shall be provided with a galvanized steel padlockable mechanism. For hazardous locations, the control stations shall be rated as explosion proof suitable for such locations. They shall be Killark Hazloc Series, Appleton, Crouse-Hinds or equal.
2. Selector Switches: Selector switches shall be heavy-duty, with NEMA rating to match enclosure type, rated 600-volt, 10-ampere, continuous. Switches shall be provided with contact blocks and number of positions as required performing the specified operations. The escutcheon legend shall be as specified on the drawings.
3. Indicating Lights: Indicating lights shall be heavy-duty, push-to-test, transformer type with 6.3-volt lamps. Indicating lights shall be NEMA rated to match enclosure type.
4. Control Stations: Unless otherwise specified, control stations shall be NEMA 12 or 13 for dry, indoor locations and NEMA 4X for process areas and outdoor locations, Allen Bradley Bulletin 800H, Crouse-Hinds NCS series, or equal.
5. Security (limit switches). Security switches shall be heavy duty, industrial type with adjustable arm, lever made of stainless steel material. Each switch shall have one normally open and one normally closed contact rated for at least 5A at 120VAC. The switches shall be NEMA 4X, and shall be as manufactured by General Electric, Square D, or equal.

B. Control Relays:

1. Load-Switching Control Relays: Control relays used for switching loads (solenoids, actuators, contactors, motor starter coils, etc.) shall be heavy-duty,

machine tool type. Relays that have contacts used for remote interlocking or for which the switching load is not shown shall also be heavy-duty machine tool type.

Contacts shall, as a minimum, be 4-pole and be field interchangeable to either normally open or normally closed. Relay shall be capable of accepting a 4-pole adder.

AC relays shall have NEMA A600 contact ratings and electrical clearances for up to 600 volts. DC relays shall have NEMA P300 contact ratings and electrical clearances of up to 250 volts.

Relays shall be Allen Bradley Bulletin-700, Square D Class 8501, or equal.

2. Logic Level Switching Control Relays: Control relays used for switching solid-state logic and signal circuits shall be Potter Brumfield series KUP, Schrack Series RA, or equal. Relays shall have a minimum of three SPDT, gold-flashed, fine silver contacts rated 3 amps resistive at 120 volts AC or 28 volts DC. Relay shall be plug-in type with heavy-duty, barrier-protected screw terminal sockets and clear polycarbonate dust cover with clip fastener. AC models shall have neon lamp indicator wired in parallel with coil.
3. Timing Relays: Solid state timing relays shall be pulse-count type using a high frequency RC oscillator and integrated circuit counter for timing. Electrolytic capacitors shall not be used in the timing circuits. Time delays from 0.1 seconds to 48 hours shall be available with each timer model adjustable over a 20:1 range. On-delay, off-delay, and single-shot timing models shall be available. Timer shall reset in 0.03 seconds or less. Timer accuracy shall be plus or minus 2.0 percent under normal conditions. The timing relay shall have two NEMA Form-C timed contacts. Solid state timing relays shall be Agastat, STA series, Eagle Signals equivalent, or equal.
4. Intrinsically Safe Relays: These relays shall be suitable for use with 24VDC power source with pilot devices located in hazardous classified locations as defined by NEC Article 500. The relays shall be manufactured by:
 - a. R.K Electronics
 - b. Gem Sensors Division of IMO, Inc.
 - c. R. Stalh, Inc.
 - d. Idec
 - e. Equal

Provide each relay with two DPDT contacts each rated for at least 5-amp.

All float switches located in Class 1 Div I hazardous location shall be provided with intrinsically safe relays located in control panel or where specifically shown on the drawings .

2.7 GROUNDING MATERIAL

- A. Cable: Grounding cable shall be concentric stranded, annealed bare copper. Cable size shall be as specified, and shall not be smaller than #4/0 AWG.
- B. Ground Rods: Ground rods shall be copper-covered steel, 3/4-inch diameter, and 10 feet long. Rods shall have threaded type, removable caps so that extension rods of the same diameter and length may be added where necessary. The rods shall be manufactured by ERICO, Galvan Industries, Inc. or equal.
- C. Compression Connectors: Compression connectors shall be cast copper as manufactured by Thomas and Betts, OZ. Gedney, or equal.
- D. Bolted Connectors: Bolted connectors shall be Burndy, O.Z. Gedney, or equal.
- E. Equipment Grounding: Install a green insulated equipment grounding conductor with each feeder and branch circuit from the power source grounding means to the load equipment or device.

2.8 LIGHTING FIXTURES:

- A. General: Unless otherwise specified, lighting materials, including fixtures, accessories and hardware, shall conform with the requirements specified on the applicable LIGHTSPECS in paragraph 16000-3.08 B. Lighting fixtures shall be provided where specified.

Where recessed fixtures are required, the fixture shall be provided with mounting hardware for the ceiling system specified. Catalog numbers given on the applicable LIGHTSPECS shall not be used for selection of mounting hardware, but only as a reference to the type of fixture required. A concealed latch and hinge mechanism shall be provided to permit access to the lamps and ballasts and for removal and replacement of the diffuser without removing the fixture from ceiling panels. Fixtures recessed in concrete shall have protective coating of bituminous paint.

Fixtures shall be aligned and directed to illuminate an area as specified. Fixtures shall be directly and rigidly mounted on their supporting structures. Unless otherwise specified, conduit system shall not be used to support fixtures. Where brackets or supports for lighting fixtures are welded to steel members, the welded area shall be treated with rust-resistant primer and finish paint.

- B. Ballasts:
 - 1. Fluorescent Magnetic: Ballasts for fluorescent lamps shall be nonleaking, thermosetting, compound filled, rated for 120-volt service unless otherwise specified. Ballasts shall be Class P, protected type, high power factor and shall carry the Certified Ballast Manufacturer's (CBM) and UL labels. Ballasts for fixtures located in covered, unheated areas and open areas shall be low temperature type. Electronic ballasts are also acceptable. They shall be low harmonic type and shall also have CBM and UL labels.

2. Mercury Vapor and Metal Halide: Ballasts for mercury vapor and metal halide lamps shall be autotransformer regulator high power factor type with a sound rating of "B" maximum. Starting current shall not exceed normal running current.
 3. High Pressure Sodium: Ballasts for high pressure sodium lamps shall be autotransformer high power factor type. Starting current shall not exceed normal running current.
- C. Lamps:
1. Acceptable Products: Lamps shall be General Electric, North American Philips (Norelco), Sylvania, Venture Lighting International, or equal.
 2. General: Lamps shall be as specified on the applicable LIGHTSPECS.
- Unless otherwise specified, fluorescent lamps shall be warm white, and mercury vapor lamps shall be phosphor-coated, deluxe white.
- Unless otherwise specified, metal halide and high-pressure sodium lamp envelopes shall be clear.
- Incandescent lamps shall be rated 130 volts AC. Unless otherwise specified, lamp shape shall be standard A or PS and envelope shall be frosted inside.
- D. Photoelectric Cell Units: Where shown and required on the drawings, photoelectric cell units shall consist of a cadmium sulfide cell housed in a plug receptacle assembly. The plug receptacle assembly shall be three-prong polarized locking type. Assembly shall be suitable for outdoor mounting and shall be rated for 1800 VA at 120 volts maximum capacity.
- E. Lighting Fixture Specifications Sheets (Lightspec): Lighting fixtures, including their related accessories, options, and hardware are specified on individual specification sheets (LIGHTSPECS) located at the end of this section. Each LIGHTSPEC and lighting fixture type shown on the drawings is identified with a unique acronym of three or four digits, as follows:
1. Lamp Sources: The first digit of the fixture type indicates the basic or predominant lamp source from which the light is produced, as follows:

A	=	Atomic (self-energized)
F	=	Fluorescent
H	=	Mercury vapor (Hg)
I	=	Incandescent
HPS	=	High pressure sodium
M	=	Metal halide
N	=	Neon
X	=	Xenon
 2. Family Groups: The second digit of the fixture type indicates a "family" of fixtures which share the same primary physical characteristics, such as appearance, construction or function. The family general requirements apply to all members of

the family. The third digit of a four-digit fixture type, if used, distinguishes individual family members which have differing secondary features, options or multiple characteristics. All family members shall be produced by the same manufacturer and have matching characteristics. Family groups are as follows:

A	=	Area light
B	=	Bare lampholder or striplight
C	=	Corrosion-resistant
D	=	Downlight
E	=	Emergency
F	=	Floodlight
G	=	General, diffuse
H	=	Hazardous location
I	=	Industrial
L	=	Louver lens
M	=	Metal sided
N	=	Sign
O	=	Pool, or fountain, underwater
P	=	Patterned plastic lens
R	=	Roadway/parking lot
S	=	Steplight
T	=	Track-mounted
U	=	Under-cabinet
V	=	Vaportight
W	=	Wraparound lens
X	=	Exit sign

Lighting fixtures specified in the LIGHTSPECS are alphabetically arranged by lamp source and function.

3. Mounting Arrangement: The last digit of the fixture type distinguishes family members which have differing mounting arrangements, as follows:

B	=	Bollard
C	=	Cove
G	=	Ground
H	=	Handrail or pipe batten
L	=	Pole
M	=	Semi-recessed
P	=	Pendant
R	=	Recessed
S	=	Surface
V	=	Valance
W	=	Wall

- F. Example Catalog Numbers: The manufacturer's catalog numbers listed are examples of the basic model, or series, and the overall quality required. While the referenced catalog numbers attempt to be as definitive as available literature permits, such items as voltage, mounting style, modifications, and other special features may not be included. The Contractor, supplier, and manufacturer shall verify and provide all of the specified requirements.

G. Lighting Fixture Spec. Sheet:

Family Group:	F – Fluorescent
Group Description:	Industrial fluorescent fully enclosed and gasketed. Outdoor use, nominally 8-inch wide by 4 feet long. Ceiling mounted.
Family Members:	F 1 Fixtures
Construction:	<u>Housing</u> : Corrosive resistance, one piece, polycarbonated, gasketed, lens is securely clamped to fixture housing. <u>Finish</u> : White color finish
Lighting:	<u>Distribution</u> : General downlight. <u>Reflector</u> : Polycarbonate Lens <u>Shielding</u> : None.
Lamps:	Energy saving T8, two lamps
Electrical:	<u>Input voltage</u> : 120 <u>Ballasts</u> : Ultrapremium grade, magnetic or electronic, low harmonic type.
Mounting:	<u>Mounting</u> : On ceiling <u>Outlet boxes</u> : PVC-coated
Acceptable Products:	Appleton Electric FR Series, Holophane ES Series, or equal.
Family Members:	F 2 Fixtures
Construction:	<u>Housing</u> : Industrial strip light <u>Finish</u> : Gray color finish
Lighting:	<u>Distribution</u> : General downlight. <u>Reflector</u> : None <u>Shielding</u> : None.
Lamps:	Energy saving T8, one lamp
Electrical:	<u>Input voltage</u> : 120 <u>Ballasts</u> : Ultrapremium grade, magnetic or electronic, low harmonic type.
Mounting:	<u>Mounting</u> : On ceiling <u>Outlet boxes</u> : Cast metal with threaded conduit entries.
Acceptable Products:	Holophane SN Series, Lithonia, or equal.
Electrical:	<u>Input voltage</u> : 120V <u>Ballasts</u> : High power factor, copper windings
Family Group:	I - Incandescent
Group Description:	Wall mounted or Stanchion Mounted, Incandescent Type
Family Members:	I-1 Not used

Family Members:	I-2
Construction:	<u>Fixture Housing</u> : Enclosed and fully gasketed suitable for outdoor installation with heavy duty guard, glass globe and external reflector.
Mounting:	Stanchion with angle
Lighting:	Down light
Lamps:	Incandescent 150W lamp
Electrical:	Input Voltage: 120VAC
Acceptable Products:	Appleton StyleMaster Series, Hubbell NV2 Series, or equal.
Family Members:	I-3
Construction:	<u>Fixture Housing</u> : Enclosed and gasketed suitable for Class 1 Div I hazardous location. Heavy duty wire guard, cast iron, corrosive resistant housing.
Mounting:	Wall mounted
Lighting:	Side distribution
Lamps:	Incandescent 150W lamp
Electrical:	

2.9 DISTRIBUTION EQUIPMENT

- A. Panelboards: Panelboards shall be circuit breaker, dead front type with bus bar construction. Panelboards shall be composed of individually mounted circuit breakers designed to be removed without disturbing other breakers.

Bus shall be tin-plated copper and shall have a current rating as shown on the panel schedules sized in accordance with UL 67. Panel fault withstand rating shall be equal to the interrupting rating of the smallest circuit breaker in the panel.

Panelboards shall be provided with a separate ground bus and a full capacity neutral bus. Neutral bus shall be mounted on insulated standoffs with removable link connector to ground bus. Provide an inside pocket to hold circuit directory. Panelboards shall be Cutler-Hammer, Allen-Bradley, or equal.

For outdoor locations, provide lighting panels with NEMA 4X enclosures with padlockable provisions.

- B. Circuit Breakers: Circuit breakers shall be molded-case type provided for the current ratings and pole configurations specified on the panelboard schedule. Circuit breakers rated 120/208 volts and 120/240 volts AC shall have a minimum interrupting current

rating of 22K amperes (symmetrical) at 240 volts AC. Circuit breakers rated 277/480 volts AC shall have a minimum interrupting current rating of 42K amperes (symmetrical) at 480 volts.

Circuit breakers shall be bolt-on type.

Circuit breakers shall be listed in accordance with UL-489 for the service specified. Breakers rated 200A or higher shall be provided with solid-state trip unit with multi-functions.

Load terminals of circuit breakers shall be solderless connectors.

Circuit breakers and panelboards shall be products of the same manufacturer.

- C. Dry-type Transformers: Transformers shall conform to IEEE-C57.12.01 and UL 506. The voltage, frequency, number of phases, and KVA rating shall be as specified. Transformers shall have "Energy Star" label as required by latest California Energy Regulations Title 24. They shall be manufactured by Cutler-Hammer, Square D, General Electric, or equal.

Transformers 15 KVA and above shall have a Class 220 insulation system in accordance with NEMA ST20. Transformers 25 KVA and greater shall be designed not to exceed 80 degrees C temperature rise.

Transformer coils shall be copper windings. Aluminum windings shall not be acceptable. Transformer coils 15 KVA and above shall be impregnated with varnish. Transformer coils 10 KVA and below shall be encapsulated.

Transformers shall have electrically isolated primary and secondary windings. Primary and secondary winding configurations shall be as specified. Provisions shall be made to permit separate grounding of the neutral conductor and the enclosure. Single-phase transformers shall be the four winding type.

Transformers 15 KVA and above shall be provided with two 2-1/2 percent full capacity taps above normal voltage and four 2-1/2 percent full capacity taps below rated voltage on the primary winding.

Terminal compartments shall be sized to permit termination of cables specified. Terminal connections shall be made in the bottom third of the enclosure. The terminals shall be copper and sized for the cable specified.

Transformers rated 15 KVA and smaller shall be provided with weatherproof, non-ventilated enclosures.

Indoor transformers rated greater than 15 KVA shall be provided with drip-proof, ventilated enclosures. Outdoor transformers shall have weatherproof enclosures.

2.10 PORTABLE GENERATOR RECEPTACLE

Portable generator receptacle shall be rated 100A 480V 4-pole in male configuration as detailed on the drawings.

2.11 SURGE SUPPRESSION SYSTEM

Provide and install an UL 1449 listed surge suppression system of latest MOV type technology. The suppressor shall be of voltage type with thermal fusing. The suppressor shall be capable of withstanding 100,000 amperes per phase and shall be equipped with LED indicator, dry contact for remote alarm and local audible alarm. It shall be Square D SurgeLogic XW series, Cutler-Hammer, or General Electric, or equal system suitable for use with 480/277V three-phase four-wire service. All main service switchboard or MCC shall be provided with surge suppression system.

2.12 NAMEPLATES

Nameplates shall be made from laminated phenolic plastic. The nominal size of the nameplates shall be 3/4 inch high by 2 inches long. Nameplates shall have black backgrounds with 1/4-inch white letters. If abbreviations are required because of space limitations, abbreviations shall be submitted to the Construction Manager for approval prior to manufacture. Nameplates shall be fastened using self-tapping stainless steel screws. The use of adhesives will not be permitted on the outside of enclosures.

2.13 AUTOMATIC TELEPHONE DIALER

Phone dialer shall have the following characteristics:

- a. 8-channels
- b. 120VAC power input and built-in battery backup
- c. NEMA 4X enclosure with programming keypad
- d. Sensaphone Model 1800 to match the District's Standards

2.14 LIMIT SWITCHES

Limit switches shall be NEMA 4X, corrosive resistant, rated suitable for monitoring door's opening to trigger two DPDT 5A rated contacts. They shall be heavy duty, industrial type made by Allen-Bradley 800 series, Square D or equal.

2.15 COMBINATION METER and MAIN

Combination meter and main shall be pad-mounted, in NEMA 3RX enclosure made by Tesco 27-100 Series with accessories as shown on the drawings, or equal. The unit shall have meter socket approved by PG&E for its installation of the energy meter. All hinges, lathes, hardware shall be made of stainless steel.

The unit shall have a 100A 3-pole circuit breaker with 42kA short circuit rating at 480V and with a multi-function electronic display meter and surge protection unit. The main breaker shall have a shunt trip and protected with a current/voltage balance relay as shown on the drawings.

PART 3 EXECUTION**3.1 GENERAL**

Unless otherwise detailed or dimensioned, electrical layout drawings are diagrammatic. Actual conduit installation shall be coordinated with field conditions. Junction boxes and pull boxes with quantity as required shall be furnished and installed. The Contractor shall coordinate the location of electrical material and equipment with the work.

Electrical equipment shall be protected from dust, water, and damage.

3.2 RACEWAY, FITTINGS, AND SUPPORTS

- A. General: The Contractor shall limit the number of directional changes of conduit to a total of not more than 270 degrees in any run between pull boxes. Conduit runs shall be limited to 400 feet, less 100 feet for each 90-degree change in direction.

Signal conduit shall be separated from AC power and control conduits. The minimum separation shall be 12 inches for rigid steel and 24 inches for PVC conduits.

Tag power, signal and control conduits with stainless steel tag fastened to conduit with stainless steel cable. Tags shall be engraved with identification as designated on the single-line diagrams. Tags shall be installed at each conduit termination to an enclosure, MCC, control panel, disconnect, motor j-box, signal transmitter, sensor etc..

Cap each spare conduit as per detail shown on the drawings.

- B. Exposed Conduits: Rigid metallic conduit shall be assembled to provide a continuous ground path. Joints shall be made with standard couplings or threaded unions. Bends and offsets shall be made with a hicky or conduit bending machine or shall be factory preformed bends.

Exposed conduit shall be run on supports spaced not more than 10 feet apart and shall be constructed with runs parallel and perpendicular to walls, structural members, or intersections of vertical planes and ceiling. No conduit shall approach closer than 6 inches to any object operating above 30 degrees C.

Conduit supports shall be secured to concrete walls and ceilings by means of cast-in-place anchors, die cast, rustproof alloy expansion shields, or cast-flush anchors. Wooden plugs, plastic inserts, or gunpowder driven inserts are not acceptable as a base for securing conduit supports.

Liquidtight, flexible steel conduit shall be used for the final connection to equipment, devices, and instruments where flexibility is required.

The length of liquidtight flexible steel conduit shall not exceed the lesser of 15 times the trade diameter of the conduit or 36 inches.

- C. Embedded or Encased Conduit: Conduits constructed in concrete which is in contact with earth shall be separated from earth by at least 3 inches of concrete. Clearances equal to

the nominal conduit diameter but not less than 2 inches, shall be maintained between encased or embedded conduits except where conduits cross or terminate.

- D. PVC-coated Rigid Galvanized Steel Conduit: All exposed conduits shall be PVC-coated rigid galvanized steel with matching conduit boxes and accessories.
- E. "Eys" seals: Install "Eys" seals as required per NEC, and as shown on the drawings for hazardous locations and locations as identified on the drawings. Fill the seals with compound recommended by the seal manufacturer.

3.3 CONDUCTORS, WIRE, AND CABLE

- A. General: Raceway construction shall be complete, cleaned, and protected from the weather prior to wire and cable being installed. Pulling wire and cable into conduit shall be completed without damaging or putting undue stress on the cable insulation. Soapstone, Talc, or UL listed pulling compounds are acceptable lubricants for pulling wire and cable. Grease is not acceptable. Nylon pull rope shall be pulled through the conduit immediately after concrete pour.

Each power, control, signal, and instrumentation conductor shall be identified at each terminal to which it is connected utilizing the wire markers specified in paragraph 16000-2.03 G.

600-volt conductors will be color coded as follows:

480 V Power

Phase A – Brown
Phase B – Orange
Phase C – Yellow
Neutral – White
Ground – Green

120/240 Lighting and Receptacles

Phase A – Black
Phase B – Red
Phase C – Blue
Neutral – White
Ground – Green

- B. 600-Volt Conductor and Cable: Slack shall be provided in junction and pull boxes. Slack shall be sufficient to allow cable or conductors to be routed along the walls of the box.

Conductors crossing hinges shall be bundled in groups not exceeding 12 and shall be so arranged that they will be protected from chaffing when the hinged member is moved.

Raceway fill limitations shall be as defined by NEC and the following:

Lighting and receptacle circuits may be together in the same conduit in accordance with derating requirements of the NEC. However, lighting and receptacle circuits shall not be in conduit with other circuits.

Solid wire shall not be lugged nor shall electrical spring connectors be used on any except for solid wires in lighting and receptacle circuits. Lugs and connectors shall be installed with a compression tool.

For submersible pump cable installation, follow the pump manufacturer's recommendations and requirements. Furnish and install 316 stainless steel cable grips

required to properly support the cables in addition to 316 stainless steel hooks and heavy duty, non corrosive, fiberglass cable ties as required. Cable grips shall be manufactured by Kellems, Hubbell, or equal.

- C. Signal and Instrumentation Cables: Signal and instrumentation circuits shall be run as individual shield twisted pairs or triads. Triads shall be used wherever three-wire circuits are required. Terminal blocks shall be provided at cable junction for running signal leads and shield drain wires. Each conductor shall be identified at such junctions. Instrumentation cables shall be continuous without any splices.

Shields shall not be used as a ground path.

3.4 WIRING DEVICES

Switches and receptacles for use outdoors and in process areas shall be mounted in "FD" type boxes or PVC-coated boxes in locations specified. Unless otherwise specified, switches shall be mounted 48 inches above the floor. Receptacles shall be mounted 18 inches above the floor in finished areas and 48 inches above the floor in process areas and outdoors unless otherwise specified.

3.5 INDIVIDUAL MOTOR STARTERS

Individual motor starters shall be mounted with the operating mechanism 48 inches above the finished floor unless otherwise specified. The Contractor shall size the overload heater elements to the nameplate full load amperes of the motor served. Motor circuit protectors shall be adjusted to the lowest setting not causing false tripping.

3.6 MISCELLANEOUS CONTROL DEVICES

Control stations shall be mounted 48 inches above the floor unless otherwise specified.

3.7 GROUNDING

Electrical equipment and enclosures, metal surfaces of equipment, and metal structural members shall be grounded. Grounding system shall be provided in compliance with the NEC and as specified on the drawings.

Embedded and buried cable connections shall be made by cast copper compression connectors utilizing diamond or hexagon dies and a hand compression tool for wire sizes 2 AWG and smaller and a hydraulic pump and compression head for wire size 2/0 AWG and larger. Embedded ground cables and fittings shall be securely attached to concrete reinforcing steel with tie wires.

Grounding conductors which extend beyond concrete surfaces for equipment connection shall be extended a sufficient length to reach the final connection point without splicing. Grounding conductors which project from a concrete surface shall be located as close as possible to a corner of the equipment pad, protected by conduit or terminated in a flush grounding plate.

Exposed ground connections shall be made by bolted connectors. Exposed grounding conductors shall be supported by noncorrosive metallic hardware at 4-foot intervals or less.

Grounding conductors entering enclosures shall be bonded together to the enclosure if it is metallic and to metallic raceway within terminating at the enclosure. Metal surfaces shall be cleaned prior to making grounding connections and bonds.

When install ground rods, field verify exact location of existing underground utilities such as water piping, gas piping, electrical conduits or ductbanks, vault or manholes etc. prior to installation of the ground rods to avoid damage to the existing underground utilities.

3.8 LIGHTING FIXTURES

- A. General: The location and type of fixtures and receptacles are shown on the drawings. Raceways and wire shall be provided from the fixtures, switches, and receptacles to the lighting panel in accordance with the NEC.

Fixtures labeled to require conductors with a temperature rating exceeding 75 degrees C shall be spliced to circuit conductors in a separately mounted junction box. Fixture shall be connected to junction box using flexible conduit with a temperature rating equal to or greater than that of the fixture.

Labels and marks, except the UL label, shall be removed from exposed parts of the fixtures. Fixtures shall be cleaned when the project is ready for acceptance.

3.9 PANELBOARDS

The contractor shall type in the circuit descriptions on the circuit directory as shown on the final record drawings or panel schedule.

3.10 TESTING

- A. General: Prior to energizing the electrical circuits, the tests shall be performed as specified. Unless otherwise specified, a 500-volt megohmmeter shall be used for resistance measurements.

The measurements of the tests shall be recorded on the specified forms and provided in accordance with paragraph 16000-1.3.

- B. Insulation Resistance Measurements:

1. General: General insulation resistance measurements shall be made on conductors and energized parts of electrical equipment. Minimum acceptable values of insulation resistance shall be in accordance with the applicable ICEA, NEMA, or ANSI standards for the equipment or material being tested, unless otherwise specified. The ambient temperature at which insulation resistance is measured shall be recorded on the test form.

2. Conductor and Cable Tests: The phase-to-ground insulation resistance shall be measured for all circuits 120 volts and above except lighting circuits. Measurements may be made with motors and other equipment connected. Insulation resistance measurements shall be recorded and submitted to the Engineer for review and approval. Insulation with resistance of less than 10 megohms is not acceptable.
3. Motor Tests: All motors shall have their insulation resistance measured before they are connected. Motors 50 HP and larger shall have their insulation resistance measured at the time of delivery as well as when they are connected. Insulation resistance values less than 10 megohms are not acceptable.

C. FUNCTIONAL CHECKOUT:

Prior to energization of equipment, the Contractor shall perform a functional checkout of the control circuit. Prior to functional testing, all protective devices shall be adjusted and made operative. Checkout shall consist of energizing each control circuit and operating each control, alarm or malfunction device and each interlock in turn to verify that the specified action occurs. Contractor shall submit a description of his proposed functional test procedures prior to the performance of functional checkout.

The Contractor shall verify that motors are connected to rotate in the correct direction. Verification may be accomplished by momentarily energizing the motor, provided the Contractor confirms that neither the motor nor the driven equipment will be damaged by reverse operation.

D. GROUNDING SYSTEM TESTS:

The Contractor shall test each grounding connection to determine the ground resistance. The grounding test shall be IEEE Standard 81. A plot of ground resistance readings for each isolated ground rod or ground mat shall be provided to the Construction Manager on 8-1/2 x 11 inch size graph paper. 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 25 feet from the test electrode and ending 75 feet from it, in direct line between the ground rod or center of grid and the current reference electrode.

A grounding system that shows greater than 2 ohm resistance for the flat portion of the plotted data shall be considered inadequately grounded. The Contractor shall add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurements meet the 2 ohm requirement. Ground rods required over that specified will be paid for as extra work. Use of salts, water, or compounds to attain the specified ground resistance is not acceptable.

3.11 DEMOLITION

Contractor shall be responsible for demolition of the existing electrical equipment and shall removed unused electrical equipment and discard them in proper manner. The following existing electrical equipment shall be returned to the District/PG&E:

- a. Existing PG&E service energy meter

3.12 RECORD DRAWINGS

Record drawings refer to those documents clearly maintained and annotated by the Contractor during construction include record drawings in accordance with these specifications. Contractor shall submit record drawings that reflect as-installed conditions. Drawings do not conform or do not show as installed conditions shall be rejected and shall be resubmitted by the Contractor for no additional cost to the District until acceptance by the Engineer. Markups for deviations and changes shall be on a full size set of drawings.

3.13 SEQUENCE OF WORK

For general project construction sequence, refer to section 01140- Work Restrictions for details. For electrical work, Contractor shall follow Sequence of Work as shown on drawing E10. Submit plan for review and approval two weeks in advance. Follow all requirements including traffic controls and barricades to provide a safe area for the pedestrians.

TEMPORARY POWER DURING CONSTRUCTION

Temporary power required during construction shall include a portable 80kW rental 240V three-phase generator to provide backup power to the existing portable generator to run at least one 25hp pump and auxiliaries at any one time. See sequence of work as shown on the drawings for details.

PERMANENT ELECTRIC SERVICE AND PHONE SERVICE

Coordinate with PG&E for installation of new, permanent, underground 480V service for the pump station. Contractor shall be responsible for complete underground, trenching for electrical service to the existing pump station as shown on the drawings. Prior to any trenching or underground digging, any and all underground utilities such as gas, water, sewage, and electric piping, conduits shall be identified to avoid damages to them. Coordinate all work with other disciplines and with PG&E.

SWITCH-OVER STRATEGY

The existing pump station shall remain functional while new pump is being built. Provide temporary power connections to temporary pumps as shown on the drawings. When permanent service is completely installed, tested and functional and accepted by the District, temporary service and equipment may be removed. No electrical switchover work may commence until after the wet well and the new submersible pump is completed.

END OF SECTION

**SECTION 16075
ELECTRICAL IDENTIFICATION****PART 1 GENERAL****1.2 SUMMARY**

- A. Section Includes: Identification of electrical conductors, raceways and equipment, and electrical equipment signs.
- B. Related Sections:
 - 1. Section 16000 – Requirements for Electrical Work

1.3 REFERENCES

- A. National Electrical Code (NEC):
 - 1. Article 110–22 - Disconnecting Means.
 - 2. Article 210–4 - Multi-wire Branch Circuits.
 - 3. Article 200 - Use and Identification of Grounded Conductors.
 - 4. Article 384 - Switchboards and Panelboards.
 - 5. Article 300 - Wiring Methods.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. General: Submit Shop Drawings for electrical equipment room layouts, drawn at a minimum at 3/8 inch = 1 foot, scale.
 - 2. Cross Reference: Diagram shall carry a uniform and coordinated set of wire numbers and terminal block numbers to permit cross-referencing between the Contract Document Drawings, the Drawings prepared by the CONTRACTOR, and equipment O&M Manual Drawings.
 - 3. Drawing number cross references and continuation references shall also be provided. Contractor-prepared Drawings shall reference applicable CONTRACTOR Drawings such as P&IDs, control and logic diagrams, interface wiring diagrams, Panel Drawings, etc. Contractor-prepared Drawings shall also reference applicable Drawings provided by equipment manufacturers.
 - 4. On any Drawing prepared for this project, if a wire, circuit, enclosure, panel, or device is continued on another Drawing, the continuation Drawing shall be referenced (and vice-versa). Wherever wires are shown connected to terminals, the Drawings which show the continuation of the circuits on those terminals must be referenced.
 - 5. Interconnection Diagrams: Cables shall not be installed into raceways until the wiring interconnection diagrams are reviewed by the design engineer.
 - 6. Sample schematics and diagrams are indicated on typical detail Drawings for reference and understanding of minimum information required for submittal of Shop Drawings schematics and diagrams, and submittal of O&M schematics and diagrams.
 - 7. Include tagging system, labels, markers, hazard tape, nameplates, and signs.

- B. Product Data: Include tagging system, labels, markers, and hazard tape.
- C. Project Record Documents:
 - 1. Document wire, cable, and conductor tags, and bundle tags installed in accordance with the Contract Documents.
 - 2. Document installed wire, cable, and conductor tags and bundle tags when not specifically indicated.
 - 3. Indicate on Record Drawings deviations from accepted Shop Drawing conductor identification.

1.5 QUALITY ASSURANCE

- A. Pre-installation Meeting:
 - 1. Conduct in accordance with Section 16000.
 - 2. Purpose: To clearly define requirements specified for circuit/cable/conductor identification, hold a meeting including representatives of CONTRACTOR, DISTRICT, and ENGINEER prior to significant cable or conductor purchase and installation/termination.

PART 2 PRODUCTS

2.1 LABELS

- A. Manufacturers: One of the following or equal:
 - 1. Brady.
 - 2. Seton.
- B. Type: Sleeve type.

2.2 CONDUCTOR AND CABLE MARKERS

- A. Manufacturers: One of the following or equal:
 - 1. Brady.
 - 2. Seton.
- B. Type: Slip-on PVC sleeve or strap-on type.
- C. Printed using Brady marker "XC PLUS," or equal.
- D. Markers used in tunnels or other wet locations shall be on heat-shrinkable marking sleeves.
- E. Use self-laminating vinyl on white background for markers within electrical equipment such as panels, termination cabinets, motor control centers.
- F. Use engraved stainless steel tags with circuit designation fastened to direct buried cables in underground pull boxes as detailed on the drawings.

2.3 RACEWAYS IDENTIFICATION (TAGS)

- A. Conduit numbers shall be pressure stamped into a non corrosive 2 inch long, 1/2 inch wide stainless steel tape, Dymo marking system or equal. A tag with number shall be fixed with No. 18 AWG or larger type 304 stainless steel wire, to each conduit segment and at the end of each conduit and within 3 feet of each pull box, panelboard, and switchboard.

2.4 NAMEPLATES, LABELS AND SIGNS

- A. Nameplates:
 - 1. Type: Black lamicoid with white letters.
 - 2. Fastener: Round head stainless steel screws.
- B. Automatic Equipment and High Voltage Warning Signs:
 - 1. Type: Suitable for exterior use and meeting OSHA regulations.
- C. Power Pole Labels: Vinyl plastic with details as shown on the drawings.
 - 1. Manufacturers: One of the following or equal:
 - a. Brady.
 - b. Seton.
- D. Underground Hazard Tape: 6 inches wide.
 - 1. Manufacturers: One of the following or equal:
 - a. Panduit.
 - b. Thomas and Betts.

PART 3 EXECUTION

3.1 CIRCUIT IDENTIFICATION

- A. Identify 3-phase system conductors and cables as Phases A, B, and C and identify 1-phase system conductors and cables at electrical equipment including, but not limited to, switchgear, switchboards, panelboards, motor control centers, and motors.
 - 1. Match DISTRICT's existing electrical system identification scheme or meet requirements of the authority responsible for the project.
 - 2. 3-phase 480 Volts AC System Conductors: Phase A, brown; Phase B, orange; Phase C, yellow.
 - 3. Single-Phase Conductors for 120/240 VAC Circuits: Phase A, black; Phase B, red; Phase C, blue.
 - 4. Neutral Conductor: White for 120 VAC and gray for 277 VAC.
 - 5. Insulated Equipment Grounding Conductor: Green.
 - 6. General Purpose AC Control Conductors: Violet.
 - 7. General Purpose DC Control Conductors: Violet with white stripes.
 - 8. Where used, identify 15 kilovolt class cables with 3 stripes of color tape specified in item 3 above.
 - 9. Where used, identify 5 kilovolt cable with 2 stripes of color tape specified in item 3 above.

- B. Use color coding and phasing consistent throughout the site. Bus bars at panelboards and motor control centers to be connected Phase A-B-C, top to bottom, or left to right facing connecting lugs.
- C. Conductors Number 2 American Wire Gauge (AWG) and smaller to be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables to be coded by the use of colored tape.
- D. In addition to color coding, for all 1-phase and 3-phase systems, identify each cable (single or multi-conductor) and conductor at each end, in each manhole, pullbox, cable tray, or other component of the raceway system. This identification is applicable to all power, control, alarm, signal, instrumentation cables, and conductors.
- E. Identify each cable (single or multi-conductor) and groups or bundles of individual single conductors in each manhole, pullbox, cable tray, or other component of the raceway system with circuit identification markers. Implement a "from-to" cable/conductor bundle tagging system as part of this identification effort.
- F. Identify each individual conductor at each termination. This includes such locations as switchgear, switchboards, motor control centers, variable frequency drives, control panels, junction/terminal boxes, all field devices, and all other locations where conductors are terminated. Identify the termination of these conductors in accordance with the accepted Shop Drawings. Tag conductors with sleeve type labels.
- G. Where more than 1 nominal voltage system exists, identify each ungrounded system conductor by phase and system. Permanently post means of identification at each branch-circuit panelboard, switchboard, switchgear, motor control center, or other type of power distribution equipment.
- H. Include the following minimum information for wire and cable identification.
 - 1. Circuit number or load identification tag number as per section 16995.
 - 2. Origin (from source).
 - 3. Destination (to load).

3.2 NAMEPLATES

- A. Furnish and install nameplates for all electrical equipment indicated on the Drawings. Each disconnect control system, breaker, switch, panelboard, MCC, switchgear, switchboard etc., shall have nameplate indicating equipment name and circuit designation.
- B. Each disconnect means for service, feeder, branch, or equipment conductors and pushbutton stations shall have nameplates indicating its purpose or identifying the load.
- C. Each lighting switch and convenience outlet shall have a nameplate indicating its 120VAC power circuit number from lighting panelboard.

3.3 AUTOMATIC EQUIPMENT WARNING

- A. Mount permanent warning signs at mechanical equipment which may be started automatically or from remote locations. Fasten warning signs with round head stainless steel screws or bolts, located and mounted in a manner acceptable to ENGINEER.
- B. Mount permanent and conspicuous warning signs on (front and back) equipment, doorways to equipment rooms, pull boxes, manholes, where the voltage exceeds 600 volts.
- C. Place a warning ribbon or other effective means suitable for conditions above ductbank underground installations.
- D. Place warning signs on utilization equipment that has more than one source of power. Provide panel and circuit number of conductor tag of the power source disconnect.
- E. Place warning signs on utilization equipment that has 120 VAC control voltage source used for interlocking. Provide panel, circuit number, and conductor tag of control voltage source disconnect.

3.4 CONDUIT TAGS

- A. Install conduit tags (engraved stainless steel round tags) at each conduit termination to control panel, MCC, enclosure, disconnect, pull box, junction box etc.. Conduit tag names shall be as per single-line and control one-line diagrams shown on the drawings.

END OF SECTION

**SECTION 16080
PERMANENT DIESEL GENERATOR****PART 1 GENERAL****1.1 SCOPE**

- A. The Contractor shall furnish and install and test complete permanent electric generating system which shall be rated for a minimum output of 80 kW, at 0.8 power factor, 480-volt, 3-phase, 4-wire, 60-Hertz, 40-degree-C ambient, without exceeding NEMA MG1 temperature rise limits at rated load.
- B. The standby electric generating system shall be suitable for outdoor use and shall be rated for up to an altitude of 1000 feet without derating.
- C. The standby systems shall be a package of:
 - 1. A diesel engine driven electric system to provide standby electric power.
 - 2. Engine mounted control system.
 - 3. Starting batteries with high cranking capacity in low temperature environment, battery charger.
 - 4. Skid-mounted accessories as specified.
 - 5. Engine skid-mounted control panel.
 - 6. All other equipment and accessories as required providing a complete and operating system.
 - 7. Outdoor- type, sound attenuated weather proof enclosure.
 - 8. Sub-base fuel tank with double wall construction.
- D. All materials, equipment, and parts comprising the units specified herein, shall be new and unused, of current manufacture and of the highest grade.

1.2 RELATED SECTIONS:

- A. Section 16000 – Requirements for Electrical Works.

1.3 QUALITY ASSURANCE:

- A. The engine, generator, and all major items of auxiliary equipment shall be manufactured in the U.S. by manufacturers currently engaged in the production of such equipment. The unit shall be factory assembled and tested by the engine manufacturer and shipped to the jobsite by his authorized dealer having a parts and service facility in the area. The performance of the generator shall be certified by manufacturer as to the full power rating stability, and voltage and frequency regulation, and field load tested at site.

- B. The unit offered under these Contract Documents shall be covered by the manufacturer's standard warranty or guarantee on new machines and shall be a minimum of two years.
- C. Before the equipment is delivered, a factory certified test log of the generator sets showing a minimum of $\frac{3}{4}$ hour testing with $\frac{1}{2}$ hour at 100 percent rated load, continuously, shall be submitted to the Engineer. This generating system shall be full-load tested at the manufacturer facilities for a period of 2 hours, with the manufacturer's providing necessary inductive load banks. Any defects which become evident during this test shall be corrected by the manufacturer at his own expense.
- D. On completion of the installation of the generator, field start-up shall be performed by a factory-trained dealer service representative. Operating and maintenance instruction books shall be supplied and procedures explained to operating personnel. This training session shall not be less than two hours.

1.4 SUBMITTALS

- A. Submit shop drawings and product data which shall include the following as a minimum:
 - 1. Catalog cuts, physical dimensions and installation details including conduit terminations.
 - 2. Wiring diagrams and control schematics including power connection requirements.
 - 3. Complete bills of material accounting for all equipment including loose spare parts.
 - 4. Air emission compliance certification.
 - 5. Complete O&M Manual. (Hard copy and electronic copy in a CD)

PART 2 PRODUCTS

2.1 ENGINE AND ACCESSORIES

- A. The engine shall be water cooled inline or Vee-type four-stroke cycle compression ignition Diesel engine.
- B. The engine governor shall maintain frequency regulation not to exceed 3 percent from no load to full rated load.
- C. The units shall be mounted on a structural steel subbase and shall be provided with suitable vibration isolators which shall be seismically fastened to the concrete slab with steel anchor bolts. The design shall conform to California seismic requirements as specified in the Special Provisions.

- D. Safety shutoffs for high water temperature, low oil pressure, over speed, and engine over crank shall be provided. An engine-mounted radiator with blower type fan shall be sized to maintain safe operation at 115 degrees F maximum ambient temperature. The radiator shall be equipped for a duct adapter flange. Air flow restriction from the radiator shall not exceed 0.5 inch water gauge.
- E. The engine cooling system shall be filled with a solution of 50 percent ethylene glycol.
- F. The engine exhaust shall be provided with a suitable critical residential type silencer manufactured by Kittel, Maxim, or approved equal. Provide a rain cap for the exhaust, vertical pipe. Spark arrestor shall be provided for the exhaust pipe.
- G. The engine's accessories such as gauges, fuel piping, fittings, and valves shall be supplied and installed with the engine in accordance with appropriate local codes and regulations. Provide 2000 Watt, 240 VAC single-phase, thermostatically controlled jacket water heater.
- H. A 24-volt DC electric starting system, as recommended by the engine manufacturer, with positive engagement drive and automatic starter cut out upon starting shall be furnished.
- I. Generator manual and automatic start-stop controls in the generator control panel shall be provided. Controls shall provide two auxiliary contacts for activating accessory items. Controls shall include a 30-second cranking cycle limit with lockout. (Three 10-second cranks or a single 30-second crank.)
- J. A 24-volt lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. The battery set shall be of sufficient capacity to provide for 1-1/2 minutes total cranking time without recharging and shall be rated no less than 220 amp-hours. A battery rack and necessary cables and clamps shall be provided. A UL listed battery charger in a NEMA 3R enclosure shall be provided to float charge the batteries. The charger shall be heavy duty, industrial type suitable for use with 120VAC power input. It shall be as manufactured by LaMarch, Sens or equal.
- K. Diesel fuel supply shall be a double wall subbase built-in fuel tank 100gal capacity suitable for a maximum capacity of running the unit at full load for 24 hours. Provide a low fuel and a fuel leak detection system with a DPDT alarm contact 5A rated for each alarm for remote indication. Provide a 4-20mA DC signal representing the fuel tank volume in percentage for remote indication.
- L. The engine shall be certified Tier 3 by the California Air Resources Board to have a particulate matter (PM) emission rate of no greater than 0.1g/bhp-hr or stricter. The certification for the engine shall be submitted to the Engineer as proof that this requirement is met. The engine shall meet all other requirements by the Bay Area Air Quality Management District for emissions from a stationary emergency standby engine.

2.2 GENERATOR

- A. The generator shall be a 4-pole or 6-pole revolving field type with static exciter and magnetic amplifier or SCR voltage regulator. Commutator or commutator brushes will not be acceptable. Class F insulation shall be used on the stator and rotor, and both shall be further protected with 100 percent epoxy impregnation and an overcoat of resilient insulating material to reduce possible fungus and abrasive deterioration. The stator shall be directly connected to the engine flywheel housing, and the rotor shall be driven through a semi flexible driving flange to insure permanent alignment. Voltage regulation shall be within plus or minus 2 percent of rated voltage, from no load to full-load. The instantaneous voltage dip shall be less than 15 percent of rated voltage when full load and rated power factor is applied to the generator. Recovery to stable operation shall occur within 5 seconds. Stable or steady-state operation is defined as operation with terminal voltage remaining constant within plus or minus one percent of rated voltage. A rheostat shall provide a minimum of plus or minus 5 percent voltage adjustment from rated value. Temperature rise at full-load determined by resistance shall be within rating as defined by NEMA MG-1.
- B. The specified standby kW shall be for continuous electrical service during use of the unit.
- C. These ratings must be substantiated by manufacturer's standard published curves. Special ratings or maximum ratings will not be acceptable.
- D. A generator mounted, general purpose type, vibration isolated 14-gauge steel control panel shall be provided. This panel shall be padlockable.
- E. Control panel shall contain, but not be limited to the following digital (or electronic keyboard type display) equipment:
 - 1. Voltmeter, 3-1/2-inch, 2 percent accuracy
 - 2. Ammeter, 3-1/2-inch, 2 percent accuracy
 - 3. Voltmeter/ammeter phase selector switch
 - 4. Frequency meter, 3-1/2-inch, dial type
 - 5. Manual, Test and Automatic starting controls
 - 6. Panel illumination lights and switch
 - 7. Voltage level adjustment rheostat
 - 8. Engine oil pressure gauge
 - 9. Engine water temperature gauge
 - 10. Indicator lights for low oil pressure, high water temperature, over speed, and over crank alarms and alarm reset pushbutton
 - 11. Running time meter and auxiliary dry contact

12. Start pushbutton, stop pushbutton and HOA control mode selector switch
 13. Starting batteries low – high charge indicator.
 14. Provide a non-resettable totalizing meter that measures hours of operation or fuel usage.
 15. Provide common engine/generator fail alarm dry contact for remote indication. A RUN dry contact shall also be provided.
- A. A generator mounted main line molded case 150A circuit breaker shall be installed as a load circuit interrupting and protection devices. The circuit breakers shall be sized in accordance with provisions of the NEC. They shall operate both manually for normal switching function and automatically during overload and short circuit conditions. It shall be provided with ground-fault interruption.
 - B. Generator exciter field type circuit breakers do not meet the above electrical standards and will not be acceptable for line protection.
 - C. Provide loose recommended spare parts such as water hoses, fan belts, air and oil filters for no additional cost to the Owner.
- 2.3 WEATHER PROOF ENCLOSURE
- A. The enclosure shall be durable, weather resistant made with 14-gauge cold-rolled steel with safety glass control panel viewing window. Finish shall be ANSI 61 gray.
 - B. An external emergency stop button shall be provided.
 - C. Rust free stainless steel hinges and locks hardware shall be provided for all doors.
 - D. Noise attenuation shall be done with critical grade silencer with a maximum noise of 68 dbA at 23 feet or better.
 - E. Provide any other signage as required by CAL OSHA
 - F. Steel screens or wire mesh shall be provided all around the base of the frame of the generator to prevent rodents' entry.
- 2.4 MANUFACTURERS:
- A. The diesel engine generator package shall be manufactured by Caterpillar, Kohler, Onan, MQPower, or approved equal.

PART 3 EXECUTION

3.1 SYSTEM INSTALLATION

- A. Provide services of a factory-trained field engineer to review, check, test and supervise installation of the standby system as per manufacturer's

recommendations and requirements. Verify exact location of conduit terminations with approved shop drawings prior to pouring concrete slab.

- B. Engine set shall be leveled and placed on vibration isolators. Shim with steel shims to ensure an even level installation.
- C. Check for correct phase rotation prior to performing at least four hours of full load test with the required load bank and record full load parameters such as engine temperature, oil pressure, load, power factor, water temperature, voltage, frequency and engine speed in rpm.
- D. Perform final functional tests including manual and automatic controls and protective devices. 2-hr full load test shall be performed with the station actual loads. Records of the field test including engine parameters shall be submitted for review and approval as part of required as-built documents. Refill generator's tank with no.2 diesel fuel (for the amount used in the testing) after testing without any additional charge to the Owner.
- E. Submit final as-built documents with any field changes and certification that the installed system has been functional properly and is ready for final acceptance by the City.

3.2 TRAINING:

- A. Provide 1 hour class room training session and 2 hours of on-site training session to the Owner's personnel. (Travel time not included).

END OF SECTION

SECTION 16222 MOTORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Single phase motors, direct current motors, and 3-phase motors up to and including 400 horsepower.

1.2 REFERENCES

- A. American Bearing Manufacturers Association (ABMA):
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. Institute of Electrical and Electronic Engineers (IEEE).
- C. National Electrical Manufacturers' Association (NEMA):
 - 1. MG-1 - Motors and Generators.

1.3 DEFINITIONS

- A. Solid-State Motor Controller: Includes variable frequency drives and solid-state reduced voltage starters.
- B. Nominal Efficiency: The average full load efficiency value of a large population of the manufacturer's motors of the same design.
- C. Minimum Efficiency: The minimum full load efficiency value of any individual motor associated with the nominal motor efficiency.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Descriptive bulletins.
 - 2. Outline Drawings with dimensions.
 - 3. Cut-away and exploded view Drawings.
 - 4. Parts list with material designations.
 - 5. Nameplate data.
 - 6. Motor weight, frame size, and conduit box location.
 - 7. Description of insulation system.
- B. Design and Performance Data:
 - 1. Bearing design and bearing life calculations.
 - 2. Performance Data Required by Schedule A, Nameplate Data, and Following Information:
 - a. Service factor.
 - b. Efficiency at 1/2 and 3/4 load.

- c. Power factor at 1/2 and 3/4 load.
- d. When required for power factor improvement, capacitor size in KVAR with calculation data for motors sized 50 horsepower and above.
- 3. Special features including condensation heaters and winding temperature detectors.
- 4. Performance data for motors with synchronous speed of 900 revolutions per minute and below.
- 5. Factory test reports with test reference standard identified.

1.5 QUALITY ASSURANCE

A. Certification:

- 1. When motors are driven by variable speed drive systems, submit certification that selected motor:
 - a. Is capable of satisfactory performance under the intended load.
 - b. Is suitable for operation with the proposed variable speed drive unit.

B. Rating:

- 1. All motors provided for this project shall be suitable for an elevation of 1,250 feet without derating.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Motors: One of the following or equal:

- 1. U. S. Motors.
- 2. General Electric.
- 3. Reliance.

2.2 ELECTRICAL MOTORS

A. General:

- 1. Manufactured with cast iron frames in accordance with NEMA MG 1, and in accordance with specified requirements.
- 2. Alternating Current Motors: Squirrel cage induction type suitable for 60 hertz power.
- 3. Where not otherwise specified or indicated on the Drawings:
 - a. Motors 1 Horsepower and Larger: 3-phase, 460 volt.
 - b. Motors less than 1 Horsepower: Single phase, 120 volt.
- 4. 2-Speed Motors: Dual winding design.
- 5. Temperature Rating and Altitude Requirements: Where not otherwise specified or indicated on the Drawings, provide motors that are rated suitable for continuous operation in 40 degree Celsius ambient temperature at project site altitude.
 - a. Temperature Rise Under Full Load: Not to exceed that for Class B insulation (80 degrees Celsius).
- 6. Motor Data: Specific motor data including horsepower, speed, and enclosure type are indicated on the Drawings and specified under equipment for which motor is required.

7. Torque and Power of Motors:
 - a. Provide motors that develop sufficient torque for required service throughout acceleration range at voltage 10 percent less than motor nameplate rating.
 - b. Provide motors that develop sufficient torque when started using reduced voltage starters.
 8. Motor Leads and Insulating Material: Insulated leads with non-wicking, non-hygroscopic material. Class F insulation.
 9. Grounding Lugs: Provide inside conduit boxes for motor frame grounding.
 10. Hardware: Type 316 stainless steel.
- B. Provide motors that are special premium efficiency type, except motors that are to be used on hoisting equipment, heat pumps, unit heaters, sump pumps, and lubricating oil transfer pumps.
1. Provide premium efficiency type motors having nominal full load efficiencies and power factors as specified in Schedule A appended to this Section.
 2. Actual full load efficiency of individual motors within the nominal efficiency band shall not be less than the minimum efficiency value specified in Schedule A.
- C. Condensation Heaters:
1. Use: Required in motors in outdoor applications.
 2. Type: Cartridge or flexible wrap-around type installed within motor enclosure adjacent to core iron.
 3. Rating, Phase and Wattage: Rated for 120 volt, single phase with wattage as required.
 4. Bring power leads for heaters into conduit box.
- D. Winding Temperature Detectors:
1. When specified for individual equipment and on alternating current motors connected to a solid-state motor controller, provide factory installed winding temperature detector with leads terminating in conduit box.
 2. Provide detectors that protect motor against damage from overheating caused by single phasing, overload, high ambient temperature, abnormal voltage, locked rotor, frequent starts, or ventilation failure.
 - a. For Motors Less than 200 Horsepower: Provide detector that has normally closed contacts.
 - b. For Motors 200 Horsepower and Larger: Provide with resistance temperature detectors, 2 per each phase.
 3. Auxiliary Relays and Controls: Provide relays and controls and mount them in controller enclosure which is suitable for the environment.
- E. Internal Cooling Motors: Design motors having speeds of 900 revolutions per minute and less, and motors that are connected to solid-state motor controllers with special attention to internal cooling.

2.3 SINGLE PHASE MOTORS

- A. Capacitor start type rated for operation at 115 volts, 60 hertz, unless otherwise specified or indicated on the Drawings.
- B. Totally enclosed, fan cooled motors manufactured in accordance with NEMA MG 1-10.35.

- C. Ball Bearings: Sealed.
- D. 1/2 Horsepower or Less Fan Motors:
 - 1. Split-phase or shaded pole type when standard for the equipment.
 - 2. Open type when suitably protected from moisture, dripping water, and lint accumulation.
- E. Wound rotor or commutator type single-phase motors only when their specific characteristics are necessary for application and their use is acceptable to the ENGINEER.

2.4 3-PHASE MOTORS

- A. Suitable for 460 volt 3-phase power unless otherwise specified or indicated on the Drawings.
- B. NEMA Design B except where driven load characteristics require other than normal starting torque.
 - 1. Starting kilovolt ampere per horsepower (locked rotor) are not to exceed values specified in NEMA MG-1-10.37.
- C. Motor Bearings: Antifriction, regreasable, and filled initially with grease suitable for ambient temperatures to 40 degrees Celsius.
 - 1. Suitable for intended application and have ABMA B-10 rating life of 60,000 hours or more.
 - 2. Fit bearings with easily accessible grease supply, flush, drain, and relief fittings using extension tubes where necessary.
 - 3. Provide two pole motors with sleeve type bearings.
- D. Insulation Systems:
 - 1. Comply with NEMA 1-1.65.
 - 2. Class F system with Class B temperature rise.
 - 3. Resistant to attack by moisture, acids, alkalies, and mechanical or thermal shock.
- E. Conduit Boxes: Cast iron or stamped steel, split from top to bottom and capable of being rotated to 4 positions.
 - 1. Provide gaskets between following:
 - a. Frames and conduit boxes.
 - b. Conduit boxes and box covers.
- F. Motor Enclosures: When enclosure type is not specified in individual equipment specifications, provide a Totally Enclosed Fan Cooled (TEFC) enclosure for non-hazardous (unclassified) areas and explosion-proof enclosure for hazardous (classified) areas:
 - 1. Totally Enclosed Fan Cooled: Cast iron conduit box; 1.15 service factor at 40 degrees Celsius ambient; tapped drain holes with Type 316 stainless steel plugs for frames 286T and smaller, and automatic breather and drain devices for frames 324T and larger; upgraded insulation by minimum of 3 dips and bakes and sealer coat of epoxy or silicone.
 - 2. Explosion-Proof: 1.15 service factor at 40 degrees Celsius; tapped drain holes with corrosion resistant plugs for frames 286T and smaller and automatic

- breather and drain devices for frames 324T and larger; UL label for Class I, Division 1, Group D hazardous area.
3. For special application such as corrosive environment, use a Severe Duty motor. Corrosion resistant type conforming to motors designated by manufacturer as "Chemical Duty," "Mill and Chemical," "Custom Severe Duty," or similar applicable manufacturer's quality designation with 1.15 service factor at 40 degrees Celsius; tapped drain holes with Type 316 stainless steel plugs for frames 286T and smaller and automatic breather and drain devices for frames 324T and larger; epoxy finish; and upgraded insulation using encapsulated or dip and bake windings.
 4. Submersible: Watertight casing with insulated windings which are moisture resistant.
 - a. Pump Motors Specified to be Submersible: Provide motors having cooling characteristics suitable for continuous operation in totally, partially, or non-submerged condition without overheating or other damage.
 - b. Electrical Cables: Provide cables of adequate length to allow unit to be wired without splices.
 5. Open Drip Proof where specified elsewhere: Stamped steel conduit boxes; 1.15 service factor at 40 degrees Celsius.

2.5 MOTOR SIZES

- A. Motor sizes specified in the Specifications and indicated on the Drawings are minimum sizes.
- B. Provide motors, electrical circuits, and equipment of ample horsepower capacity to operate equipment without exceeding rated nameplate horsepower, full-load current at rated nameplate voltage, or overheating at maximum load capacity.

2.6 SOURCE QUALITY CONTROL

- A. Factory Testing of 3-Phase Motors:
 1. When specified in individual equipment Specifications, factory test motors. Include testing of:
 - a. No load current.
 - b. Locked rotor current.
 - c. Winding resistance.
 - d. High potential.
 2. Perform in accordance with applicable NEMA Standards.
 3. Furnish copies of test reports.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install motors in accordance with manufacturer's instructions.

3.2 SCHEDULES

- A. Schedule A: Full load motor efficiency and power factor rating requirements for premium efficiency, 460 volt, 3-phase horizontal motors.

<u>SCHEDULE A</u>							
FULL LOAD MOTOR EFFICIENCY AND POWER FACTOR RATING REQUIREMENTS FOR PREMIUM EFFICIENCY, 460 VOLT, 3 PHASE HORIZONTAL AND VERTICAL MOTORS							
		Protected (Open Drip Proof)⁽¹⁾			Totally Enclosed Fan Cooled⁽¹⁾		
Nominal Horsepower (Horsepower)	Syn. (revolutions per minute)	Minimum Efficiency (Percent)	Nominal Efficiency (Percent)	Power Factor (Percent)	Minimum Efficiency (Percent)	Nominal Efficiency (Percent)	Power Factor (Percent)
1	1,800	81.5	84.0	70.9	81.5	84.0	77.7
	1,200	78.5	81.5	57.0	78.5	81.5	57.0
2	3,600	81.5	84.0	87.7	84.0	86.5	87.7
	1,800	81.5	84.0	76.7	81.5	84.0	78.8
	1,200	84.0	86.5	68.1	85.5	87.5	68.1
3	3,600	80.0	82.5	90.4	84.0	86.5	82.8
	1,800	86.5	88.5	78.9	86.5	88.5	79.2
	1,200	87.5	89.5	71.0	87.5	89.5	71.0
5	3,600	86.5	81.5	84.5	86.5	88.5	87.0
	1,800	87.5	88.5	80.4	86.5	88.5	81.0
	1,200	88.5	89.5	73.0	87.5	89.5	74.4
	900	87.5	87.5	70.0	87.5	89.5	70.5
7-1/2	3,600	86.5	88.5	86.7	87.5	89.5	86.3
	1,800	87.5	89.5	83.3	88.5	90.2	84.4
	1,200	88.5	90.2	78.2	88.5	90.2	78.3
	900	87.5	89.5	72.0	87.5	89.5	72.0

<u>SCHEDULE A</u>							
FULL LOAD MOTOR EFFICIENCY AND POWER FACTOR RATING REQUIREMENTS FOR PREMIUM EFFICIENCY, 460 VOLT, 3 PHASE HORIZONTAL AND VERTICAL MOTORS							
		Protected (Open Drip Proof)⁽¹⁾			Totally Enclosed Fan Cooled⁽¹⁾		
Nominal Horsepower (Horsepower)	Syn. (revolutions per minute)	Minimum Efficiency (Percent)	Nominal Efficiency (Percent)	Power Factor (Percent)	Minimum Efficiency (Percent)	Nominal Efficiency (Percent)	Power Factor (Percent)
10	3,600	88.5	90.2	85.5	89.5	91.0	87.5
	1,800	88.5	90.2	82.8	88.5	90.2	86.0
	1,200	89.5	91.0	80.5	89.5	91.0	81.0
	900	89.5	91.0	75.8	88.5	90.2	76.0
15	3,600	88.5	90.2	86.7	89.5	91.0	87.4
	1,800	90.2	91.7	81.9	91.0	92.4	82.7
	1,200	89.5	91.0	81.7	90.2	91.7	78.9
	900	89.5	91.0	76.8	88.5	90.2	77.0
20	3,600	90.2	91.7	87.1	90.2	91.7	88.7
	1,800	91.0	92.4	83.1	91.0	92.4	84.2
	1,200	90.2	91.7	83.7	90.2	91.7	79.0
	900	90.2	91.7	77.2	89.5	91.0	77.2
25	3,600	90.2	91.7	88.1	91.0	92.4	85.5
	1,800	91.7	93.0	82.7	92.4	93.6	84.3
	1,200	91.0	92.4	79.2	91.0	92.4	83.5
	900	90.2	91.7	76.3	90.2	91.7	76.4
30	3,600	91.7	93.0	88.3	91.0	92.4	73.9
	1,800	91.7	93.0	83.3	92.4	93.6	83.1
	1,200	91.7	93.0	82.1	91.7	93.0	83.5
	900	91.7	93.0	76.0	91.0	92.4	76.5

SCHEDULE A**FULL LOAD MOTOR EFFICIENCY AND POWER
FACTOR RATING REQUIREMENTS FOR PREMIUM EFFICIENCY,
460 VOLT, 3 PHASE HORIZONTAL AND VERTICAL MOTORS**

		Protected (Open Drip Proof) ⁽¹⁾			Totally Enclosed Fan Cooled ⁽¹⁾		
Nominal Horsepower (Horsepower)	Syn. (revolutions per minute)	Minimum Efficiency (Percent)	Nominal Efficiency (Percent)	Power Factor (Percent)	Minimum Efficiency (Percent)	Nominal Efficiency (Percent)	Power Factor (Percent)
40	3,600	92.4	93.6	89.2	92.4	93.6	87.5
	1,800	93.0	94.1	80.8	93.0	94.1	82.3
	1,200	92.4	93.6	82.2	92.4	93.6	80.5
	900	91.7	93.0	75.0	91.7	93.0	75.5
50	3,600	91.7	93.0	86.3	91.7	93.0	87.7
	1,800	93.0	94.1	83.3	93.0	94.1	84.2
	1,200	92.4	93.6	83.0	92.4	93.6	80.6
	900	92.4	93.6	79.2	91.7	93.0	79.5
60	3,600	92.4	93.6	88.8	92.4	93.6	88.9
	1,800	94.1	95.0	84.5	94.1	95.0	84.2
	1,200	93.6	94.5	84.4	93.0	94.1	85.4
	900	92.4	93.6	78.8	91.7	93.0	79.3
400	1800	95.4	96.2	90.1	93.4	94	88.4
	1200	96.3	96.7	86.5	95.2	95.5	80.3
	900	96.3	96.5	77.5	95.2	95.4	72.7

NOTES:

- (1) Motor data for continuous duty, NEMA Design B, 1.15 service factor, 40 degrees Celsius ambient, Class F insulation, 3 phase, 460 volt, at listed speed rating.
- (2) Correct to 95 percent power factor and submit capacitor size in KVAR as specified in Article titled "Submittals."
- (3) Totally enclosed fan cooled efficiencies apply to both horizontal and vertical motors.

END OF SECTION

SECTION 16422 MOTOR CONTROL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Manual starters, magnetic contactors, overload relays, combination starters and related motor controllers.
- B. Related Sections:
 - 1. Section 16000 – Requirements for Electrical Work

1.2 REFERENCES

- A. National Electrical Code (NEC):
 - 1. Article 430 - Motors, Motor Circuits and Controllers.
- B. National Electrical Manufacturers Association (NEMA).

1.3 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 16000.
- B. Manufacturer's installation instructions.

1.4 WARRANTY

- A. Submit manufacturer's standard warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manual Motor Starters: One of the following or equal:
 - 1. Square D Company.
 - 2. Cutler-Hammer.
 - 3. General Electric.
- B. Full Voltage Magnetic Starters: One of the following or equal:
 - 1. Cutler-Hammer.
 - 2. Allen-Bradley.
 - 3. Square D Company.
- C. Reduced Voltage Closed-transition Autotransformer Starters: One of the following or equal:
 - 1. Cutler-Hammer.
 - 2. Square D Company.
 - 3. Allen-Bradley.

2.2 STARTERS

- A. Suitable for the horsepower ratings specified, and in accordance with NEC Article 430.
- B. Verify motor ratings and coordinate starter and overload trip ratings with actual horsepower and nameplate current ratings of motors installed.
- C. Magnetic Contactors: Factory adjusted and chatter free.
- D. Overload Relays: Install bimetallic type overload relays in each line conductor as indicated on the Drawings. Provide contacts for remote monitoring of overload status as indicated on the Drawings.
- E. Mount extended overload reset buttons to be accessible for operation without opening door of enclosure. Plastic overload relay reset buttons with plastic operator shafts are unacceptable.
- F. Provide starters Size 2 and larger with arc quenchers on load breaking contacts.
- G. Minimum Size Starter: NEMA Size 1, and not smaller than size indicated on the Drawings.
- H. Provide starters of sufficient size to accommodate motors furnished, including larger starters required for larger motors supplied by CONTRACTOR.
- I. Combination Starters: Furnish complete with a 120 volt control transformer and accessories unless otherwise noted.
- J. Control Fuses: Size and furnish as required and where indicated in the schematics.

2.3 MANUAL MOTOR STARTERS

- A. Across-the-line manual motor starters for motors up to 1 horsepower, 600 volts shall have the electrical characteristics indicated on the Drawings.
- B. Provide single-pole or 3 pole as indicated on the Drawings with overload devices.
- C. Provide handles that clearly indicate the ON, OFF with lockout, and TRIPPED positions, pilot light, and positive, quick-make, quick-break mechanisms.
- D. Provide enclosures as indicated on the Drawings. Where not indicated, provide NEMA 12 enclosures for indoor location and NEMA 3R or 4X stainless steel enclosures for outdoor locations and corrosive, chemical areas. Provide enclosures compatible with type of conduit system being used for each specific application.

2.4 FULL VOLTAGE MAGNETIC STARTERS

- A. Across-the-line full voltage magnetic starters for up to 600 volts shall have electrical characteristics indicated on the Drawings.

- B. Provide positive, quick-make, quick-break mechanisms; padlockable enclosure doors; 3 overload relays with plus or minus 15 percent adjustment from nominal heater rating on the overload relay; cover mounted reset button, and at least 3 reversible contacts in addition to hold-in contact.
- C. Provide magnetic starter enclosures as indicated on the Drawings. Where not indicated, provide NEMA 12 enclosures for indoor locations and NEMA 3R or 4X stainless steel enclosures for outdoor locations and corrosive, chemical areas. Provide enclosures compatible with type of conduit being used for each specific application.
- D. Provide magnetic starters in accordance with latest NEMA Standards.
- E. Provide pilot devices such as push buttons, pilot lights (push-to-test type), running time meter, motor protector modules as shown on the drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install motor starters in accordance with section 16000.

3.2 APPLICATION

- A. Supply circuit breaker trip elements and starter overload trip elements to meet above normal ambient temperatures where such conditions are anticipated (subject to ENGINEER's acceptance).

3.3 DEMONSTRATION

- A. Demonstrate successful operation of equipment.

3.4 PROTECTION

- A. Protect products until acceptance by DISTRICT.

END OF SECTION

**SECTION 16920
600 VOLT MOTOR CONTROLLERS (MC)****PART 1 GENERAL****1.1 DESCRIPTION**

- A. Scope: This section specifies freestanding, factory assembled, customized 600 volt motor controller (MC) section.
- B. Equipment List: The controller and entire assembly specified herein shall be manufactured by Tesco, KBL, MCC, or equal.

1.2 RELATED SECTIONS

- A. Section 16000 – Requirements for Electrical Work.

1.3 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ANSI/NEMA ICS 1-88	General Standards for Industrial Controls and Systems
ANSI/NEMA ICS 2-88	Industrial Control Devices, Controllers and Assemblies
JIC EMP 1-67	Electrical Standards for Mass Production Equipment
UL 508A and 698A	Industrial Control Panels

1.4 SUBMITTALS

- A. The following specific submittal requirements for the MC's shall be followed:
1. Contractor shall formally place an order with motor controller manufacturer within sixty days or sooner of the award of the contract. The order shall include all relevant drawings and specs including any addendum items associated with the equipment.
 2. Contractor shall submit shop drawings to the District within 6 weeks of the order being placed.

3. Contractor shall forward review comments to motor controller manufacturer within two days after receipt of the comments by the District.
 4. Contractor shall provide the release for manufacturing to MC manufacturer within 3 business days of receiving a favorably reviewed submittal and shall provide the District with the shipping date.
 5. Prior to shipment, a factory test of the equipment optionally witnessed by the District shall occur.
- B. The following information contain in three-ring binder shall be provided and submitted in accordance with Section 16000:
1. Elementary connection, single-line diagram, individual equipment control schematic diagrams, and interconnection diagrams as required in accordance with JIC EMP 1 and/or NEMA ICS standards. Each and every terminal shall be identified with terminal number. Remote mounted pilot devices shall also be identified on wiring diagram.
 2. List of starters and feeder tap compartments indicating the size and type of circuit protection. Nameplate schedule for each equipment compartment door shall also be submitted.
 3. Interrupting withstand and continuous current rating of:
 - a. Bus bars
 - b. Feeder tap units
 - c. Starter units
 - d. Main incoming units
 4. A copy of this specification section with addenda updates, and all referenced sections with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.

PART 2 PRODUCTS

2.1 ACCEPTABLE PRODUCTS

- A. Motor controller shall comply with ANSI/NEMA ICS 2-322, AC General-Purpose Motor Control Centers, and UL 845 or UL508A.

2.2 SEISMIC REQUIREMENT

MC shall have provisions for being tied down to resist seismic forces as per latest California Building Code requirements. Provide certification from the MC manufacturer that the MC meets and exceeds seismic requirements for the project location in the San Francisco Bay Area.

2.3 FINISH AND COLOR

- A. The MC enclosure shall be free-standing, NEMA 3RX, vented, 316 stainless steel enclosure.

2.4 WIRING

- A. General: Motor controller shall be provided with NEMA Class II, Type B wiring. All starter units shall have terminal blocks for control wiring. Terminal blocks shall be provided for power wiring for starters size 2 and smaller. Motor control centers shall be provided with all necessary interconnecting wiring and interlocking. When a relay cubicle is specified on the drawings or schedules, wire directly to the relay sockets of plug-in relays as part of the interconnecting wiring. Provide elementary and connection diagrams for each starter unit and an interconnection diagram for the entire motor control center.
- B. Power Wire: Power wire shall be copper 90 degrees C, dry locations, "MTW" insulated, sized to suit load; minimum power wire size shall be No. 12 AWG copper stranded. All power cable terminals shall be color coded with color tapes and shall indicate circuit designation as shown on single-line diagram.
- C. Control Wire: Control wire shall be No. 16 AWG stranded copper wire, rated 90 degrees C and UL listed for panel wiring.
- D. Terminations and Cable Connections:
 - 1. Terminals: Control wiring shall be lugged with ring-tongue or locking spade crimp type terminals made from electrolytic copper, tin-plated.
 - 2. Cable Connectors: Cable connectors for use with stranded copper wire, sizes No. 8 AWG to 1000 MCM, shall be UL listed. Dished conical washers shall be used for each bolted connection. Connectors shall be reusable and shall be rated for use with copper conductors. Incoming line and outgoing feeder compartments shall be provided with crimp type lugs, 3M, Burndy, or equal.
- E. Conductor Markers: Markers used for identification shall meet the requirements of paragraph 16000-2.7.

2.5 MAIN AND FEEDER BRANCH CIRCUIT PROTECTION

Circuit Breakers (Thermal Magnetic): Thermal-magnetic circuit breakers shall be molded case equipped with toggle type handle, quick-make, quick-break over center switching mechanism that is trip-free so that breaker cannot be held closed against short circuits and abnormal currents. The tripped position shall be clearly indicated by breaker handle maintaining a position between "ON" and "OFF." All poles shall open, close, and trip simultaneously. Minimum short circuit capacity shall be 42,000 amps symmetrical at 480V AC. Main breaker of 200 amp or larger shall be provided with solid-state multi function trip units with long time, long time delay, short time, short time delay and ground fault protection. Main breaker for MCC shall be provided with a shunt trip coil and with two auxiliary switches rated for 5A minimum.

MOTOR CONTROLLER UNITS

General: Motor starter units shall be combination type with contactor motor circuit protector as specified on the drawings. The starter units shall have a minimum combination UL listing of 42,000 amps RMS, symmetrical at 480V AC.

- B. Motor Circuit Protectors: The molded case motor circuit protector shall operate on the magnetic principle with a current sensing coil in each of the three poles to provide an instantaneous trip for short circuit protection. The trip setting shall be adjustable from 700 to 1300 percent of the motor full load amperes from the front of the breaker. The motor circuit protector shall be set at its lowest position at the factory.
- C. Control Transformers: Each control transformer shall be rated 480/240-120V, single phase, 2 wire, 60 Hz. The transformer shall be sized for the load it feeds but shall not be less than the minimum ratings as follows:

NEMA starter size	Minimum transformer volt-ampere rating
1	100
2	150
3	200
4	300

1. Each control transformer shall be provided with time-delay, slow-blow secondary fuse rated to interrupt 10,000 amperes short circuit at 250 volts AC. Two primary fuses rated to interrupt 200,000 amperes at 600 volts shall be provided on all starters. Provide an extra 50VA for CPTs of motor control circuit serves motor space heater.
 2. Fuse holder for secondary fuse shall be drawout indicating type and mounted on the door of the compartment. Fuse holders for primary fuses shall be fuse clips with full barriers between fuses.
- E. Spare Parts: Provide the following spares with no additional costs to the District:
- a. Two dozens control fuses.
 - b. Three 100VA CPTs
 - c. Three pushbuttons and three pilot lights of each type.
 - d. One gallon of touch up paint.
 - e. One remote electronic keypad
- F. Auxiliary Contacts: Contactors shall be equipped with auxiliary contacts, rated 10 amperes at 120 volts AC. Unless otherwise specified on the drawings, each contactor shall be equipped with two normally open and two normally closed electrically isolated auxiliary contacts. Auxiliary contacts shall be wired out to terminal blocks. Refer to drawings for actual quantities required.
- G. Overload Relay: The overload relay with three heater elements shall protect the power wiring and motor from excessive overcurrents. The relay shall be ambient compensated and have adjustment from 90 to 110 percent of the normal heater rating.

The sensing element shall be bimetal type and conform to ANSI/NEMA ICS 2-222.06, Class 20 tripping time.

- H. Terminal Blocks: Terminal blocks shall be screw type rated 600 volts; 20 amperes for control wiring and 30 amperes power wiring (starters size 3 and larger shall terminate the power leads directly to the contactor). The number of terminal blocks shall be specified on the drawings. Terminal blocks shall be provided with integral marking strips and shall be permanently marked with the conductor number as specified on the drawings. Internal wiring shall be connected on one side of the terminal block; outgoing conductors shall be connected to the other side.

2.7 MISCELLANEOUS

- A. General:
 - 1. Control devices such as pushbuttons, selector switches, indicating lights (push-to-test type) and overload reset pushbuttons shall be mounted on the unit compartment door.
 - 2. The control devices shall comply with the requirements of Section 16000.
 - 3. Wire motor protection relay Minicas II provided by the pump manufacturer as part of the control circuitries as shown on the drawings. This relay shall be installed away from the power cables or power components of the drive to avoid possible interferences.
 - 4. Wire Automatic Transfer Switch (ATS) as per the design drawings and as recommended by the manufacturer.
- B. Provide a permanent pocket on the side of the MC to hold as-built documents and O&M Manual.
- C. Nameplates: Nameplates shall be provided in accordance with the requirements of paragraph 16000-2.11 Nameplates shall be provided for all cubicles and compartments. A Master nameplate with large lettering (one-inch high) shall be provided identifying name of the motor control center.
- D. Other components: Refer to the drawings for other components such as ATS, Power Distribution Panel, power and control transformers, mini loadcenter etc. to be located within the Motor Controller. These components are specified in this section and other sections of Div 16 specification.

2.8 PRODUCT DATA

- A. The following information shall be provided in accordance with Section 01300:
 - 1. Applicable operation and maintenance information as specified in Section 16000.
 - 2. Dimensions and weights.

3. Installation instructions.
4. Manufacturer's product data of each component.

PART 3 EXECUTION

3.1 GENERAL

- A. The motor controller sections shall be erected in accordance with the recommendations of the manufacturer and with the details specified herein.
- B. The overload relay heater elements shall be provided by the Contractor and sized based on the actual full load amperes of the motor connected to the starter. Provide a summary of all overload heaters including the motor nameplate data and corresponding overload heater catalog number and rating as part of as-built drawings for review and approval.
- C. The motor circuit protectors shall be adjusted by the Contractor to the lowest setting not causing false tripping.
- D. Install anchor bolts to hold down MC as per typical detail shown on the drawing to resist seismic activities. Install anchor bolts to hold down auxiliary enclosure as per the manufacturer's requirements to meet seismic requirements per California Building Code. Caulk around the base of the auxiliary enclosure after installation.
- E. Provide color coded tapes and circuit identification to all power cables and terminals. Refer to section 16000 for color assignment.

3.2 FIELD TESTS

- A. Motor controller shall be tested in accordance with Section 16000. Testing shall include individual controller. Submit final as-built prior to performing final acceptance test. Field test records shall include data such as motor nameplate rating, overload catalog number and rating and actual full load current drawn by the installed equipment at 100 percent speed.

3.3 TRAINING

- A. Provide training to the DISTRICT's electrical and instrumentation staff. Training shall include one session of four hours which includes one two hours of theory of operations and two hours of hand-on practice. Training shall be performed by the manufacturers' field representatives.

END OF SECTION

**SECTION 16938
POWER SYSTEM STUDY**

PART 1 GENERAL

1.1 REQUIREMENTS

- A. The Contractor shall prepare a short circuit (SC), load flow (LF), and protective device evaluation/coordination (PDEC) and arc flash study for the electrical power system in accordance with the requirements of these Specifications and as shown.
- B. The study shall include all portions of the electrical distribution system from the utility service for utility power sources and standby power sources down to and including the 480V distribution system. This shall include all new electrical equipment as shown on the single-line diagram.
- C. It is the responsibility of the Contractor to obtain the short circuit information required for the study from PG&E. The equipment characteristics and data in the study shall match the equipment and associated impedance actually being installed.
- D. The Contractor shall expedite and be fully responsible for collection of data from equipment suppliers, from the District to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacture.
- E. The study shall be performed with SKM Electrical Engineering software.

1.2 QUALIFICATIONS OF ORGANIZATION RESPONSIBLE FOR THE STUDY

- A. Short circuit studies, protective device evaluation studies, and protective device coordination studies shall be performed by a professional electrical engineer from the medium voltage switchgear manufacturer or an electrical testing agency who has been regularly engaged in short circuit and protective device coordination services for a period of at least 10 years. The study shall utilize proven computer programs for making three-phase fault duty and single phase ground fault duty calculations. The studies shall be signed and stamped by a professional electrical engineer, registered in the State of California, responsible for the studies. This service shall be performed by Square D Engineering services, Emerson Electric Reliability Services, Eaton Engineering Services, or General Electric Engineering Services.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The short circuit and protective device coordination study shall be conducted under the applicable standards of the American National Standards Institute (ANSI), and the latest edition of the National Electrical Code (NEC). Specifically, the following standards shall apply.

ANSI/IEEE 141 - Recommended Practice for Electrical Power Distribution for Industrial Plants

ANSI/IEEE 242 - Recommended Practice for Protection, and Coordination of Industrial, and Commercial Power Systems

ANSI/IEEE C 37.010 - Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

ANSI/IEEE C 37.13 - Low-Voltage AC Power Circuit Breakers Used in Enclosures

ANSI/IEEE C 57.109 - Guide for Transformer Through-Fault-Current Duration

1.4 CONTRACTOR SUBMITTAL

- A. The short circuit protective device coordination report shall conform to the requirements of this Section entitled "Power Systems Study."
- B. Studies related to distribution system protection and coordination shall be submitted to the District prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture. If formal completion of the studies may cause delay in equipment manufacture, approval from the Engineer may be obtained for a preliminary submittal of sufficient detail to ensure that device selection will be adequate. Preliminary submittal shall indicate the computer program (preferably SKM) for use in performing the work of this section. Submit both hard copy and electronic version including completed SKM databases to the PWP. A copy of a full size 22" x 34" single-line diagram folded in a plastic 8.5" x 11" holder shall be submitted as part of the submittal.
- C. Protective device and coordination evaluation studies must be approved by the District and the Engineer prior to system implementation and testing.

PART 2 PRODUCTS

2.1 GENERAL

- A. The study organization shall prepare a single-line diagram of the power system. This single-line diagram shall identify all specific components considered in the study, and the ratings as well as contributions of all power devices (This includes, but is not limited to: transformers, circuit breakers, relays, fuses, buses, conduit material and cables). The study input data shall include the power company's short circuit contribution, resistance and reactance components of the branch impedances, the X/R ratios, base quantities selected, and other source impedances.

2.2 SHORT CIRCUIT STUDY (SC)

- A. The short circuit study shall be performed with the aid of a digital computer program and shall be in accordance with ANSI C37.5, IEEE Standard 242,

and IEEE Standard 141. The short circuit study shall include a minimum of two general groups of system-wide calculations including 3-phase bolted faults and single-phase line-to-ground faults. The study shall produce a minimum of 4 complete system-wide sets of data and calculation results including 4 sets covering 3-phase bolted faults and 6 sets covering single-phase line-to-ground faults. The 4 sets of data and results for each group shall correspond to switching, motor and power supply operating arrangements for the worst-case faults on the bus of:

1. Combination Meter and Main Disconnect
- B. Typical operating arrangements for worst-case faults are indicated in Table 1

**SHORT CIRCUIT STUDY
OPERATING ARRANGEMENTS FOR WORST-CASE FAULTS**

TABLE 1

Short Circuit Case	Main Bus On	Notes
480V service available (bolted 3-phase fault) symmetrical	Combination Meter and Main Disconnect	Assume all pumps and auxiliaries are operating
Same as above (ground fault)	Combination Meter and Main Disconnect	Assume all pumps and auxiliaries are operating

2.3 PROTECTIVE DEVICE EVALUATION STUDY (PDEC)

- A. A protective device evaluation study shall be performed to determine the adequacy of current transformers, circuit breakers, molded case switches, relays, fuses, and other protective devices by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents. Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the Engineer's attention.

2.4 PROTECTIVE DEVICE COORDINATION STUDY (PDEC)

- A. A protective device coordination study shall be performed to provide the necessary calculations required to select or check the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low-voltage breaker trip characteristics and settings.

2.5 TIME / CURRENT COORDINATION CURVES (PDEC)

- A. As a minimum, the time current coordination curves for the power distribution system shall include the following on 5 cycle log-log graph paper:

1. Time-current curve for each circuit breaker, protective relay or fuse showing graphically that the settings will provide protection and selectivity within industry standards. Each curve shall be identified; relay taps and time dial settings shall be specified. Curves shall be provided for ground fault settings as well as phase bolted fault settings.
2. Time-current curves for each device shall be positioned to provide the maximum selectivity to minimize system disturbances during fault clearing. Where selectivity cannot be achieved, the Engineer shall be notified as to the cause.
3. Time-current curves and points for transformer, motor, bus, cable and equipment damage.
4. Circuit interrupting device operating and interrupting times.
5. Indicate maximum fault values on the graph.
6. Sketch of bus and breaker arrangement.
7. Magnetizing inrush points of transformers.
8. Motor starting currents and thermal limits of motors 150 HP and above.
9. All restrictions of the ANSI and National Electrical Code shall be adhered to and proper coordination intervals and separation of characteristics curves shall be maintained.

2.6 LOAD FLOW (LF)

- A. Several steady state load flow studies shall be conducted. The initial tap settings of all the 480 volt transformers shall deliver the nominal 480 volts at the associated switchboard and MC main buses, and all transformers seeing all connected load running at full load. For any power system with a combined 100hp of motor loads or larger, a steady state load flow with the above initial conditions shall be provided for the following cases and shall be submitted for Engineer review.
 1. Load flow studies shall be provided for the two switching and operational arrangements described in Table 1 for the short circuit calculations.
 2. Load flow studies shall show all major node voltages and branch currents including motor terminals, associated MCC, and associated transformers both secondary and primary. A summary of identified branch voltage drops shall be provided to identify voltage drop problems.

2.7 ARC FLASH HAZARD ANALYSIS

- A. Perform an arc flash hazard analysis after the short circuit and protective device coordination study has been completed.
- B. The analysis shall be calculated by means of the SKM Power Tools for Windows computer software package. Pertinent data, rationale employed, and assumptions in developing the calculations shall be incorporated in the introductory remarks of the study.
- C. The analysis shall be in accordance with latest applicable NFPA 70E, OSHA 29-CFR, Part 1910 Sub part S and IEEE 1584 Standards.
- D. The arc flash analysis will determine the following:
 - 1. Flash Hazard Protection Boundary
 - 2. Limited Approach Boundary
 - 3. Restricted Boundary
 - 4. Prohibited Boundary
 - 5. Incident Energy Level
 - 6. Required Personal Protective Equipment Class
 - 7. Type of Fire Rated Clothing
- E. Produce an Arc Flash Warning label listing items above for each of the major equipment covered in the scope of work. Also include the bus name and voltage. Labels shall be printed in color and be printed on adhesive backed heavy duty vinyl Labels.
- F. Produce Bus Detail sheets that list the items D 1-7 from above and the following additional items:
 - 1. Bus Name
 - 2. Upstream Protective Device Name, Type, and Settings
 - 3. Bus Line to Line Voltage
- G. Produce Arc Flash Evaluation Summary Sheet listing the following additional items:
 - 1. Bus Name
 - 2. Upstream Protective Device Name, Type, and Settings
 - 3. Bus Line to Line Voltage

4. Bus Bolted Fault
5. Protective Device Bolted Fault Current
6. Arcing Fault Current
7. Protective Device Trip / Delay Time
8. Breaker Opening Time
9. Solidly Grounded Column
10. Equipment Type
11. Gap
12. Arc Flash Boundary
13. Working Distance
14. Incident Energy
15. Required Protective Fire Rated Clothing Type and Class

2.8 STUDY REPORT

The results of the power system study shall be summarized in a final report signed and stamped by a California registered professional engineer. The report shall include the following minimum sections:

- A. Introduction, executive summary and recommendations, assumptions, reduced copy of the one-line drawing and a folded full size one-line drawing.
- B. Arc Flash Evaluations Summary Spreadsheet
- C. Bus Detail Sheets
- D. Coordination curves and settings of protective devices
- E. Arc Flash Hazard Warning Labels printed in color on adhesive backed labels. On each label, date, name, address and phone of the organization performing the study shall be indicated. Each label shall not be smaller than 4" by 6". For outdoor electrical equipment, the labels shall be suitable for outdoor usage and shall be water-proof.

PART 3 EXECUTION

3.1 FIELD INVESTIGATION

- A. The Contractor shall provide a field data of motor, transformer, conduit, buses, cable, switchboard, protective device, interlocks, operational and

setting data and nameplate information from new electrical equipment in the field for input into the studies.

3.2 PROTECTIVE DEVICE TESTING, CALIBRATION TESTING, CALIBRATION AND ADJUSTMENT

- A. For breakers with multi-function electronic settings, the Low Voltage 600V equipment manufacturer may have an option to provide the services of a qualified field engineer and necessary tools and equipment to test, calibrate, and adjust the protective relays, motor protection devices, and circuit breaker trip devices as recommended in the power system coordination study.

3.3 STUDY REPORT

- A. The results of the power system study shall be summarized in a final report. Six bound copies of the final report signed and sealed with PE stamp and signature shall be submitted. The report shall include the following:
 - 1. Description, purpose, basis, criteria, scope and assumptions of the study.
 - 2. Single-line diagram drawing with short circuit data and details.
 - 3. Tabulation of all protective devices, which shall be identified on the single line diagram. Devices ratings versus calculated short circuit duties, and commentary regarding same. Device settings versus transformer inrush currents, motor starting currents and calculated short circuit currents and commentary regarding same.
 - 4. Time/current coordination, colored curves for all protective devices.
 - 5. Computerized fault current calculations and input data.
 - 6. Specific recommendations on equipment ratings, protective device settings and ratings.
 - 7. Equipment and wire input data impedances shall be clearly listed.
 - 8. Instrumentation, condition, and connections for each study
 - 9. Transformer, motor and cable damage curves.
 - 10. Equipment hazard category and labels.

3.4 RECOMMENDED CHANGES

- A. If recommended changes in breakers or fuses or protective devices will provide coordination where coordination was not originally possible, the Contractor shall incorporate these changes at no additional cost to the District. Additional protective devices recommended by this study, not shown

or specified in the Contract Documents, may be proposed, but are not part of the requirements of the Contract Documents.

3.5 FINAL STUDY REPORT

- A. After all the District's submittal comments and any setting revisions to the equipment have been incorporated, a Final Study Report (hard copy and electronic version) shall be submitted to the Engineer prior to implementation of the settings and affixing the arc flash labels on the electrical equipment..
- B. Computer disk copies of the report input and output SKM data bases shall be submitted with the final report in addition to the 4 bound copies. The SC, LF and PDEC computer program name version and phone number and address of the manufacturer shall be indicated.

3.6 LABEL IMPLEMENTATION

- A. Affix all respective arc flash labels on all electrical equipment that have been covered by the study. In addition, furnish and install the following reflective tapes:
 - 1. At 48" in front of each 480V electrical power panel, switchboard, MC, starters, disconnects etc.
 - 2. At 36" in front of each 120/208/240V electrical power panel, control panel, disconnect.
 - 3. Reflective floor warning tapes shall be 2" wide, vinyl, and self-adhesive, yellow and black slanted stripes. The tapes shall be manufactured by 3M, or equal.
 - 4. Where shown on the drawings, provide one spare 10-yard rolls of warning tapes to the District for future use.

END OF SECTION

**SECTION 16950
ELECTRICAL TESTING**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Acceptance testing of electrical system, wiring, equipment, and grounding.
- B. Related Sections:
 - 1. 16000 – Requirements for Electrical Work.

1.2 REFERENCES

- A. National Electrical Testing Association (NETA):
 - 1. ATS-1995: Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems.
- B. ANSI: Test Procedures for Electrical Equipment.
- C. ASTM: American Society for Testing and Materials.
- D. ANSI/IEEE: Recommended Practices for Testing: Machinery, Ground Impedance, Cables and Terminations.

1.3 SUBMITTALS

- A. Pre-Test Submittals:
 - 1. Testing service qualifications.
 - 2. Test personnel qualifications (resumes).
 - 3. Equipment testing schedule.
 - 4. Test data forms, custom edited for difference types of electrical equipment.
- B. Post-Test Submittals: Summary Test Report consists of the following:
 - 1. Summary of testing for the project.
 - 2. Description of the equipment tested.
 - 3. Description of the test and test procedures.
 - 4. Test results for each apparatus and motorized equipment.
 - 5. Conclusions and recommendations.
 - 6. Completed test forms, including witness's signatures.
 - 7. List of test equipment and calibration documents.
 - 8. Date and time.
 - 9. A copy of this specification section with each paragraph check marked indicating compliance or marked with explicit deviations.
- C. Submit Equipment Testing Schedule no later than 7 days prior to scheduled date of testing.

- D. Project Record Documents: Submit as specified in Section 16000. Note or indicate wiring deviations from Contract Documents on Project Record Documents.

1.4 QUALITY ASSURANCE

- A. Testing Firm Qualifications:
1. Obtain the services of an independent testing service firm that meets the Federal OSHA criteria for accreditation of testing laboratories, Title 29, Part 1910.7 and has a work history and qualifications acceptable to ENGINEER.
 2. Prequalified Testing Services and Manufacturing Firms:
 - a. General Electric Company.
 - b. Square D Company Technical Service Divisions.
 - c. Electrical Reliability Services
 - d. Siemens/Westinghouse Technical Services.
 3. Testing service or testing personnel may be accepted or rejected based upon, but not limited to, the testing equipment intended to be used, the qualifications of the firm, and personnel.
- B. Test Equipment Traceability:
1. Testing firm shall have a calibration program to maintain test instrumentation and equipment within rated accuracy, including stickers with calibration dates record.
 2. Equipment and instruments used to evaluate electrical performance shall be calibrated to a standard traceable to the National Institute of Standards and Technology.
 3. Test equipment operating instructions and procedures shall be with the test equipment.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 SAFETY AND PRECAUTIONS

- A. Testing firm shall perform tests following a safe practice in accordance with OSHA and accident prevention procedures by National Safety Council and applicable codes.
- B. Tests shall be performed with apparatus de-energized, except as necessary for equipment performance and functional test.

3.2 EXAMINATION

- A. Verify that electrical work is free from improper grounds, short circuits, and overloads.

- B. Verify correctness of wiring first by visual comparison of the conductor connections with connection diagrams.
- C. Make individual circuit continuity checks by using electrical circuit testers.
- D. Verify correctness of wiring by actual electrical operation of electrical and mechanical devices in both manual and automatic modes of operation.

3.3 IMPLEMENTATION OF POWER SYSTEMS STUDIES

- A. Prior to perform acceptance testing, the testing firm shall inspect and verify adequate short circuit rating of electrical equipment as determined by the short circuit study specified in Section 16938.
- B. The testing firm shall implement the adequate settings and calibration of protective relays, circuit breakers, fuses and other applicable protective devices as recommended in the protective devices coordination study in Section 16938.

3.4 ACCEPTANCE TESTING

- A. General Requirements:
 - 1. Perform testing and allow DISTRICT and ENGINEER to witness testing.
 - 2. Perform tests to assure that electrical equipment will operate within industry and manufacturer's published tolerances, and will perform safely. Record test result data, to be used as a baseline for future tests.
 - 3. Test motorized equipment to verify conformance with the Contract Documents and for acceptance.
 - 4. Equipment for which acceptable test data has not been submitted, or has been submitted but rejected, shall be deemed as not meeting Contract requirements.
- B. Equipment and Materials Inspection and Test Procedures. Complete test reports for each individual piece of equipment and systems:
 - 1. Switchboard Assemblies (Low Voltage):
 - a. Visual and Mechanical Inspection:
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect physical, electrical, and mechanical condition.
 - 3) Confirm correct application of manufacturer's recommended lubricants.
 - 4) Verify appropriate anchorage, required area clearances, physical damage, and correct alignment.
 - 5) Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.
 - 6) Verify that fuse and/or circuit breaker sizes and types correspond to drawings and coordination study as well as to the circuit breaker's address for microprocessor-communication packages.
 - 7) Verify that current and potential transformer ratios correspond to drawings.

- 8) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
- 9) Confirm correct operation and sequencing of electrical and mechanical interlock systems.
 - a) Attempt closure on locked-open devices. Attempt to open locked-closed devices.
 - b) Make key exchange with devices operated in off-normal positions.
- 10) Clean Switchboard.
- 11) Inspect insulators for evidence of physical damage or contaminated surfaces.
- 12) Verify correct barrier and shutter installation and operation.
- 13) Exercise all active components.
- 14) Inspect all mechanical indicating devices for correct operation.
- 15) Verify that filters are in place and/or vents are clear.
- 16) Test operation, alignment, and penetration of instrument transformer withdrawal disconnects, current-carrying and grounding.
- 17) Inspect control power transformers.
 - a) Inspect physical damage, cracked insulation, broken leads, and tightness of connections, defective wiring, and overall general condition.
 - b) Verify that primary and secondary fuse ratings or circuit breakers match drawings.
 - c) Verify correct functioning of draw out disconnecting and grounding contacts and interlocks.
- b. Electrical Tests:
 - 1) Perform tests on all instrument transformers.
 - 2) Perform ground-resistance tests.
 - 3) Perform resistance tests through ball bus joints with a low-resistance ohmmeter. Any joints that cannot be directly measured due to permanently installed insulation wrap shall be indirectly measured from closet accessible connection.
 - 4) Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground.
 - 5) Perform an over potential or megger test on each bus section, each phase-to-ground with phases not under test grounded, in accordance with manufacturer's published data.
 - 6) Perform control wiring performance test.
 - 7) Perform current injection tests on the entire current circuit in each section of switchboard.
 - 8) Determine accuracy of all meters and calibrate.
 - 9) Perform phasing check on double-ended switchboard to insure correct bus phasing from each source.
 - 10) Perform the following tests on control power transformers.
 - a) Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground.
 - b) Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to correct secondary voltage. Confirm correct potential at all devices.

- c) Verify correct function of control transfer relays located in switchgear with multiple power sources.
 - 11) Potential Transformer Circuits:
 - a) Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to correct secondary voltage. Confirm potential at all devices.
 - 12) Verify operation of switchgear/switchboard heaters.
- 2. Protective Relays: All relays installed on switchboard shall be tested regardless if the units are not indicated on the subsequent list.
 - a. Visual and Mechanical Inspection
 - 1) Compare equipment nameplate data with drawing and specifications.
 - 2) Inspect relays and cases for physical damage. Remove shipping restraint material.
 - 3) Tighten case connections. Inspect cover for correct gasket seal. Clean cover glass. Inspect shorting hardware, connection paddles, and/or knife switches. Remove any foreign material from the case. Verify target reset.
 - 4) Inspect relay for foreign material, particularly in disc slots of the damping and electromagnets. Verify disk clearance. Verify contact clearance and spring bias. Inspect spiral spring convolutions. Inspect disk and contacts for freedom of movement and correct travel. Verify tightness of mounting hardware and connections. Burnish contacts. Inspect bearings and/or pivots.
 - 5) Set relays in accordance with coordination study supplied by Waste Management.
 - b. Electrical Tests
 - 1) Perform insulation-resistance test on each circuit-to-frame. Determine from the manufacturer's instructions the allowable procedures for this test for the solid-state and microprocessor-based relays.
 - 2) Inspect targets and indicators
 - a) Determine pickup and dropout of electromechanical targets.
 - b) Verify operation of all light-emitting diode indicators.
 - c) Set contrast for liquid-crystal display readouts.
- 3. Instrument Transformers
 - a. Visual and Mechanical Inspection
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Verify correct connection of transformers with system requirements.
 - 4) Verify that adequate clearances exist between primary and secondary circuit wiring.
 - 5) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 - 6) Verify that all required grounding and shorting connections provide contact.
 - 7) Verify correct operation of transformer withdrawal mechanism and grounding operation.

- 8) Verify correct primary and secondary fuse sizes for potential transformers.
- b. Electrical Tests - Current Transformers
 - 1) Perform insulation-resistance test of the current transformer and wiring-to-ground at 1000 volts dc. Do not perform this test on solid-state devices.
 - 2) Perform a polarity test of each current transformer.
 - 3) Perform a ratio-verification test using the voltage or current method in accordance with ANSI C57.13.1 (IEEE Guide to Field Testing of Relaying Current Transformers).
 - 4) Measure current circuit burdens at transformer terminals and determine the total burden.
- c. Electrical Tests - Voltage Transformers
 - 1) Perform insulation-resistance test winding-to-winding and each winding-to-ground. Do not perform this test with solid-state devices connected.
 - 2) Perform a polarity test on each transformer to verify the polarity marks or H1-X1 relationship as applicable.
 - 3) Perform a turn's ratio test on all tap positions, if applicable.
4. Metering
 - a. Visual and Mechanical Inspection
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Verify tightness of electrical connections.
 - 4) Inspect cover gasket, cover glass, conditions of spiral spring, disc clearance, contacts, and case-shorting contacts, as applicable.
 - 5) Verify mechanically for freedom of movement, correct travel and alignment, and tightness of mounting hardware.
 - b. Electrical Tests
 - 1) Check calibration of meters at all cardinal points.
 - 2) Verify all instruments multipliers.
 - 3) Electrically confirm that current transformer and voltage transformer secondary circuits are intact.
5. Transformers
 - a. Visual and Mechanical Inspection
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Verify removal of any shipping bracing after final placement.
 - 4) Inspect impact recorder prior to unloading, if applicable.
 - 5) Verify that alarm, control, and trip settings on temperature indicators are as specified.
 - 6) Verify that cooling fans and pumps operate correctly and that fan and pump motors have correct overcurrent protection.
 - 7) Verify operation of all alarm, control, and trip circuits form temperature and level indicators, pressure relief device, and fault pressure relay.

- 8) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
- 9) Verify correct liquid level in all tanks and bushings.
- 10) Verify that positive pressure is maintained on nitrogen-blanketed transformers.
- 11) Perform specific inspections and mechanical tests as recommended by manufacturer.
- 12) Verify correct equipment grounding.
- b. Electrical Tests
 - 1) Perform insulation-resistance tests, winding-to-winding and each winding-to-ground with test voltage. Test duration shall be for ten minutes with resistances tabulated at thirty seconds, one minute, and ten minutes. Calculate polarization index.
 - 2) Perform a turns-ratio test on all no-load tap-changer positions and all load tap-changer positions. Verify that tap setting is as specified. Verify that winding polarities are in accordance with nameplate.
 - 3) Measure resistance of each high-voltage winding in each no-load tap-changer positions. Measure resistance of each low-voltage winding in each load tap-changer position, if applicable.
 - 4) If core ground strap is accessible, measure core insulation resistance at 500 volts dc.
- c. Test Values
 - 1) Bolt-torque levels shall be in accordance with data by manufacturer.
 - 2) Insulation-resistance test values.
 - 3) The polarization index should be compared to manufacturer's factory test results. If manufacturer's data is not available, acceptance test results will serve as baseline data.
 - 4) Turns-ratio test results shall not deviate more than one-half percent from either the adjacent coils or the calculated ratio.
 - 5) Consult manufacturer if winding-resistance measurements vary more than one percent from adjacent windings.
 - 6) Consult manufacturer if core insulation is less than one megohm at 500 volts dc.
6. Low-Voltage Power Circuit Breakers where shown on the drawings.
 - a. Visual and Mechanical Inspection
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Confirm correct application of manufacturer's recommended lubricants.
 - 4) Inspect anchorage, alignment, and grounding. Inspect arc chutes. Inspect moving and stationary contacts for condition, wear, and alignment.
 - 5) Verify that all maintenance devices are available for servicing and operating the breaker.
 - 6) Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.
 - 7) Perform all mechanical operator and contact alignment tests on both the breaker and its operating mechanism.

- 8) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Refer to manufacturer's instructions.
- 9) Check cell fit and element alignment.
- 10) Check racking mechanism.
- b. Electrical Tests
 - 1) Perform a contact-resistance test.
 - 2) Perform an insulation-resistance test at 1000 volts dc from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase.
 - 3) Make adjustments for the final settings in accordance with the coordination study supplied by Waste Management.
 - 4) Determine minimum pickup current by primary current injection.
 - 5) Determine long-time delay by primary current injection.
 - 6) Determine short-time pickup and delay by primary current injection.
 - 7) Determine ground-fault pickup and delay by primary current injection.
 - 8) Determine instantaneous pickup value by primary current injection.
 - 9) Activate auxiliary protective devices, such as ground-fault or under voltage relays, to insure operation of shunt trip devices. Check the operation of electrically-operated breakers in their cubicles.
 - 10) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free and anti-pump function.
 - 11) Check charging mechanism.
- c. Test Values
 - 1) Bolt-torque levels shall be in accordance with data specified by manufacturer.
 - 2) Compare microhm or millivolt drop values to adjacent poles and similar breakers. Investigate deviations of more than 25 percent.
 - 3) Insulation resistance shall not be less than 100 megohms. Investigate values less than 100 megohms.
 - 4) Trip characteristics of breakers shall fall within manufacturer's published time-current tolerance bands.
7. Motor Control Centers, Motor Controllers and Motor Starters: Low Voltage
 - a. Visual and Mechanical Inspection
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 - b. Electrical Tests
 - 1) Insulation Tests
 - a) Measure insulation-resistance of each combination starter, phase-to-phase and phase-to-ground, with the starter contacts closed and the protective device open. Test voltage shall be in accordance with manufacturer's instructions for devices with solid-state components.
 - b) Test the motor overload relay elements by injecting primary current through the overload circuit and monitoring trip time of the overload element.

Note: Test times for thermal trip units will, in general, be longer than manufacturer's curve if single-pole testing is performed. Optionally test with all poles in series for time test and each pole separately for comparison. (Refer to NEMA ICS 2-1993, Part 4.)

- c. Test Values
 - 1) Bolt-torque levels shall be in accordance with data specified by manufacturer.
 - 2) Insulation-resistance values.
 - 3) Overload trip times shall be in accordance with manufacturer's published data.
- d. Motor Control Center Bus
 - 1) See section switchgear assemblies for inspection and tests of MCC bus.
- 8. Circuit Breakers: Low-Voltage Molded Case - 100 Amp or Larger Only
 - a. Visual and Mechanical Inspection
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect circuit breaker for correct mounting.
 - 3) Operate circuit breaker to insure smooth operation.
 - 4) Inspect case for cracks or other defects.
 - 5) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 - b. Electrical Tests
 - 1) Perform a contact-resistance test.
 - 2) Perform an insulation-resistance test at 1000 volts dc from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase.
 - 3) Perform adjustments for the final settings in accordance with the coordination study.
 - 4) Perform long-time delay time-current characteristics tests by passing 300 percent through each pole separately unless series testing is required to defeat ground fault functions.
 - 5) Determine short-time pickup and delay by primary current injection.
 - 6) Determine ground-fault pickup and time delay by primary current injection.
 - 7) Determine instantaneous pickup current by primary injection using run-up or pulse method.
 - 8) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and anti-pump function.
 - c. Test Values
 - 1) Bolt-torque levels shall be in accordance with data specified by manufacturer.
 - 2) Compare microhm or millivolt drop values to adjacent poles and similar breakers. Investigate deviations of more than 25 percent. Investigate any value exceeding manufacturer's recommendations.
 - 3) Insulation resistance shall not be less than 100 megohms.
 - 4) Trip characteristics of breakers shall fall within manufacturer's published time-current tolerance bands, including adjustment factors.

9. Rotating Machinery: AC Motors
 - a. Visual and Mechanical Inspection
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Inspect for correct anchorage, mounting, grounding, connection, and lubrication.
 - 4) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 - 5) When applicable, perform special tests such as air gap spacing and pedestal alignment.
 - 6) Verify the absence of unusual mechanical or electrical noise or signs of overheating during initial test run.
 - b. Electrical Tests: Induction Motors
 - 1) Perform insulation-resistance tests in accordance with ANSI/IEEE Standard 43.
 - a) Motors larger than 200 horsepower: Test duration shall be for ten minutes. Calculate polarization index.
 - b) Motors 200 horsepower and less: Test duration shall be for one minute. Calculate the dielectric-absorption ratio.
 - 2) Test motor starter in accordance with Section 7.16 of these specifications.
 - 3) Verify that resistance temperature detector (RTD) circuits conform to drawings. Verify that metering or relaying devices using the RTD's have the correct rating.
 - 4) Verify that the motor space heater is functional.
 - 5) Perform a rotation test to insure correct shaft direction.
 - 6) Measure running current and evaluate relative to load conditions and nameplate full-load amperes.
10. Capacitors where shown on the drawings:
 - a. Visual and Mechanical Inspection
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Inspect capacitors for correct mountings and required clearances.
 - 4) Verify that capacitors are electrically connected in their specified configuration.
11. Low-Voltage Surge Protection Devices where shown on the drawings:
 - a. Visual and Mechanical Inspection
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Inspect for correct mounting and adequate clearances.
 - 4) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 - 5) Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

12. Dry Type Transformers
 - a. Air-Cooled, 600 Volt and Below (167kVA Single-Phase, 500 kVA Three-Phase and Smaller)
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Verify that resilient mounts are free and that any shipping brackets have been removed.
 - 4) Perform insulation-resistance test. Calculate polarization index. Measurements shall be made from winding-to-winding and each winding-to-ground. Test voltages and minimum resistance.
 - 5) Verify that winding turns-ratio measurements and polarities are in accordance with nameplate.
 - 6) Verify that as-left tap connections are as specified.
13. Grounding Systems
 - a. Visual and Mechanical Inspection
 - 1) Verify ground system is in compliance with drawings and specifications.
 - b. Electrical Tests
 - 1) Perform fall-of-potential test or alternative in accordance with IEEE Standard 81-1991 on the main grounding electrode or system.
 - 2) Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
 - c. Test Values
 - 1) The resistance between the main grounding electrode and ground should be no greater than five ohms for commercial or industrial systems and one ohm or less for generating grounds unless otherwise specified.
 - 2) Investigate point-to-point resistance values which exceed 0.5 ohm.
14. Ground-Fault Protection Systems
 - a. Visual and Mechanical Inspection
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Visually inspect the components for damage and errors in polarity or conductor routing.
 - 3) Verify tightness of all electrical connections including control circuits.
 - 4) Verify correct operation of all functions of the self-test panel.
 - 5) Verify that the control power transformer has adequate capacity for the system.
 - 6) Set pickup and time-delay settings in accordance with the settings provided in the coordination study. Record appropriate operation and test sequences as required by NEC Article 230-95.
 - b. Electrical Tests
 - 1) Verify that relay does not operate at 90 percent of the pickup setting.
15. Low-Voltage Cables: 600 Volt
 - a. Visual and Mechanical Inspection
 - 1) Compare cable data with drawings and specifications.
 - 2) Inspect exposed sections of cables for physical damage and correct connection in accordance with single-line diagram.

- 3) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
- 4) Inspect compression-applied connectors for correct cable match and indentation.
- 5) Verify cable color coding with applicable engineer's specifications and National Electrical Code standards.
- b. Electrical Tests
 - 1) Perform an insulation resistance test on all cables.
16. Systems Function Tests
 - a. Perform system function tests upon completion of equipment tests. It is the purpose of system function tests to prove the correct interaction of all sensing, processing, and action devices.
 - b. Develop test parameters for the purpose of evaluating performance of all integral components and their functioning as a complete unit within design requirements. Perform these tests.
 - c. Verify the correct operation of all interlock safety devices for fail-safe functions in addition to design function.
 - d. Verify the correct operation of all sensing devices, alarms, and indicating devices.

3.5 SUMMARY TEST REPORT

- A. Upon completion of testing of all electrical equipment, submit summary test report in a 3-ring binder with proper tabs and table of contents for review and approval.

END OF SECTION

SECTION 16955 - LOW-VOLTAGE AUTOMATIC TRANSFER SWITCHES

PART 1 GENERAL

1.1 SCOPE

- A. The Contractor shall furnish and install wall-mounted, indoor type low-voltage (600 volts and below) 100AA 480V three-phase, 3-pole, automatic transfer switch (ATS) function having the ratings, features/accessories and enclosures as specified herein. It shall be installed in a common NEMA 3RX auxiliary enclosure as detailed on the drawings.

1.2 RELATED SECTIONS

- A. Section 16000 – Electrical Requirements

1.3 REFERENCES

- A. The automatic transfer switches and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of UL and NEMA as follows:
 - 1. UL 50 -- Cabinets and Boxes
 - 2. UL 489 -- Molded Case Circuit Breakers
 - 3. UL 508 -- Industrial Control Systems
 - 4. UL 1008 -- Transfer Switches
 - 5. UL 1087 -- Molded Case Switches
 - 6. NEMA ICS -- Industrial Controls and Systems.

1.4 SUBMITTALS -- FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the ENGINEER:
 - 1. Master drawing index
 - 2. Dimensioned outline drawing
 - 3. Schematic diagram and theory of operation
 - 4. Component list
 - 5. Conduit entry/exit locations

6. Assembly ratings including:

- a. Short-circuit rating
- b. Voltage
- c. Continuous current.

1.5 REGULATORY REQUIREMENTS

- A. A certificate of compliance with UL 1008 must be submitted for the transfer switches to be supplied. The certificate is not required if the manufacturer's published data submitted and approved reflect a UL 1008 listing. Proof of UL 1008 listing does not, however, relieve the Contractor of compliance with other provisions of this specification.

1.6 DELIVERY, STORAGE AND HANDLING

- A. The automatic transfer switches shall be delivered to the job site suitably protected against the environmental conditions and with space heaters wired for temporary connection to prevent condensation while in storage.

1.7 OPERATION AND MAINTENANCE MANUALS

- A. Submit in accordance with the requirements of the Special Provisions, copies of the equipment and maintenance manuals shall be provided.
- B. Operation and maintenance manuals shall include the following information:
 - 1. Instruction books and/or leaflets
 - 2. Recommended renewal parts list
 - 3. Drawings and information required by section 1.4.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. The automatic transfer switch shall be the product of ASCO 7000 Series, General Electric, Kohler, or equal.

2.2 RATINGS

- A. The transfer switch shall have withstand, closing and interrupting ratings of 42,000 amperes minimum. Continuous Ampere rating shall be 100A 480V three-phase, three-pole as shown on the drawings.

- B. The voltage rating of the transfer switch shall be no less than the system voltage rating. The continuous current rating of the transfer switch shall be no less than the maximum continuous current requirements of the system.
- C. The transfer switch shall be 100% equipment rated for continuous duty as shown on the drawings and shall conform to the applicable requirements of UL 1008 for emergency system total load.
- D. All pilot devices and relays shall be of the industrial type with self-cleaning contacts and rated 10-amperes.
- E. The automatic transfer switches shall be fully rated to protect all types of loads, inductive and resistive, from loss of continuity of power, without derating, either open or enclosed.
- F. Transfer switches shall have a minimum 60-cycle withstand rating of 42 kA. The transfer switch shall be rated for application with upstream power circuit breakers and insulated case circuit breakers having short-time delay settings of up to 30 cycles. Contacts shall not weld when used with upstream overcurrent protective devices that do not incorporate instantaneous trip units.

2.3 CONSTRUCTION

- A. The transfer switches shall consist of completely enclosed contact assemblies and a separate control logic panel. The contact assemblies shall be operated by a non-fused motor operator or stored energy mechanism and be energized only momentarily during transfer, providing inherently double throw switching action. Control power for all transfer operations shall be derived from the line side of the source to which the load is being transferred.
- B. Transfer switches shall be capable of being operated manually or automatically under full load conditions. Manual operation shall be accomplished via a permanently affixed manual operator or integrally mounted pushbutton operators located on the face of the contact assemblies. Removable manual operating handles and handles which move in the event that electrical operators should suddenly become energized while performing a manual transfer operation are not acceptable. The manual operator shall provide the same contact-to-contact transfer time as provided under normal automatic operation to prevent possible flashovers from switching the main contacts slowly. In addition, provisions shall be made to allow disengagement of the electrical operator during manual operation.
- C. Each transfer switch shall be positively interlocked both mechanically and electrically to prevent simultaneous closing of both sources under either automatic or manual operation. Main contacts shall be mechanically locked in position in both normal and emergency positions. A neutral position shall not be possible under normal electrical operation unless a delayed transition accessory is required for switching highly inductive loads. Each transfer switch shall have a manual neutral position for load circuit maintenance. A transfer switch position indicator shall be visible from the front of the switch to show to which source the transfer switch is connected.

- D. Inspection and replacement of all separate arcing contacts (moving and stationary) shall be possible from the front of the transfer switch.
- E. An electronic sensing and control logic panel shall be separately mounted from the power switching portion of the transfer switch. The two sections shall be connected by control cables with plug-in connectors. The control section shall be capable of being disconnected from the power section for maintenance purposes.
- F. The logic circuit shall utilize electronic components mounted on printed circuit boards to accomplish functions such as timing, time delays, and voltage and frequency monitoring. LEDs shall be furnished to indicate the operation of each solid-state function. Modifications shall be available for field installation without voiding the UL label.
- G. The transfer switch shall be equipped with a voltage selection plug making it suitable for operation on standard voltages from 208 through 600 volts AC, 50 or 60 hertz, by placing the voltage selection plug in the proper voltage receptacle.
- H. Provide an energy meter for the normal source. The meter shall be Electro Industries model MMS or equal.

2.4 WIRING/TERMINATIONS

- A. Terminal blocks shall conform to NEMA ICS 4. Terminal facilities shall be arranged for entrance of external conductors from the top or bottom of the enclosure. The main transfer switch terminals shall be suitable for the termination of conductors shown on the plans.

2.5 SEQUENCE OF OPERATION

- A. The transfer switch shall automatically transfer its load circuit to a standby power supply upon failure of its normal or preferred source.
- B. Upon loss of phase-to-phase voltage of the normal source to 80% of nominal, and after a time delay, adjustable from 0.5 to 15 seconds, to override momentary dips and/or outages, a 10-ampere, 30-Vdc contact shall close to initiate starting of the emergency or standby source power plant. Transfer to the alternate source shall take place immediately upon attainment of 90% of rated voltage and frequency of that source. For switches not involving engine generator sets as power plants, transfer shall occur after an adjustable time delay of 1 to 60 seconds to override momentary dips and outages.
- C. When the normal source has been restored to 90% of rated voltage, and after a time delay, adjustable from 0.5 to 32 minutes (to ensure the integrity of the normal power source), the load shall be automatically retransferred to the normal source. The transfer switch shall also have the capability to be programmed in such a manner that the re-transfer can also be done manually.
- D. A time delay, adjustable from 0.5 to 32 minutes, shall delay shutdown of the emergency or standby power source after retransfer to allow the generator to run

unloaded for cool-down, after which the generator shall be automatically shut down.

- E. If the emergency or standby power should fail while carrying the load, transfer to the normal power supply shall be made instantaneously upon restoration of the normal source to satisfactory conditions.

2.6 ENCLOSURE

- A. The transfer switch shall be installed in a NEMA 1 enclosure.

2.7 ACCESSORIES

- A. The following logic and options shall be supplied:

1. The logic of the transfer switch shall function via a microprocessor. The set points shall be field adjustable without the use of special tools. The switch shall have a multi-tap voltage selection plug for ease of voltage adjustment in the field. LED lights shall be included on the exterior of the switch to show:

Normal	Source	Available
Emergency	Source	Available
Normal	Source	Connected
Emergency	Source	Connected
Load Energized.		

- B. A digital readout shall display each option as it is functioning. Readouts shall display actual line-to-line voltage, line frequency and timers. When timers are functioning, the microprocessor shall display the timer counting down. All set points can be re-programmed from the front of the switch when the switch is in the program mode. A test pushbutton shall be included as part of the microprocessor. The switch shall include the following:

- a. Provide a time delay transfer from the normal power source to the emergency power source (0 seconds to 30 minutes). This option does not effect the engine start circuit.
- b. Provide a timer to override a momentary power outage or voltage fluctuation (0 seconds to 120 seconds).
- c. Provide a time delay transfer from the emergency power source to the normal power source (0 seconds to 30 minutes).
- d. Provide a timer to allow the generator to run unloaded after re-transfer to the normal power supply (1 second to 30 minutes).
- e. Provide single-phase under voltage and under frequency sensing on the emergency power source. Voltage shall be factory set at 90%

pickup and 80% dropout. Frequency sensing shall be set at 58-hertz pickup and 56-hertz dropout.

- f. Provide a pilot light to indicate that the switch is in the normal position as an integral part of the microprocessor.
- g. Provide a pilot light to indicate that the switch is in the emergency position as an integral part of the microprocessor.
- h. Provide a pilot light to indicate that the normal power is available as an integral part of the microprocessor.
- i. Provide a pilot light to indicate that the emergency power is available as an integral part of the microprocessor.
- j. Provide auxiliary relay contacts that are energized when the power is available on the normal source.
- k. Provide auxiliary relay contacts that are energized when the power is available on the emergency source.
- l. Provide double lugs on the load side for connections to loads.

C. The following features shall be provided:

- 1. Time delay normal to emergency, adjustable.
- 2. Time delay emergency to normal, adjustable.
- 3. Green pilot light to indicate switch in normal position and red pilot light to indicate switch in emergency position.
- 4. White pilot lights marked "Normal Source" and "Emergency Source" to indicate that respective source voltages are available.
- 5. Tripped position indicating lights for both sources.
- 6. Relay auxiliary contacts (2 NO and 2 NC) to indicate transfer switch position and the availability of each source.

D. The following features shall also be provided:

- 1. Time delay engine start, adjustable.
- 2. Time delay engine cool off, adjustable.
- 3. Engine start dry contact.
- 4. Loadbank dump dry contact

5. Frequency/voltage relay for emergency source, frequency adjustable from 45 to 60 Hz and voltage fixed at 90 percent pickup, 70 percent dropout.
 6. Delayed transition time delay, adjustable from 0 to 120 seconds, to allow disconnection of the load during transfer in either direction to prevent excessive inrush currents due to out-of-phase switching of large inductive loads.
 7. Four-position selector switch permitting four (4) modes of transfer switch operation: TEST (simulates normal power outage), AUTO (standard automatic operation), OFF (de-energizes control relays and opens the engine start circuit for maintenance purposes), ENGINE START (retains transfer switch in normal position and initiates a testing of the engine start circuit). Furnish white pilot light for OFF indication.
- E. A transfer switch position indicator shall be visible from the front of the switch.
- F. Provide pump station exerciser (selectable load, no-load transfer). The exerciser will be 7 day selectable for any duration for any day during the week.
- G. Provide a serial (Modbus RTU) with RS-485 communication port for future use.

PART 3 EXECUTION

3.1 EXAMINATION

Check for shipping materials and remove them before installation. Observe for any damage on the enclosure.

3.2 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.
1. Insulation check to ensure the integrity of insulation and continuity of the entire system.
 2. Visual inspection to ensure that the switch matches the specification requirements and to verify that the fit and finish meet quality standards.
 3. Mechanical tests to verify that the switch's power sections are free of mechanical hindrances.
 4. Electrical tests to verify the complete electrical operation of the switch and to set up time delays and voltage sensing settings of the logic.
- B. The manufacturer shall provide three (3) certified copies of factory test reports.

3.3 INSTALLATION

- A. The Contractor shall install all equipment per the manufacturer's recommendations and the Contract Drawings. Contractor shall have a service of the ATS manufacturer field engineer to supervise the installation of the ATS. This field work shall be one day minimum in addition to required field startup and training.

3.4 FIELD ADJUSTMENTS

- A. The Contractor shall field adjust all timing and voltage settings of the transfer switch as necessary for proper operation of the unit.

3.5 FIELD TESTING

- A. Demonstrate satisfactory operations of the installed unit to the Engineer for acceptance. Make sure to have the transfer switch programmed in such a manner that re-transfer functions shall be manually initiated by the District attending staff.

3.6 TRAINING

- A. Provide one 1-hr classroom training session and one 2-hr onsite training session to the District's electrical personnel. (Travel time not included)

END OF SECTION

APPENDIX A

Geotechnical Investigation Report



January 12, 2016
File: 2213.002altr.doc

Carollo Engineers, Inc.
2700 Ygnacio Valley Road, Suite 300
Walnut Creek, CA 94598

Attn: Ms. Jill Shankel

Re: Geotechnical Investigation Report
Sausalito-Marín City Sanitary District
Highway Booster Pump Station Improvements Project
Sausalito, California

Introduction

This letter summarizes our geotechnical investigation for the planned Sausalito-Marín City Sanitary District's Highway Booster Pump Station improvements project located in Sausalito, California. The project location is shown on Figure 1.

The purpose of our investigation is to evaluate subsurface conditions in order to provide recommendations for the design and construction of the project. Our work was performed in general accordance with our Agreement dated October 30, 2015. Our scope includes review of a technical memorandum by DCM Consulting, exploring subsurface conditions with two exploratory boreholes, laboratory testing of select samples, evaluating field and laboratory data, and summarizing our geotechnical investigation in this letter report.

Project Description

The project generally consists of rehabilitating the existing pump station adjacent to and on the south side of Highway 101 approximately 450-feet east of the Buckeye Roadhouse. Planned improvements include converting an existing 18-foot deep dry well to a wet well, constructing a new concrete pad and low retaining wall for a standby generator, new pumps and electrical/mechanical equipment, and new shallow pipelines requiring trenching up to about 5-feet in depth. Existing site conditions are shown on the Site Plan, Figure 2.

Regional Geology

The site is located within the Coast Ranges Geomorphic Province of California. The regional topography is characterized by northwest-southeast trending mountain ridges and intervening valleys that were formed by tectonic interaction between the North American and the Pacific Plates. Regional geologic mapping indicates the site is underlain by colluvial soil deposits over Franciscan Melange bedrock. Colluvium consists of unconsolidated soil and rock fragments deposited by gravity and slope wash processes. Franciscan Melange is highly variable bedrock consisting of large masses of resistant rock types including sandstone, greenstone, chert and

other rocks embedded in a matrix of highly sheared material. A regional geologic map is shown on Figure 3.

The closest known active fault is the San Andreas Fault, located approximately 9.9 kilometers west of the project site. Earthquakes along any of several active faults in the region, as shown on Figure 4, could cause moderate to strong ground shaking at the site.

Field Exploration and Laboratory Testing

On December 18, 2015 we explored subsurface conditions by excavating two test borings using track-mounted equipment at the locations shown on Figure 2. Our Staff Geologist logged the soils encountered in general accordance with ASTM Standard D 2487, "Field Identification and Description of Soils (Visual-Manual Procedure)." This standard is briefly explained on Figures A-1 and A-2 (Soil and Rock Classification Charts). The boring logs are presented on Figures A-3 and A-4.

Laboratory testing of relatively "undisturbed" samples from the exploratory borings included moisture content, dry density, and percent passing the #200 sieve. Laboratory test results are presented on the boring logs and the laboratory testing program is described in further detail in Appendix A.

Subsurface Conditions

Boring 1, drilled on the northwest side of the pump station, adjacent to the base of the hillside, encountered fill deposits consisting of approximately 2.5-feet of medium dense clayey sand with gravel underlain by approximately 6.5-feet of friable, weathered and pervasively sheared sandstone bedrock. Boring 1 was terminated at a depth of 9.5-feet.

Boring 2 was drilled adjacent to the southwest side of the existing dry well. We encountered approximately 4-feet of clayey sand fill over approximately 6.5-feet of hard, strong shale bedrock. Boring 2 was terminated at a depth of 10.5-feet. Boring 2 had to be moved from a location on the east side of the dry well where drilling refusal occurred three times at a depth of 3.5-feet on hard material that may be concrete or concrete rubble within the fill.

During drilling, groundwater was not observed in either boring. Since the borings were not left open for an extended period of time after drilling was completed, a stabilized depth to groundwater was likely not observed. However, we anticipate that shallow groundwater will be present throughout the winter and spring months or following heavy rain, with perched groundwater levels occurring near the bedrock surface.

Foundation and Retaining Wall Design

Based on our subsurface exploration, we judge that concrete slab-on-grade foundations are suitable for the new planned at-grade generator pad. Concrete slabs should be a minimum of 5-inches thick and be reinforced with steel rebar, not wire mesh. Slab thickness could be increased to 6- or 8-inches if heavy loads are anticipated. New slabs should be underlain with a minimum of 4-inches of clean, free-draining $\frac{3}{4}$ crushed drain rock or Class II aggregate base

compacted to at least 90% relative compaction. The project Civil Engineer should design the concrete slab floors for an allowable bearing pressure of 750 psf.

An approximately 2-foot tall retaining wall will be required along the upslope side of the new generator pad. The low retaining wall can be designed using an unrestrained equivalent fluid pressure of 50 pcf. Lateral support can be obtained from frictional sliding resistance of the attached generator pad slab using a coefficient of friction of 0.35.

Dry Well Moisture Intrusion

We understand the dry well is currently experiencing moisture intrusion along a shallow joint between sections of pre-cast concrete. The cause of the seepage appears to be shallow groundwater and a poor seal between sections of pipe. We understand that grouting of the soils is being considered to mitigate the moisture intrusion at the joint. In our opinion, given the clayey sands encountered during our exploration, either polyurethane grouting or low pressure permeation grouting can be utilized to address the seepage.

Excavation Conditions

Based on the results of our exploration, excavations for the project will likely encounter medium dense clayey sand fill over variable strength sandstone and shale bedrock. Given the proposed depths of excavations, groundwater should be anticipated in excavations at the project site if construction is performed in winter or spring months. The rate of groundwater infiltration will be dependent on material permeabilities, but we anticipate dewatering may be required in the sewer line excavations to maintain dry working conditions. We recommend the use of pumps to control groundwater seepage into excavations. Significant groundwater seepage can cause instability of excavations.

The California Division of Occupational Safety and Health, better known as Cal/OSHA, has promulgated rules for excavations. Cal/OSHA dictates allowable slope configurations and minimum shoring requirements based on categorized soil types. In conformance with Cal/OSHA's categorization, the medium dense fill soils and bedrock would classify as "Type B" soils. The Contractor should implement a shoring system during construction to prevent potential instability of the sides of the excavations. Many shoring systems are available, and the selected system should be capable of providing immediate support to the sides of excavations as to minimize the time in which vertical cuts are left unsupported. Excavations having a depth of five feet or more which will be entered by workers must be sloped, braced, or shored in accordance with current Cal/OSHA regulations.

Supplemental Services

During construction, we should observe and test the trench backfill to confirm that the contractor meets the intent of the minimum backfill compaction criteria and to confirm subsurface conditions are as expected.

January 12, 2016

Please do not hesitate to call should there be any questions or if we can be of further assistance.

Yours very truly,
MILLER PACIFIC ENGINEERING GROUP

DRAFT

Eric Dabanian
Geotechnical Engineer No. 2526
(Expires 6/30/17)

Attachments: Figures 1 through 4;
Appendix A: Subsurface Exploration and Lab Testing, Figures A-1 through A-4;

APPENDIX A SUBSURFACE EXPLORATION AND LABORATORY TESTING

1.0 Subsurface Exploration

We explored subsurface conditions at the sites by drilling 2 test borings on December 18, 2015 at the locations shown on Figure 2. Borings were drilled to depths between 9.5 and 10.5 feet using track-mounted equipment equipped with 4-inch diameter solid stem augers.

The soils encountered were logged and identified by our engineer in general accordance with ASTM Standard D 2487, "Field Identification and Description of Soils (Visual-Manual Procedure)." This standard is briefly explained on Figure A-1, Soil Classification Chart and Key to Log Symbols. A Rock Classification Chart is presented on Figure A-2, and the boring logs are presented on Figures A-3 and A-4.

We obtained relatively undisturbed samples using a 2.5-inch diameter, split-barrel California sampler with 2 by 6-inch brass tube liners. The sampler was driven with a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler 18 inches was recorded and is reported on the boring logs as blows per foot for the last 12 inches of driving. The samples obtained were examined in the field, sealed to prevent moisture loss, and transported to our laboratory. Depths to groundwater were measured during drilling.

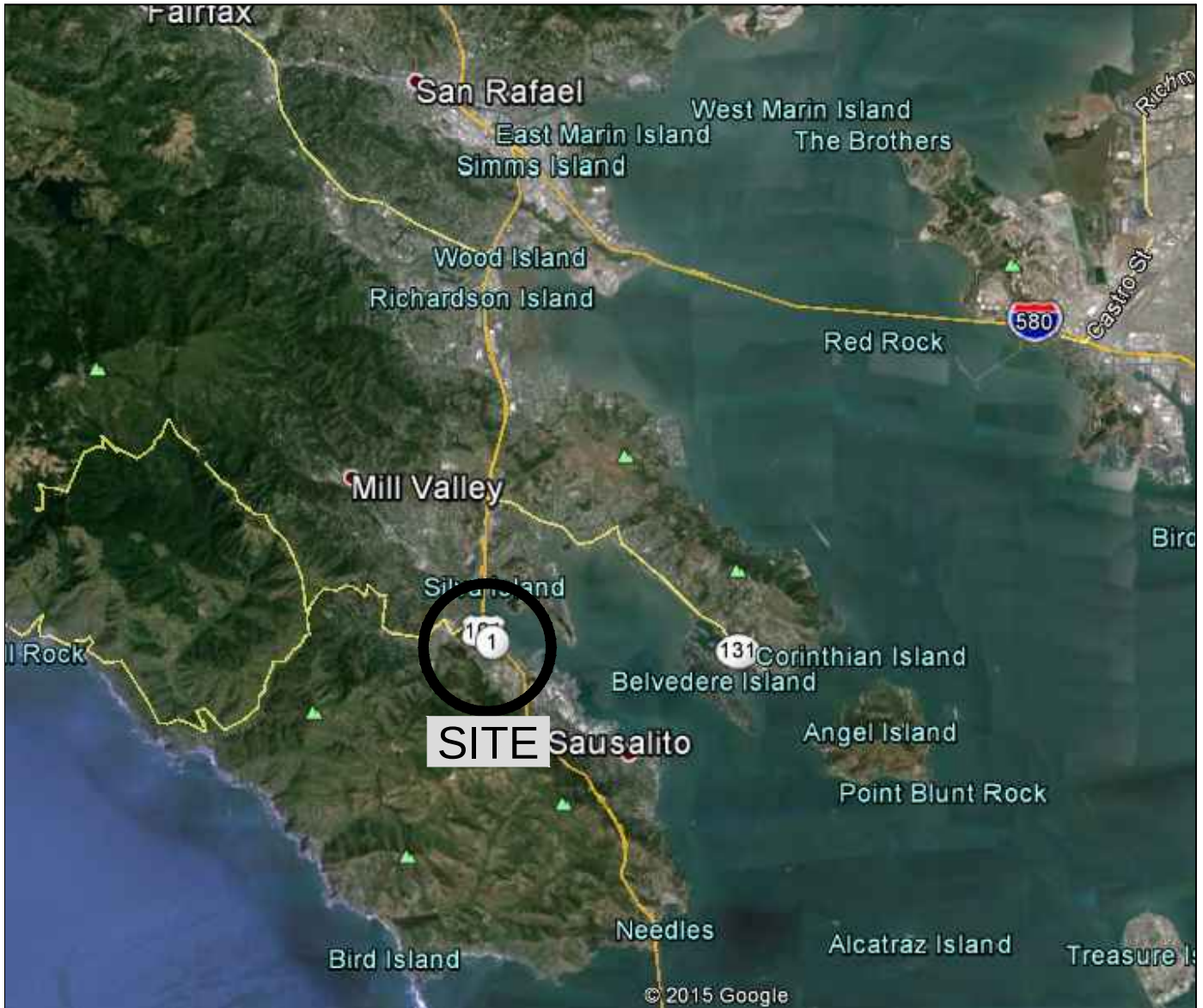
2.0 Laboratory Testing

We re-examined samples obtained from the test borings in the laboratory to confirm field classification and suitability for testing.

We conducted the following laboratory tests on selected intact samples. The laboratory tests were conducted in accordance with the ASTM standard test method cited:

- Laboratory Determination of Water (Moisture Content) of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D 2216;
- Density of Soil in Place by the Drive-Cylinder Method, ASTM D 2937; and
- Amount of Material in Soils Finer than No. 200 (75- μ m) Sieve, ASTM D 1140;

The laboratory test results are shown on the exploratory boring logs, Figures A-3 and A-4. The test borings, description of soils encountered and the laboratory test data reflect conditions only at the location of the boring or sampling at the time they were excavated or retrieved. Conditions may differ at other locations and may change with the passage of time due to a variety of causes



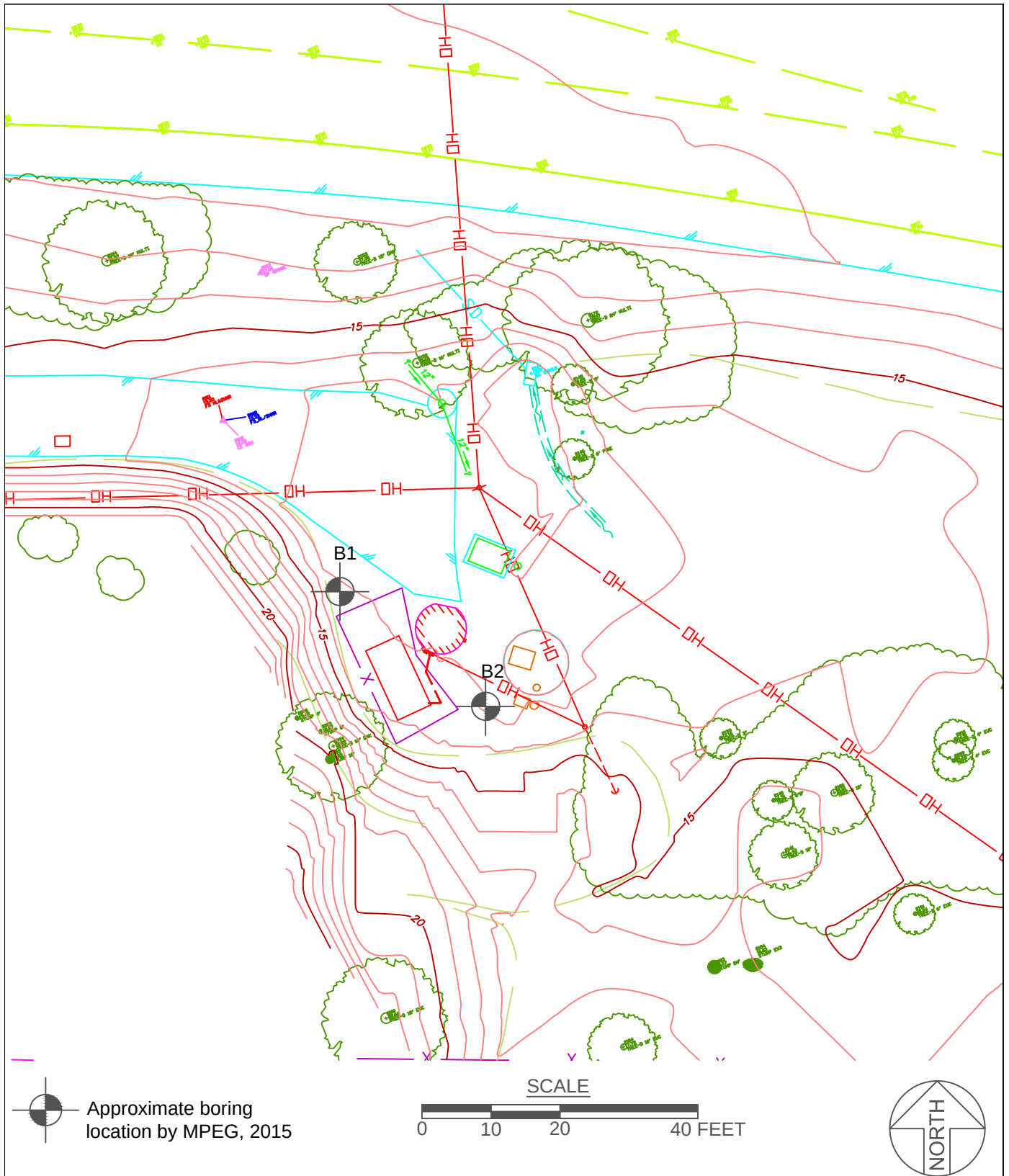
SITE: LATITUDE, 37.8781°
LONGITUDE, -122.5148°

SITE LOCATION
N.T.S.



REFERENCE: Google Earth, 2015

Miller Pacific ENGINEERING GROUP A CALIFORNIA CORPORATION, © 2012, ALL RIGHTS RESERVED FILE: 2213.002 SLM.dwg	504 Redwood Blvd. Suite 220 Novato, CA 94947 T 415 / 382-3444 F 415 / 382-3450 www.millerpac.com	SITE LOCATION MAP Highway Booster Pump Station Carollo-SMCSD Sausalito, California Project No. 2213.002 Date: 12/21/2015	Drawn <u>PMR</u> Checked	1 FIGURE



Reference provided by: LCC Engineering and Surveying, 2015

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SITE PLAN

Highway Booster Pump Station
Carollo-SMCSD
Sausalito, California

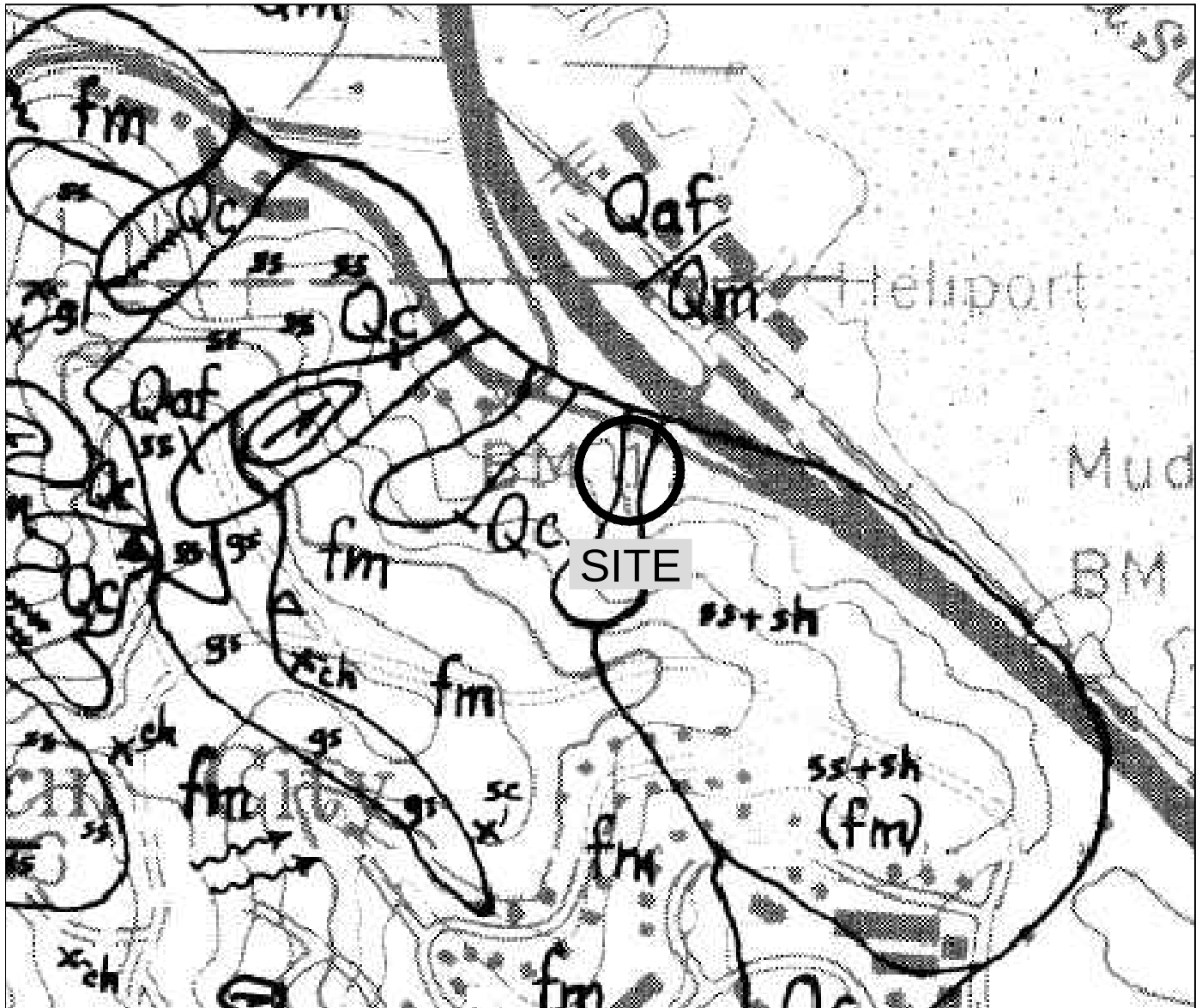
Project No. 2213.002

Date: 12/22/2015

Drawn PMR
Checked



2
FIGURE



LEGEND



Qaf: Quaternary artificial fill- Deposits of rock and soil placed by man

Qm: Bay mud- Marshlands, former marshlands, and mudflats bordering San Francisco Bay.

Qc: Quaternary colluvium- Unconsolidated and unsorted soil and rock fragments deposited by means of gravitational or slope wash processes

fm: Franciscan Melange- A tectonic mixture of small to large masses of resistant rock types including sandstone, greenstone, chert and serpentine, embedded in a matrix or pervasively sheared rock material

ss+sh: Sandstone and Shale- Graywacke-type sandstone with or without small amounts of shale

REFERENCE: Rice, S.J., Strand, R.G., and Smith, T.C., "Geology of the Eastern Part of the San Rafael Area, Marin County, California" in Geology for Planning in Central and Southeastern Marin County, California, California Department of Conservation, Division of Mines and Geology Open-File Report 76-2 S.F., Plate 1C, Map Scale 1:12,000

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REGIONAL GEOLOGY MAP

Highway Booster Pump Station
Carollo-SMCS
Sausalito, California

Project No. 2213.002

Date: 12/21/2015

Drawn PMR
Checked

3
FIGURE



SITE COORDINATES: LAT. 37.8771, LON. -122.5148

LEGEND

(COLOR INDICATES AGE OF MOST RECENT KNOWN MOVEMENT)

— HISTORIC (<150 YEARS)

— HOLOCENE (<11,000 YEARS)

— LATE QUATERNARY (<1.0M YEARS)

32% PROBABILITY OF AT LEAST ONE M>6.7 EARTHQUAKE BETWEEN 2015 AND 2045 FOR FAULTS SHOWN



DATA SOURCE:

1) Working Group on California Earthquake Probabilities (WGCEP)(2014), "Long-Term Time-Dependent Probabilities for the Third Uniform California Earthquake Rupture Forecast (UCERF3), Bulletin of the Seismological Society of America (BSSA), Volume 105, No. 2A, 33pp, April 2015.

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ACTIVE FAULT MAP

Highway Booster Pump Station
Carollo-SMCSD
Sausalito, California

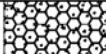
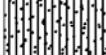
Project No. 2213.002

Date: 12/21/2015

Drawn PMR
Checked

4

FIGURE

MAJOR DIVISIONS		SYMBOL	DESCRIPTION	
COARSE GRAINED SOILS over 50% sand and gravel	CLEAN GRAVEL	GW		Well-graded gravels or gravel-sand mixtures, little or no fines
		GP		Poorly-graded gravels or gravel-sand mixtures, little or no fines
	GRAVEL with fines	GM		Silty gravels, gravel-sand-silt mixtures
		GC		Clayey gravels, gravel-sand-clay mixtures
	CLEAN SAND	SW		Well-graded sands or gravelly sands, little or no fines
		SP		Poorly-graded sands or gravelly sands, little or no fines
	SAND with fines	SM		Silty sands, sand-silt mixtures
		SC		Clayey sands, sand-clay mixtures
FINE GRAINED SOILS over 50% silt and clay	SILT AND CLAY liquid limit <50%	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL		Organic silts and organic silt-clays of low plasticity
	SILT AND CLAY liquid limit >50%	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		CH		Inorganic clays of high plasticity, fat clays
		OH		Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS		PT		Peat, muck, and other highly organic soils
ROCK			Undifferentiated as to type or composition	

KEY TO BORING AND TEST PIT SYMBOLS

CLASSIFICATION TESTS

PI	PLASTICITY INDEX
LL	LIQUID LIMIT
SA	SIEVE ANALYSIS
HYD	HYDROMETER ANALYSIS
P200	PERCENT PASSING NO. 200 SIEVE
P4	PERCENT PASSING NO. 4 SIEVE

SAMPLER TYPE

	MODIFIED CALIFORNIA		HAND SAMPLER
	STANDARD PENETRATION TEST		ROCK CORE
	THIN-WALLED / FIXED PISTON		DISTURBED OR BULK SAMPLE

NOTE: Test boring and test pit logs are an interpretation of conditions encountered at the excavation location during the time of exploration. Subsurface rock, soil or water conditions may vary in different locations within the project site and with the passage of time. Boundaries between differing soil or rock descriptions are approximate and may indicate a gradual transition.

STRENGTH TESTS

TV	FIELD TORVANE (UNDRAINED SHEAR)
UC	LABORATORY UNCONFINED COMPRESSION
TXCU	CONSOLIDATED UNDRAINED TRIAXIAL
TXUU	UNCONSOLIDATED UNDRAINED TRIAXIAL
UC, CU, UU = 1/2 Deviator Stress	

SAMPLER DRIVING RESISTANCE

Modified California and Standard Penetration Test samplers are driven 18 inches with a 140-pound hammer falling 30 inches per blow. Blows for the initial 6-inch drive seat the sampler. Blows for the final 12-inch drive are recorded onto the logs. Sampler refusal is defined as 50 blows during a 6-inch drive. Examples of blow records are as follows:

25 sampler driven 12 inches with 25 blows after initial 6-inch drive

85/7" sampler driven 7 inches with 85 blows after initial 6-inch drive

50/3" sampler driven 3 inches with 50 blows during initial 6-inch drive or beginning of final 12-inch drive

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SOIL CLASSIFICATION CHART

Highway Booster Pump Station
Carollo-SMCSD
Sausalito, California

Project No. 2213.002

Date: 12/21/2015

Drawn PMR
Checked

A-1
FIGURE

FRACTURING AND BEDDING

Fracture Classification

Crushed
Intensely fractured
Closely fractured
Moderately fractured
Widely fractured
Very widely fractured

Spacing

less than 3/4 inch
3/4 to 2-1/2 inches
2-1/2 to 8 inches
8 to 24 inches
2 to 6 feet
greater than 6 feet

Bedding Classification

Laminated
Very thinly bedded
Thinly bedded
Medium bedded
Thickly bedded
Very thickly bedded

HARDNESS

Low
Moderate
Hard
Very hard

Carved or gouged with a knife
Easily scratched with a knife, friable
Difficult to scratch, knife scratch leaves dust trace
Rock scratches metal

STRENGTH

Friable
Weak
Moderate
Strong
Very strong

Crumbles by rubbing with fingers
Crumbles under light hammer blows
Indentations <1/8 inch with moderate blow with pick end of rock hammer
Withstands few heavy hammer blows, yields large fragments
Withstands many heavy hammer blows, yields dust, small fragments

WEATHERING

Complete	Minerals decomposed to soil, but fabric and structure preserved
High	Rock decomposition, thorough discoloration, all fractures are extensively coated with clay, oxides or carbonates
Moderate	Fracture surfaces coated with weathering minerals, moderate or localized discoloration
Slight	A few stained fractures, slight discoloration, no mineral decomposition, no affect on cementation
Fresh	Rock unaffected by weathering, no change with depth, rings under hammer impact

NOTE: Test boring and test pit logs are an interpretation of conditions encountered at the location and time of exploration. Subsurface rock, soil and water conditions may differ in other locations and with the passage of time.

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ROCK CLASSIFICATION CHART

Highway Booster Pump Station
Carollo-SMCSD
Sausalito, California
Project No. 2213.002 Date: 12/21/2015

Drawn _____
Checked _____
PMR

A-2
FIGURE

OTHER TEST DATA	OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH 0 meters - 0 feet	SAMPLE	SYMBOL (3)	BORING 1 EQUIPMENT: Portable Hydraulic Drill Rig with 4.0-inch Solid Flight Auger DATE: 12/18/15 ELEVATION: 16 - feet* *REFERENCE: Google Earth, 2015
								4-inches of aggregate baserock	
								Clayey SAND with Gravel (SC) Dark brown and mottled orange, moist, dense, low to medium plasticity, approximately 5% subangular gravel and 30% silt and clay. [FILL]	
			38	9.4	122	- 1		SANDSTONE Light brown and mottled orange, crushed to intensely fractured, low hardness, friable, highly to completely weathered, pervasively sheared. [BEDROCK]	
						- 5			
						- 2			
						- 3			
			50/1"			- 10			
						- 4			
						- 15			
						- 5			
						- 6			
						- 20			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m³ = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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Highway Booster Pump Station

Carollo-SMCSD

Sausalito, California

Project No. 2213.002

Date: 12/21/2015

Drawn

Checked

PMR

A-3

FIGURE

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APPENDIX B

Discharge Limits for Non-Sanitary Wastewater Discharges into the SMCSD

TABLE 1⁽¹⁾

DISCHARGE LIMITS FOR NON-SANITARY WASTEWATER DISCHARGES INTO THE SMCSO

CONSTITUENT	UNITS		WASTEWATER	
	Avg.	Peak	Avg.	Peak
I. GENERAL (Standard Methods for Examination of Water & Wastewater) ⁽²⁾				
Flow	GPD	GPM	X	10X
Ph	---	---	6-9	5-10
BOD	mg/L	mg/L	300	1000
Total Suspended Solids	mg/L	mg/L	500	1500
Settleable Solids	MI/L	MI/L	30	100
Oil and Grease	mg/L	mg/L	100	200
Detergent (MBAS)	mg/L	mg/L	10	30
Total Dissolved Solids	mg/L	mg/L	1000	2000
Chlorides	mg/L	mg/L	500	1000
Sulfates	mg/L	mg/L	500	1000
Dissolved Sulfides	mg/L	mg/L	0.5	1
Fluoride	mg/L	mg/L	2.5	5
Nitrates	mg/L	mg/L	25	50
Cyanide	mg/L	mg/L	0.05	0.1
Phenols	mg/L	mg/L	1	2
Color	C.U.	C.U.	25	50
II. METALS (EPA Method 3005/3010 - AA/ICP)				
Arsenic	mg/L	mg/L	0.5	1.0
Cadmium	mg/L	mg/L	0.05	0.1
Chromium	mg/L	mg/L	0.1	0.2
Copper	mg/L	mg/L	0.05	0.1
Lead	mg/L	mg/L	0.1	0.2
Mercury	mg/L	mg/L	0.001	0.002
Nickel	mg/L	mg/L	0.1	0.2
Selenium	mg/L	mg/L	0.1	0.2
Silver	mg/L	mg/L	0.05	0.1
Zinc	mg/L	mg/L	1	2
III. PURGEABLE HALOCARBONS (EPA METHOD 601)				
Carbon Tetrachloride	µg/L	µg/L	5	10
1,2-Dichloroethane	µg/L	µg/L	5	10
Vinyl Chloride	µg/L	µg/L	5	10
Tetrachlorethylene	µg/L	µg/L	10	20
1,1-Dichloroethane	µg/L	µg/L	20	40
Chloroform	µg/L	µg/L	5	10
All other 601 compounds	µg/L	µg/L	20	40

TABLE 1
(CONTINUED)

CONSTITUENT	UNITS		WASTEWATER	
	Avg.	Peak	Avg.	Peak
IV. PURGEABLE AROMATICS (EPA METHOD 602)				
Benzene	µg/L	µg/L	2	4
1,2 Dichlorobenzene	µg/L	µg/L	25	50
1,3 Dichlorobenzene	µg/L	µg/L	10	20
1,4 Dichlorobenzene	µg/L	µg/L	5	10
Toluene	µg/L	µg/L	25	50
All other 602 compounds	µg/L	µg/L	10	20
V. VOLATILE ORGANIC COMPOUNDS (EPA METHOD 624)				
Each, not covered in III or IV	µg/L	µg/L	10	20
VI. TOTAL PETROLEUM HYDROCARBONS (MODIFIED EPA METHOD 8015)				
Total	mg/L	mg/L	50	100
VII. PHTHALATES (EPA METHOD 625)				
Total	mg/L	mg/L	0.5	1
VIII. POLYNUCLEAR AROMATIC HYDROCARBONS (EPA METHOD 625)				
TOTAL	µg/L	µg/L	50	100
IX. BASE/NEUTRAL COMPOUNDS (EPA METHOD 625)				
Each	µg/L	µg/L	25	50
X. MISC. EPA 625 CMPNDS.				
2,4 dichlorophenol	µg/L	µg/L	100	200
2,4,6 Trichlorophenol	µg/L	µg/L	50	100
4-chloro-3-methylphenol	µg/L	µg/L	10	20
Fluoranthene	µg/L	µg/L	200	400
Hexachlorobenzene	µg/L	µg/L	.005	.01
Pentachlorophenol	µg/L	µg/L	50	100
XI. TOTAL CHLORINATED HYDROCARBONS				
Total halomethanes	mg/L	mg/L	5	10
Total as ID'd by 601, 602, 624, and 625	mg/L	mg/L	0.05	0.1
XII. OTHER COMPOUNDS OF POTENTIAL CONCERN (Standard Methods for Examination of Water & Wastewater Analysis) ⁽²⁾				
EDB	mg/L	mg/L	0.25	0.5
TEL	mg/L	mg/L	1	2
Aldrin	mg/L	mg/L	0.25	0.5
A-BHC	µg/L	µg/L	1	2
B-BHC	µg/L	µg/L	0.04	.1
Chlordane	µg/L	µg/L	0.04	.1
Cresols and Creosote	mg/L	mg/L	1	2

TABLE 1
(CONTINUED)

CONSTITUENT	UNITS		WASTEWATER	
	Avg.	Peak	Avg.	Peak
DDT	mg/L	mg/L	0.01	0.02
Dichloromethane	mg/L	mg/L	5	10
Dieldrin	µg/L	µg/L	0.02	0.04
Endosulfan	µg/L	µg/L	0.1	0.2
Endrin	µg/L	µg/L	0.02	0.04
G-GHC (Lindane)	µg/L	µg/L	0.5	1
Heptachlor	µg/L	µg/L	0.02	0.04
Heptachlor Epoxide	µg/L	µg/L	0.01	0.02
PCBs (total)	µg/L	µg/L	0.1	0.2
Toxaphene	µg/L	µg/L	0.005	0.01
Tributyltin	µg/L	µg/L	0.1	0.2
Organic Solvents	mg/L	mg/L	1	2

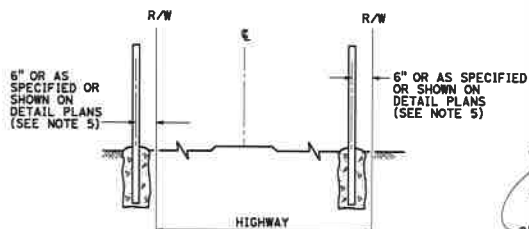
- (1) Testing Schedule - All constituents listed above shall be tested initially and once per year from a 24-hour composite sample of the discharged wastewater. Then the general constituents listed in Part 1, and any other constituent that is within fifty percent of the constituent limit shall be tested from 24-hour composite samples once each month for the first year of permitted discharge, and then quarterly if all constituents meet the limit.
- (2) Standard Methods for the Examination of Water & Wastewater, APHA (latest edition will be used for sampling and analysis).

APPENDIX C

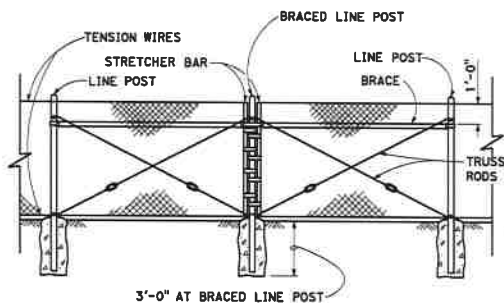
Marin County and Caltrans Encroachment Permits (by Addendum)

APPENDIX D

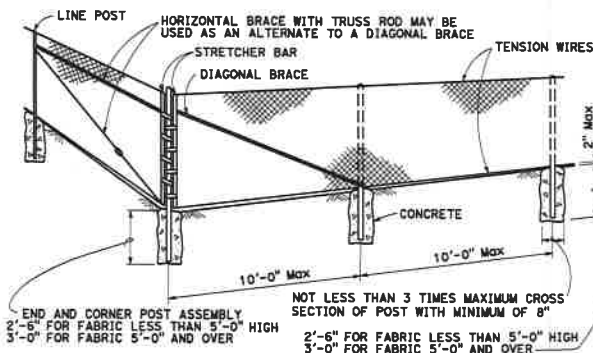
Agency Standard Details



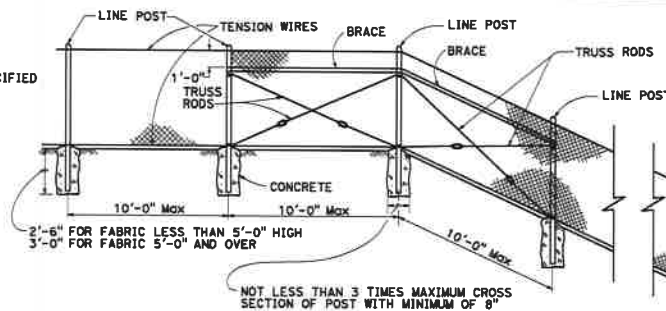
OTHER HIGHWAYS
FENCE LOCATION



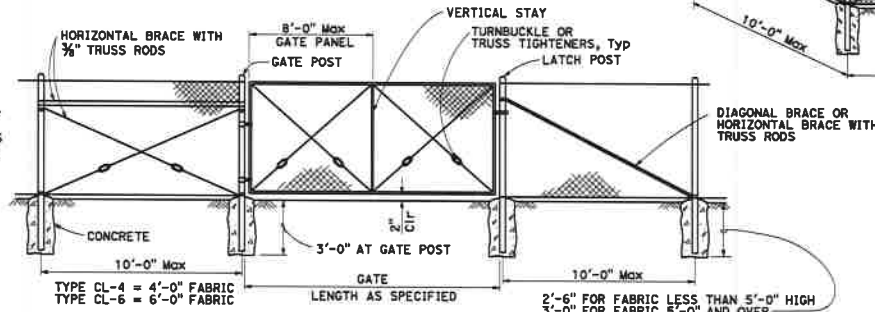
BRACED LINE POST INSTALLATION
Braced line post at intervals not exceeding 1000'



CORNER POST



CHAIN LINK FENCE ON SHARP BREAK IN GRADE



CHAIN LINK GATE INSTALLATION

NOTES:

1. The table below shows minimum sized posts and braces complying with the specifications. Larger or heavier post and brace sizes may be used upon approval.
2. Sections shown in the tables must also comply with the strength requirements and other provisions of the specifications.
3. Other sections which comply with the strength requirements and other provisions of the specifications may be used upon approval.
4. Options exercised shall be uniform on any one project.
5. Offset to be 2'-0\"/>

TYPICAL MEMBER DIMENSIONS (See Notes)										
FENCE HEIGHT	LINE POSTS				END, LATCH AND CORNER POSTS		BRACES			
	ROUND OD PIPE	WEIGHT (lb/ft)	ROLL FORMED		ROUND OD PIPE	WEIGHT (lb/ft)	ROUND OD PIPE	WEIGHT (lb/ft)	ROLL FORMED	
			□ □						□ □	
			SECTION	WEIGHT (lb/ft)					SECTION	WEIGHT (lb/ft)
6'-0" AND LESS	1.900"	2.72	1.875" x 1.625"	1.85	2.375"	3.65	1.66"	2.27	1.625" x 1.25"	1.35
OVER 6'-0" TO 8'-0" MAX	2.375"	3.65	2.25" x 1.70"	2.78	2.875"	5.80	1.66"	2.27	1.625" x 1.25"	1.35

STATE COUNTY ROUTE POST MILES SHEET TOTAL
 TOTAL PROJECT NO. SHEETS
 July 18, 2014
 PLANS APPROVAL DATE
 THE STATE OF CALIFORNIA ON ITS OFFICIAL SEAL OF OFFICE
 OF AGENTS SHALL HAVE NO RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

GATE POST			
FENCE HEIGHT	GATE WIDTHS	ROUND OD PIPE	WEIGHT (lb/ft)
6'-0" AND LESS	UP THRU 6'-0"	2.875"	5.80
	OVER 6'-0" THRU 12'-0"	4.500"	10.80
	OVER 12'-0" THRU 18'-0"	5.563"	14.63
	OVER 18'-0" TO 24'-0" Max	6.625"	18.99
OVER 6'-0" TO 8'-0" Max	UP THRU 6'-0"	3.500"	7.58
	OVER 6'-0" THRU 12'-0"	5.563"	14.63
	OVER 12'-0" THRU 18'-0"	6.625"	18.99
	OVER 18'-0" TO 24'-0" Max	8.625"	28.58

Above post dimensions and weights are minimums. Larger sizes may be used upon approval.

STATE OF CALIFORNIA
 DEPARTMENT OF TRANSPORTATION
CHAIN LINK FENCE
 NO SCALE

RSP A85 DATED JULY 18, 2014 SUPERSEDES STANDARD PLAN A85
 DATED MAY 20, 2011 - PAGE 112 OF THE STANDARD PLANS BOOK DATED 2010.

REVISED STANDARD PLAN RSP A85

2010 REVISED STANDARD PLAN RSP A85