

Professional

Engineering

Services

Northwest WWTP Clarifier Rehabilitation Project

Contract 1-2025

Bid No.
PW 2025-03-84

Project Manual

City of Copperas Cove

Copperas Cove, Texas

Issued for Bid

September 5, 2025



PLAN HOLDER: _____

Set No.: _____

PROJECT MANUAL

CITY OF COPPERAS COVE
COPPERAS COVE, TEXAS
NORTHWEST WWTP CLARIFIER REHABILITATION PROJECT
CONTRACT 1-2025
BID NO. PW 2025-03-84

Prepared by:

STRAND ASSOCIATES, INC.®

TBPE No. F-8405

TBPLS No. 10030000

1906 Niebuhr Street

Brenham, TX 77833

www.strand.com

Issued for Bid
September 5, 2025



CERTIFICATION PAGE

CITY OF COPPERAS COVE
COPPERAS COVE, TEXAS
NORTHWEST WWTP CLARIFIER REHABILITATION PROJECT
CONTRACT 1-2025
BID NO. PW 2025-03-84

 SEAL <i>Jake D. Collins</i> 9/3/2025	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Texas. FOR STRAND ASSOCIATES, INC.® <i>Jake D. Collins</i> 9/3/2025
	Jake D. Collins License Number 155800 My license renewal date is December 31, 2025 Specification sections covered by this seal: All sections unless otherwise noted. Date

 SEAL <i>Mary Seehafer</i> 9/3/25	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Texas. FOR STRAND ASSOCIATES, INC.® <i>Mary Seehafer</i> 9/3/25
	Mary E. Seehafer, P.E. License Number: 138988 My license renewal date is June 30, 2026 Specification sections covered by this seal: All of Division 26 Date

SECTION 00 01 10

TABLE OF CONTENTS

CITY OF COPPERAS COVE
COPPERAS COVE, TEXAS
NORTHWEST WWTP CLARIFIER REHABILITATION PROJECT
CONTRACT 1-2025
BID NO. PW 2025-03-84

Pages
Through

DIVISION 00–BIDDING AND CONTRACTING REQUIREMENTS

INVITATION TO BID	1
ADVERTISEMENT FOR BIDS	1
INSTRUCTIONS TO BIDDERS	8
BID FORM	9
BID BOND	2
CONFLICT OF INTEREST QUESTIONNAIRE (FORM CIQ)	2
FORM 06-B NON-COLLUSION CERTIFICATION	1
FORM 06-C COMPLIANCE TO STATE SALES TAX CODE	1
FORM 06-D COMPLIANCE TO STATE LAW ON NONRESIDENT BIDDERS.....	1
CERTIFICATE OF INTERESTED PARTIES (FORM 1295)	1
VENDOR CERTIFICATIONS.....	4
CAPITAL IMPROVEMENT PROJECT CONSTRUCTION AGREEMENT BETWEEN OWNER AND CONTRACTOR.....	6
GENERAL CONDITIONS OF THE AGREEMENT	19
SUPPLEMENTAL GENERAL CONDITIONS	6
PREVAILING WAGE DETERMINATION	11
STATUTORY PAYMENT BOND.....	2
STATUTORY PERFORMANCE BOND	2
WARRANTY BOND	2

SPECIFICATIONS

DIVISION 01–GENERAL REQUIREMENTS

SUMMARY OF WORK	01 11 00- 7
CONTRACT CONSIDERATIONS.....	01 29 00- 2
COORDINATION, FIELD ENGINEERING, AND MEETINGS	01 31 00- 3
SUBMITTALS	01 33 00-10
REGULATORY REQUIREMENTS.....	01 41 00- 2
REFERENCE STANDARDS AND DEFINITIONS	01 42 00- 6
QUALITY CONTROL	01 45 00- 2
TEMPORARY FACILITIES	01 50 00- 3
FIELD OFFICES AND SHEDS	01 52 13- 2
TEMPORARY CONTROLS	01 57 00- 2
MATERIALS AND EQUIPMENT	01 60 00- 4
CUTTING, PATCHING, AND ALTERATIONS	01 73 29- 4

TABLE OF CONTENTS Continued

	Pages Through
CONTRACT CLOSEOUT	01 77 00- 3
STARTING OF SYSTEMS.....	01 91 00- 8
 <u>DIVISION 02–EXISTING CONDITIONS</u>	
DEMOLITION	02 41 00- 3
 <u>DIVISION 03–CONCRETE</u>	
CONCRETE SURFACE REPAIR.....	03 01 30- 3
CONCRETE FORMWORK	03 11 00- 4
CONCRETE REINFORCEMENT	03 20 00- 5
CAST-IN-PLACE CONCRETE.....	03 30 00-13
 <u>DIVISION 05–METALS</u>	
METAL FABRICATIONS	05 50 00- 7
HANDRAILS AND RAILINGS	05 52 00- 2
GRATING	05 53 00- 3
ANCHOR BOLTS AND POST-INSTALLED ANCHORS	05 56 00- 3
 <u>DIVISION 09–FINISHES</u>	
PAINTING.....	09 91 00-11
 <u>DIVISION 22–PLUMBING</u>	
SUBMERSIBLE PUMPS.....	22 13 29- 4
 <u>DIVISION 26–ELECTRICAL</u>	
GENERAL ELECTRICAL REQUIREMENTS	26 05 00- 9
WIRE	26 05 19- 7
INSTRUMENT AND COMMUNICATION WIRE AND CABLE	26 05 23- 3
SECONDARY GROUNDING	26 05 26- 2
SUPPORTING DEVICES	26 05 29- 2
CONDUIT	26 05 33- 8
BOXES	26 05 35- 3
ELECTRICAL IDENTIFICATION	26 05 53- 5
CONTROLS AND INSTRUMENTATION	26 09 00-26
CONTROLS AND INSTRUMENTATION DRAWINGS.....	26 09 10- 4
SCADA SYSTEM I/O LISTING	26 09 90- 2
MOTOR CONTROL.....	26 24 19- 9
WIRING DEVICES.....	26 27 26- 3
OVERCURRENT PROTECTIVE DEVICES	26 28 00- 2
DISCONNECT SWITCHES	26 28 16- 2
SURGE PROTECTIVE DEVICES (SPD)	26 43 13- 4
LIGHTING.....	26 51 13- 5

TABLE OF CONTENTS Continued

Pages
Through

DIVISION 31-EARTHWORK

EXCAVATION, FILL, BACKFILL, AND GRADING	31 23 00- 6
DEWATERING	31 23 19- 3
CEMENT STABILIZED SAND	31 23 23.46- 3
EXCAVATION SAFETY	31 50 00- 2
CAISSONS	31 64 00- 5

DIVISION 32-EXTERIOR IMPROVEMENTS

SEEDING	32 92 19- 4

DIVISION 33-UTILITIES

BURIED PIPING AND APPURTENANCES	33 00 10-17

DIVISION 40-PROCESS INTERCONNECTIONS

PIPING AND APPURTENANCES.....	40 05 00-17
IDENTIFICATION FOR PROCESS INTERCONNECTIONS PIPING AND EQUIPMENT	40 05 53- 4
ACTUATORS FOR PROCESS VALVES	40 05 57- 5
SLIDE GATES	40 05 59.23- 4

DIVISION 43-PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT

CENTRIFUGAL SLUDGE PUMPS	43 23 21- 7

DIVISION 46-WATER AND WASTEWATER EQUIPMENT

FINAL CLARIFIER COLLECTORS	46 43 22-14

APPENDICES (NOT PART OF CONTRACT DOCUMENTS)

SAMPLE DRAWINGS.....	23
GEOTECHNICAL ENGINEERING REPORT	46

END OF SECTION



CITY OF COPPERAS COVE

INVITATION TO BID

By order of the City Council of the
City of Copperas Cove, Texas,

BIDS

Will be received for:

No. PW 2025-03-84

Northwest WWTP Clarifier Rehabilitation Project

Sealed bids will be received until
October 2, 2025 @ 2:00 p.m.

Return Bid To: City of Copperas Cove Public Works Department
ATTN: Cynthia Taylor
1601 N. 1st St.
Copperas Cove, TX 76522

ADVERTISEMENT FOR BIDS

Bid No. PW 2025-03-84

Northwest WWTP Clarifier Rehabilitation Project

Notice is hereby given that the City of Copperas Cove, Texas, will receive sealed Bids for the above referenced item. Bids will be received on behalf of the City Public Works Department, Attn. Cynthia Taylor, at the City of Copperas Cove Public Works Department, located at 1601 N. 1st Street, Copperas Cove, TX 76522, until **2:00 p.m.** on October 2, 2025. Bid opening will be held in the Public Works Conference Room, 1601 N. 1st Street, Copperas Cove, TX 76522. Bids will be opened publicly and read aloud immediately after closing time.

Digital copies of the Bid Package, including Plans and Specifications can be obtained at no cost beginning **September 5, 2025**, from www.civcastusa.com. Reference Bid number PW 2025-03-84.

The Pre-Bid Conference will be held on **September 19, 2025, at 10:00 a.m.** with an accompanied site visit immediately following. The Pre-Bid Conference and accompanied site visit will both take place at the project site. **The Pre-Bid Conference and site visit are non-mandatory prerequisites to bid submission.** Please RSVP if you are attending to:

Jake Collins, P.E., ENV SP
Assistant Project Manager
Strand Associates, Inc.®
(979) 836-7937
jake.collins@strand.com

All employees directly employed on the work shall be paid not less than the established prevailing wage scale for work of a similar character in this locality. A prevailing wage determination for the work has been included with the contract associated with this project and is incorporated therein for all purposes. The Contractor shall pay not less than the general prevailing wages as established by the U.S. Department of Labor and shall keep accurate wage records accessible in accordance with Chapter 2258, Texas Government Code.

The City reserves the right to award the Bid to either the lowest responsible Bidder or to the Bidder who provides goods or services at the best value for the City, in accordance with the Texas Local Government Code.

All Bids submitted must be plainly marked on the outside indicating the Bid number, opening time and date. Award will be made at a later date. Any Bid received after closing time will be returned unopened. The City of Copperas Cove reserves the right to reject any or all Bids.

INSTRUCTIONS TO BIDDERS

Proposal

The Proposal (or copies of the Proposal) shall be submitted on the bidding forms, which are included herein, and shall be enclosed in a sealed envelope addressed to:

COPPERAS COVE PUBLIC WORKS DEPARTMENT

Attn: Cynthia Taylor

1601 N. 1st Street

Copperas Cove, Texas 76522

and shall be identified as follows:

“BID PW 2025-03-84 for Northwest WWTP Clarifier Rehabilitation Project, to be opened at 2:00 p.m., October 2, 2025.”

Any questions or requests for clarification must be submitted on www.civcastusa.com or www.strand.com, prior to **12:00 p.m., September 25, 2025**. All responses to the questions will be made available to all plan holders on www.civcastusa.com. Any requests received after this date and time will not be responded to. There will be no exceptions.

1. DEFINED TERMS.

Terms used in these Instructions to BIDDERS which are defined in the General Conditions of the construction contract shall have the same meanings assigned to them in these Instructions to BIDDERS. The term "successful BIDDER" means the lowest, qualified, responsible and responsive BIDDER to whom OWNER (on the basis of OWNER's evaluation as hereinafter provided), makes an award. The term "bidding documents" includes the ADVERTISEMENT FOR BIDS, INSTRUCTIONS TO BIDDERS, the BID FORM and the proposed contract documents (including all addenda issued prior to receipt of bids).

2. COPIES OF BIDDING DOCUMENTS.

2.1. Complete digital sets of the Bidding Documents are available at www.strand.com or at www.civcastusa.com at no cost. Please contact CivcastUSA.com for assistance with free membership registration, downloading, and working with this digital project information. Partial sets will not be issued.

2.2. Complete sets of bidding documents must be used in preparing bids; neither OWNER nor ENGINEER assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of bidding documents.

2.3. OWNER and ENGINEER in making copies of bidding documents available on the above terms do so only for the purpose of obtaining bids on the work and do not confer a license or grant for any other use.

3. EXPERIENCE RECORD AND FINANCIAL STATEMENT.

- 3.1 The Experience Record, included herein, shall be filled in showing completed jobs of a similar nature to the one covered by the bid and the work in progress with contract and bond amounts and percent of completion.
- 3.2 A sworn statement of the current financial condition of the BIDDER shall be included in order to provide the OWNER with information relative to the responsibility of BIDDERS and their ability to finance and construct the work. The sworn financial statement shall include, but not be limited to the following:
 - A. List of all previous bankruptcies by the BIDDER or BIDDERS;
 - B. List all liens on the BIDDER or BIDDERS within the last twelve (12) months;
 - C. An indication of outstanding debt and the ability to finance the project;
 - D. A summary of liabilities and assets of the company.

This statement shall be enclosed with the Bid in a separate envelope labeled "Financial Statement". All but two (2) apparent low BIDDERS' financial statements will be returned to the BIDDER with the return of his bid security. Other BIDDERS' financial statements will be returned to the BIDDER upon return of the bid security after execution of the Agreement.

4. EXAMINATION OF CONTRACT DOCUMENTS AND SITE.

- 4.1 It is the responsibility of each BIDDER before submitting a bid to (a) examine the contract documents thoroughly; (b) visit the site to become familiar with local conditions that may in any manner affect cost, progress or performance, or furnishing of the work; (c) consider federal, state, and local laws and regulations that may in any manner affect cost, progress or performance of the work; (d) study and carefully correlate BIDDER's observations with the contract documents; and (e) notify the ENGINEER of all conflicts, errors or discrepancies in the contract documents.
- 4.2 Information and data reflected in the contract documents with respect to underground facilities at or contiguous to the site is based upon information and data furnished to OWNER and ENGINEER by owners of such underground facilities or others, and OWNER does not assume responsibility for the accuracy or completeness thereof unless it is expressly provided otherwise in the Supplementary Conditions.
- 4.3 Provisions concerning responsibilities for the adequacy of data furnished to prospective BIDDERS on subsurface conditions, underground facilities and other physical conditions, and possible changes in the contract documents due to differing conditions appear in Paragraphs 4.07 of the General Conditions.

- 4.4 Before submitting a bid, each BIDDER will be responsible to make or obtain such explorations, tests and data concerning physical conditions (surface, and underground facilities) at or contiguous to the site, or otherwise which may affect cost, progress, performance or furnishing of the work and which BIDDER deems necessary to determine its bid for performing and furnishing the work in accordance with the time, price and other terms and conditions of the contract documents.
- 4.5 On request in advance, OWNER will provide each BIDDER access to the site to conduct such explorations and tests as each BIDDER deems necessary for submission of a bid. BIDDER shall fill in all holes, clean up and restore the site to its former condition upon completion of such explorations. Explorations and tests are the financial responsibility of BIDDER.
- 4.6 The lands upon which the work is to be performed, rights-of-way for access thereto and other lands designated for use by CONTRACTOR in performing the work are identified in the contract documents. All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by CONTRACTOR. The CONTRACTOR shall use barricades, lights, etc. and sufficient protection to assure the safety of the public.
- 4.7 The submission of a bid will constitute an incontrovertible representation by the BIDDER that BIDDER has complied with every requirement of this Article, that without exception the bid is premised upon performing and furnishing the work required by the contract documents, and such means, methods, techniques, sequences or procedure of construction as may be indicated in or required by the contract documents, and that the contract documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the work.

5. INTERPRETATIONS AND ADDENDA.

- 5.1 All questions about the meaning or intent of the contract documents shall be directed to ENGINEER. Interpretations or clarifications considered necessary by ENGINEER in response to such questions will be issued by addenda mailed or delivered to all parties recorded by ENGINEER as having received the bidding documents. Questions received less than seven (7) days prior to the date for opening of bids may not be answered. Only questions answered by formal writing will be binding. Oral and other interpretations or clarifications will be without legal effect.
- 5.2 Addenda may also be issued to modify the bidding documents as deemed advisable by OWNER or ENGINEER.

6. BID SECURITY.

- 6.1 Each bid must be accompanied by bid security made payable to the OWNER, in an amount of five percent (5%) of the BIDDER's maximum bid price and in the form of a Bid Bond issued by an acceptable surety, cashier's check, or certified check.
- 6.2 The bid security of the successful BIDDER will be retained until such BIDDER has executed the Agreement and furnished the required contract security, whereupon it will be returned. If the successful BIDDER fails to execute and deliver the Agreement and furnish the required contract security within ten (10) business days of the Notice of Award, OWNER may annul the Notice of Award and the bid security of that BIDDER will be forfeited. The Bid Security of other BIDDERS whom OWNER believes to have a reasonable chance of receiving the award may be retained by OWNER until the earlier of the thirtieth (30th) day after effective date of the Agreement or the ninetieth (90th) day after the bid opening, whereupon bid security furnished by such BIDDERS will be returned. Bid security with bids which are not competitive will be returned within sixty (60) days after the bid opening.

7. CONTRACT TIME.

The number of days within which, or the date by which, the work is to be substantially completed and also completed and ready for final payment (the contract time) are on the Bid Form.

8. LIQUIDATED DAMAGES.

Provisions for liquidated damages, if any, are set forth in the Agreement.

9. SUBSTITUTE AND "OR EQUAL" ITEMS.

The Contract, if awarded, will be on the basis of material and equipment described in the drawings or specified in the specifications without consideration of possible substitute or "or-equal" items. Whenever it is indicated in the drawings or specified in the specification that a substitute or "or-equal" item of material or equipment may be furnished or used by CONTRACTOR if acceptable to ENGINEER, application for such acceptance will not be considered by ENGINEER until after the effective date in the Agreement. The procedure for submittal of any such application by CONTRACTOR and consideration by ENGINEER is set forth in paragraphs 2.20 of the General Conditions which may be supplemented in the Supplementary Conditions.

10. SUBCONTRACTORS, SUPPLIERS AND OTHERS.

The BIDDER must submit with the bid a list of any and all subcontractors to which it is proposed to subcontract 25% or more of the total bid amount. The identification is to be made in the form contained in these contract documents. For each subcontractor so

identified, a separate Experience Record and Financial Statement must be submitted if requested by the ENGINEER.

If OWNER or ENGINEER, after due investigation, has reasonable objection to subcontractors so identified, they may, before the Notice of Award is given, request the apparent successful BIDDER to submit an acceptable substitute without an increase in bid price.

If apparent successful BIDDER declines to make any such substitution, OWNER may award the contract to the next lowest BIDDER that proposes to use acceptable subcontractors, suppliers and other persons and organizations. The declining to make requested substitutions will not constitute grounds for sacrificing the bid security of any BIDDER. Any subcontractor, supplier, other person or organization listed and to whom OWNER or ENGINEER does not make written objection prior to the giving of the Notice of Award will be deemed acceptable to OWNER and ENGINEER subject to revocation of such acceptance after the effective date of the Agreement as provided in Paragraphs 2.15 of the General Conditions.

Other proposed subcontractors and suppliers will be subject to approval by the OWNER and ENGINEER after the effective date of the Agreement.

11. BID FORM.

11.1 The Bid Form is included with the bidding documents; additional copies may be obtained from Engineer.

11.2 Bid Forms must be completed in ink or prepared electronically. The unit price bid for each item on the form must be stated in words and numerals; in each case of a conflict, words will take precedence.

11.3 Bids by corporations must be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown below the signature.

11.4 Bids by partnerships must be executed in the partnership name and signed by a partner, whose title must appear under the signature and the official address of the partnership must be shown below the signature.

11.5 All names must be typed or printed below the signature.

11.6 The bid shall contain an acknowledgment of receipt of all addenda (the numbers of which shall be filled in on the Bid Form).

11.7 The address and telephone number for communications regarding the bid must be shown.

11.8 Current Texas state law prohibits amendment, alteration or change of bids after opening for the purpose of correcting errors. BE CAREFUL in preparing your bid. If errors occur, your bid may be subject to rejection because of the error, or you may be required to contract based upon the uncorrected error.

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

12. SUBMISSION OF BIDS.

Bids shall be submitted at the time and place indicated in the ADVERTISEMENT FOR BIDS and shall be included in an opaque sealed envelope, marked with the project title and name and address of the BIDDER and accompanied by the bid security and other required documents indicated in these instructions, including without limitation, a completed Conflict of Interest Questionnaire, Non-Collusion Certification, State Sales Tax Compliance form and Non-Resident Bidders Compliance form. If the bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face thereof.

Bids received after the deadline shall be considered void and unacceptable and will be returned to the bidder unopened.

13. MODIFICATION AND WITHDRAWAL OF BIDS.

Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a bid must be executed) and delivered to the place where bids are to be submitted at any time prior to the opening of bids.

14. OPENING OF BIDS.

Bids will be read aloud publicly. An abstract of the amounts of the base bids and major alternates (if any) will be made available to BIDDERS after the opening of bids. Unit price amounts shall remain confidential until after award of the bid.

15. BIDS TO REMAIN OPEN.

All bids shall remain subject to acceptance for ninety (90) days after the day of the bid opening, but OWNER may, in its sole discretion, release any bid and return the bid security prior to that date.

16. AWARD OF CONTRACT.

- 16.1 OWNER reserves the right to reject any and all bids, to waive any and all informalities not involving price, time or changes in the work and to negotiate contract terms with the successful BIDDER, and the right to disregard all non-conforming, non-responsive, unbalanced or conditional bids. Also, OWNER reserves the right to reject the bid of any BIDDER if OWNER believes that it would not be in the best interest of the project to make an award to that BIDDER, whether because the bid is not responsive or the BIDDER is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by OWNER.
- 16.2 In evaluating bids, OWNER will consider the qualifications of the BIDDERS, whether or not the bids comply with the prescribed requirements, and such alternates, unit prices, contract time, and other data, as may be requested in the Bid Form or prior to the Notice of Award in order for OWNER to establish BIDDER qualifications.
- 16.3 OWNER may consider the qualifications and experience of subcontractors, suppliers, and other persons and organizations proposed for those portions of the work as to which the identity of subcontractors, suppliers, and other persons or organizations must be submitted as provided in the Supplementary Conditions. OWNER may consider the operating costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the work when such data is required to be submitted prior to the Notice of Award.
- 16.4 OWNER may conduct such investigations as it deems necessary to assist in the evaluation of any bid and to establish the responsibility, qualifications and financial ability of BIDDERS, proposed subcontractors, suppliers and other persons and organizations to do the work in accordance with the contract documents to OWNER'S satisfaction within the prescribed time.
- 16.5 The OWNER reserves the right to reject the bid of any BIDDER who does not pass any such evaluation to OWNER'S satisfaction.
- 16.6 The OWNER may also reject any bid which is considered irregular. Examples of irregularities include the following:
- A. If the Bid Form provided herein is not used by or is altered by the BIDDER;
 - B. If there are any unauthorized additions or conditional bids, or irregularities of any kind which may tend to make the bid incomplete, indefinite, or ambiguous as to its meaning;
 - C. If the BIDDER adds any provisions reserving the right to accept or reject any award, or to enter into a contract pursuant to an award;

- D. If, in the opinion of the ENGINEER, the unit or lump sum prices contained in the bid are obviously unbalanced (where the prices of certain items have been made substantially greater or less than reasonable values);
- 16.7 BASE BID shall be a Unit Price Bid and shall include all work shown on the Drawing or called out in the Specifications unless specifically noted an alternate or furnished and installed by others.
- 16.8 The contractor is not required to bid on the Base Bid item(s) if the contractor chooses to bid on the Alternate Bid item(s) only. The Owner reserves the right to award a bid for an Alternate Bid Item to an individual contractor as stated in 16.10.
- 16.9 The contractor shall provide an equipment list of manufacturers with their bid. Contractors submitting ambiguous and/or incomplete lists will be eliminated. Alternate manufacturers or non-prequalified manufacturers will be eliminated from consideration.
- 16.10 The Owner reserves the right to award bids on the lump sum or unit price basis, whichever is in the best interest of the Owner. The Owner also reserves the right to award the bid to either the lowest responsible bidder or to the bidder who provides goods or services at the best value for the City. Bids shall be valid for a period of ninety (90) days after Owner reserves the right. The Owner reserves the right to award alternate bids items separately from the Base Bid if it is determined to be in the best interest of the City.

17. CONTRACT SECURITIES.

Paragraph 3.02 of the General Conditions and the Supplementary Conditions set forth OWNER'S requirements as to Performance and Payment Bonds. When the successful BIDDER delivers the executed agreement to OWNER it must be accompanied by the required Performance and Payment Bonds. BIDDER must submit bonds on forms provided in the contract documents.

18. SIGNING OF AGREEMENT.

When OWNER gives a Notice of Award to the successful BIDDER, it will be accompanied by the required number of unsigned counterparts of the agreement and all other written contract documents attached. Within ten business days thereafter, CONTRACTOR shall sign and deliver the required number of counterparts of the agreement and attached documents to OWNER with the required bonds. Thereafter, OWNER shall deliver one fully signed counterpart to CONTRACTOR.

BID FORM

Bidding Firm: _____

Address: _____

City: _____

State, Zip: _____

PROJECT IDENTIFICATION: Northwest WWTP Clarifier Rehabilitation Project
Bid No. PW 2025-03-84
City of Copperas Cove, Texas

THIS BID IS SUBMITTED TO: Copperas Cove Public Works Department
ATTN: Cynthia Taylor
1601 N. 1st Street
Copperas Cove, Texas 76522

- A. The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an Agreement with OWNER, in the form included in the Contract Documents, to complete all Work as specified or indicated in the Contract Documents for the Contract Price, and within the Contract Time indicated in the Bid and in accordance with the Contract Documents.
- B. BIDDER accepts all of the terms and conditions of the Instruction to Bidders, including without limitation those dealing with the disposition of Bid Security. This Bid will remain open for ninety (90) days after the day of Bid opening. BIDDER will sign the Agreement and submit the Contract Security and other documents required by the Contract Documents within ten business days after the date of OWNER's Notice of Award.
- C. In submitting this Bid, BIDDER represents, as more fully set forth in the Agreement, that:
1. Bidder has examined copies of all the Contract Documents and of the following addenda, receipt of which is hereby acknowledged, and also copies of the Advertisement for Bids and the Instructions to Bidders.

Number

Date

2. BIDDER has examined the site and locality where the Work is to be performed, the legal requirements (federal, state and local laws, ordinances, rules and regulations) and

the conditions affecting cost, progress or performance of the Work and has made such independent investigations as BIDDER deems necessary.

3. This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; BIDDER has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; BIDDER has not solicited or induced any person, firm or a corporation to refrain from bidding; and BIDDER has not sought by collusion to obtain for himself any advantage over any other Bidder or over OWNER.
- D. BIDDER hereby agrees to maintain the unit prices shown on the Bid Form should a reduction in the scope of the work be necessary. It is the intent of the OWNER to award a contract for all work items and quantities listed in the Bid Form. In the event that the low bid submitted by a qualified bidder exceeds the funds budgeted for this Project, the OWNER reserves the right to reduce the scope of the work by eliminating alternate bids or reducing base bid items so that the Project can be completed within the budgeted amount. This may be done by eliminating any or all parts of the Project.
- E. BIDDER will complete the work for the following unit prices:

Base Bid Items					
ITEM NO.	ITEM DESCRIPTIONS	EST. QTY.	UNITS	UNIT PRICE	EXTENSION
1.	Lump Sum Bid	1	LS	\$ _____	\$ _____
2.	Concrete Surface Reparis (Section 03 01 30)	10	CY	\$ _____	\$ _____
3.	Excavation Safety (Section 31 50 00)	1	LS	\$ _____	\$ _____

****All items above shall include the cost of all ancillary work, material and equipment or any other cost associated with completing the Project.**

Total Bid in Words: _____

Total Bid (Sum): \$ _____

OWNER reserves the right to accept or reject any Alternative Equipment Manufacturers to the Lump Sum Bid. Consideration of Alternative Equipment Manufacturers of the selected BIDDER will be made by OWNER within 60 days after the Effective Date of the Contract.

EQUIPMENT ALTERNATIVES

The name of the Base Bid Equipment Manufacturer, which Bidder shall include in the Lump Sum Base Bid, is listed for each equipment item. When more the one Base Bid Equipment Manufacturer name is listed for an item, Bidder shall circle the name of the equipment manufacturer selected for the Lump Sum Base Bid and write in the price for the selected equipment.

Where a Requested Alternative Equipment Manufacturer is listed in the Bid Form, Bidder shall include an add or deduct to the price of the Base Bid equipment that Bidder included in the Lump Sum Base Bid. The add or deduct price shall include the cost of any changes, including engineering changes, necessary to accommodate the alternative equipment including, but not limited to, process, structural, mechanical, and electrical work.

Where spaces are provided, Bidder may write in Other Alternative Equipment Manufacturers into the blank(s) provided on the Bid Form and include an add or deduct to the price of the Base Bid equipment that Bidder included in the Lump Sum Base Bid. The add or deduct price shall include the cost of the engineering services required for review of the alternative equipment in comparison to the Base Bid equipment and shall include the cost of any changes, including engineering changes, necessary to accommodate the alternative equipment including, but not limited to, process, structural, mechanical, and electrical work.

Whether or not an Alternative Equipment Manufacturer is offered to one or more Base Bid Equipment Manufacturers provided in the Bid Form, Bidder shall write (in numbers) the price for providing the Base Bid Equipment Manufacturer, as included in the Lump Sum Base Bid.

	Item	Base Bid Equipment Manufacturer Included in the Lump Sum Base Bid (Circle One)	Cost of Equipment Included in the Lump Sum Base Bid	Alternative Equipment Manufacturer	Add to Base Bid for Alternative Equipment Manufacturer	Deduct From Base Bid for Alternative Equipment Manufacturer
A.	Controls and Instrumentation (Section 26 09 00)	Integrated Process Solutions OR ESCO Automation OR Wunderlich-Malec	\$		(+) _____ (+) _____	(-) _____ (-) _____
B.	Final Clarifier Collectors (Section 46 43 22)	Ovivio USA, LLC. OR Envirodyne Systems, Inc.	\$		(+) _____ (+) _____	(-) _____ (-) _____

- F. BIDDER agrees that the Work covered by the Base Bid will be substantially completed within 365 calendar days after the date the Contract Time commences to run and finally completed within 425 calendar days after commencement. Bidder accepts the provisions of the agreement as to liquidated damages in the event of failure to complete the Work on time.
- G. The following documents are attached to and made a Condition of this Bid:
1. Required Bid Security in the form of a Bid Bond issued by an acceptable surety, certified check, or cashier's check.
 2. Financial Statement enclosed in a separate sealed envelope.
 3. A tabulation of Subcontractors and organizations required to be identified in this Bid.
 4. Experience record as indicated on this Bid Form.
 5. Form 06-A Conflict of Interest Questionnaire.
 6. Form 06-B Non-Collusion Certification.
 7. Form 06-C Compliance of State Sales Tax Code.
 8. Form 06-D Compliance to State Law on Nonresident Bidders (If Applicable).
 9. Form 1295–Certificate of Interested Parties.
 10. Vendor Certifications.
- H. Communications concerning this Bid shall be delivered to the address of bidder indicated below.
- I. The terms in this Bid which are defined in the General Conditions of the Construction Contract included as part of the Contract Documents have the meanings assigned to them in the General Conditions.

SUBMITTED ON _____, 20____.

If BIDDER is:

An Individual

By: _____ (SEAL)
(Individual's Name)

Doing business as: _____

Business address: _____

Telephone No: _____

A Partnership

By: _____ (SEAL)
(Firm Name)

(General Partner)

Business address: _____

Telephone No: _____

A Corporation

By: _____(CORPORATE SEAL)
(Corporation Name)

(State of Incorporation)

By: _____
(Name of Person Authorized to Sign)

(Title)

Attest: _____
(Secretary)

Business address:

Telephone No.:

TABULATION OF SUBCONTRACTORS

The BIDDER shall list the subcontractors to be used on this project.

<u>Subcontractor</u>	<u>Address</u>	<u>Type of Work</u>	<u>Percentage of Project</u>

Dated at ____ this _____ day of _____, 20____.

BIDDER: _____

BY: _____
(Signature)

NAME: _____

TITLE: _____

EXPERIENCE RECORD

List of projects, similar to that covered by proposal, which BIDDER has successfully completed:

<u>Amount of Contract Award</u>	<u>Type of Work</u>	<u>Date Completed</u>	<u>Name and Address of Owner</u>

List of projects BIDDER is now engaged in completing:

<u>Amount of Contract Award</u>	<u>Type of Work</u>	<u>% Complete</u>	<u>Name and Address of Owner</u>

List of surety bonds in force on the above uncompleted work:

<u>Amount of Contract Award</u>	<u>Amount of Bond</u>	<u>Name of Surety Company</u>

Dated at _____ this _____ day of _____, 20____.

BIDDER: _____

BY: _____
(Signature)

NAME: _____

TITLE: _____

DATE: _____

Bidder as Principal Name: Mailing address (principal place of business): 	Surety Name: Mailing address (principal place of business):
Owner Name: Mailing address (principal place of business): 	Physical address (principal place of business): Telephone (Main): Telephone (Claims):
Procurement Contract Project name and number: Bid/Proposal Due Date: 	Surety's state of incorporation:
	<i>By submitting this bond, Surety affirms it is authorized to do business and licensed to execute bonds in the state of Texas.</i>
Bond Procurement Contract Price Offered: Penal Sum of Bond: 5% of Procurement Contract Price offered Date of Bond:	Local Agent for Surety Name: Mailing address (principal place of business): Telephone (Main):
	<i>The address of the surety company to which any notice of claim should be sent may be obtained from the Texas Dept. of Insurance by calling the following toll-free number: 1-800-252-3439.</i>

Surety and Offeror, intending to be legally bound by this bond, do each cause this bond to be duly executed on its behalf by its authorized officer, agent, or representative. The Offeror and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally to this bond. The condition of this obligation is such that if Buyer accepts Offeror's Bid/Proposal and Offeror delivers the executed Agreement and the required performance and payment bonds within the time stipulated in the Bidding/Proposal Documents this obligation is null and void. Payment under this bond will be due and payable upon default by Offeror and within 30 calendar days after receipt by Offeror and Surety of written notice of default from Buyer. Venue lies exclusively in Coryell County, Texas for any legal action.

Offeror as Principal Signature: _____ Name: _____ Title: _____ Email: _____	Surety Signature: _____ Name: _____ Title: _____ Email: _____ <i>(Attach Power of Attorney)</i>

END OF SECTION

FORM 06-A CONFLICT OF INTEREST QUESTIONNAIRE

CONFLICT OF INTEREST QUESTIONNAIRE For vendor doing business with local governmental entity		FORM CIQ
This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session. This questionnaire is being filed in accordance with Chapter 176 of the Local Government Code by a vendor who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the vendor meets requirements under Section 176.006(a). By law this questionnaire must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the vendor becomes aware of facts that require the statement to be filed. See Section 176.006(a-1), Local Government Code. A vendor commits an offense if the vendor knowingly violates Section 176.006, Local Government Code. An offense under this section is a misdemeanor.	OFFICE USE ONLY 	
1 Name of vendor who has a business relationship with local governmental entity.		
2 ☐ Check this box if you are filing an update to a previously filed questionnaire. (The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date on which you became aware that the originally filed questionnaire was incomplete or inaccurate.)		
3 Name of local government officer about whom the information is being disclosed.		
Name of Officer		
4 Describe each employment or other business relationship with the local government officer, or a family member of the officer, as described by Section 176.003(a)(2)(A). Also describe any family relationship with the local government officer. Complete subparts A and B for each employment or business relationship described. Attach additional pages to this Form CIQ as necessary.		
A. Is the local government officer or a family member of the officer receiving or likely to receive taxable income, other than investment income, from the vendor? ☐ Yes ☐ No		
B. Is the vendor receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer or a family member of the officer AND the taxable income is not received from the local governmental entity? ☐ Yes ☐ No		
5 Describe each employment or business relationship that the vendor named in Section 1 maintains with a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership interest of one percent or more.		
6 ☐ Check this box if the vendor has given the local government officer or a family member of the officer one or more gifts as described in Section 176.003(a)(2)(B), excluding gifts described in Section 176.003(a-1)		
7	Signature of vendor doing business with the governmental entity	Date

Form provided by Texas Ethics Commission

www.ethics.state.tx.us

Revised 11/30/2015

CONFLICT OF INTEREST QUESTIONNAIRE
For vendor doing business with local governmental entity

A complete copy of Chapter 176 of the Local Government Code may be found at <http://www.statutes.legis.state.tx.us/Docs/LG/htm/LG.176.htm>. For easy reference, below are some of the sections cited on this form.

Local Government Code § 176.001(1-a): "Business relationship" means a connection between two or more parties based on commercial activity of one of the parties. The term does not include a connection based on:

- (A) a transaction that is subject to rate or fee regulation by a federal, state, or local governmental entity or an agency of a federal, state, or local governmental entity;
- (B) a transaction conducted at a price and subject to terms available to the public; or
- (C) a purchase or lease of goods or services from a person that is chartered by a state or federal agency and that is subject to regular examination by, and reporting to, that agency.

Local Government Code § 176.003(a)(2)(A) and (B):

(a) A local government officer shall file a conflicts disclosure statement with respect to a vendor if:

(2) the vendor:

(A) has an employment or other business relationship with the local government officer or a family member of the officer that results in the officer or family member receiving taxable income, other than investment income, that exceeds \$2,500 during the 12-month period preceding the date that the officer becomes aware that

(i) a contract between the local governmental entity and vendor has been executed; or

or

(ii) the local governmental entity is considering entering into a contract with the vendor;

(B) has given to the local government officer or a family member of the officer one or more gifts that have an aggregate value of more than \$100 in the 12-month period preceding the date the officer becomes aware that:

(i) a contract between the local governmental entity and vendor has been executed; or

(ii) the local governmental entity is considering entering into a contract with the vendor.

Local Government Code § 176.006(a) and (a-1)

(a) A vendor shall file a completed conflict of interest questionnaire if the vendor has a business relationship with a local governmental entity and:

(1) has an employment or other business relationship with a local government officer of that local governmental entity, or a family member of the officer, described by Section 176.003(a)(2)(A);

(2) has given a local government officer of that local governmental entity, or a family member of the officer, one or more gifts with the aggregate value specified by Section 176.003(a)(2)(B), excluding any gift described by Section 176.003(a-1); or

(3) has a family relationship with a local government officer of that local governmental entity.

(a-1) The completed conflict of interest questionnaire must be filed with the appropriate records administrator not later than the seventh business day after the later of:

(1) the date that the vendor:

(A) begins discussions or negotiations to enter into a contract with the local governmental entity; or

(B) submits to the local governmental entity an application, response to a request for proposals or bids, correspondence, or another writing related to a potential contract with the local governmental entity; or

(2) the date the vendor becomes aware:

(A) of an employment or other business relationship with a local government officer, or a family member of the officer, described by Subsection (a);

(B) that the vendor has given one or more gifts described by Subsection (a); or

(C) of a family relationship with a local government officer.

END OF SECTION

STATE OF _____

COUNTY OF _____

Contract: **Northwest WWTP Clarifier Rehabilitation Project**
Contract 1-2025
Bid No. PW 2025-03-84

Bidder certifies that it has not been a party to any collusion among Bidders in the restraint of freedom of competition by agreement to submit a Bid or Proposal at a fixed price or to refrain from submitting a Bid or Proposal; or with any official or employee of the Owner as to quantity, quality, or price in the prospective contract, or any other terms of said prospective contract; or in any discussion between Bidders and any official of the Owner concerning exchange of money or other thing of value for special consideration in the letting of a contract.

Title: _____
(typed or printed)

Business Address:

Phone: _____ Email: _____
(Attach evidence of authority to sign if Bidder is a corporation, partnership, or a joint venture.)

END OF SECTION

FORM 06-C COMPLIANCE TO STATE SALES TAX CODE

Comply with all applicable sales, excise, and use tax requirements of the Texas Tax Code. The Bidder hereby certifies that the Procurement Contract Price is divided as follows:

Tax exempt products, materials, and services (See Notes 1 and 2)	\$	_____
Taxable products, materials, and services (See Note 3)	\$	_____
Total (See Note 4)	\$	_____

Bidder: _____
(typed or printed name of organization)

Signature: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Business Address: _____

Phone: _____ Email: _____

(Attach evidence of authority to sign if Bidder is a corporation, partnership, or a joint venture.)

Notes:

1. Exempt products and materials are those items purchased for the Project which are physically incorporated into the facilities constructed for the Owner or are necessary and essential for providing Goods and Special Services and are completely consumed for the Project. For purposes of this definition, products and materials are completely consumed if after being used once for its intended purpose it is used up or destroyed. Products and materials rented or leased for use in providing Goods and Special Services cannot be completely consumed for the purposes of this definition.
2. Exempt services are those services performed at the Site where the Procurement Contract expressly requires the specific service to be provided or purchased by the person performing the service is integral to providing Goods and Special Services.
3. Products, materials, and services are not tax exempt if they are used by the Seller but are not physically incorporated into the Buyer's facilities or are not consumed by construction or installation as defined above. Machinery or equipment and its accessories and repair and replacement parts used in providing Goods and Special Services are not exempt.
4. The total sum of the amount for tax exempt and taxable products, materials, and services must equal the Procurement Contract Price.

END OF SECTION

FORM 06-D COMPLIANCE TO STATE LAW ON NONRESIDENT BIDDERS

Texas Government Code Chapter 2252 applies to the award of government contract to nonresident bidders. This chapter provides that:

“a government entity may not award a governmental contract to a nonresident bidder unless the nonresident underbids the lower bid submitted by a responsible resident bidder by an amount that is not less than the amount by which a resident bidder would be required to underbid the nonresident bidder to obtain a comparable contract in the state in which the nonresident’s principal place of business is located.”

“Nonresident bidder” refers to a person who is not a resident of Texas.

“Resident bidder” refers to a person whose principal place of business is in this state, including a contractor whose ultimate parent company or majority owner has its principal place of business in this state.

Check the statement that is correct for Bidder:

- ☐ Bidder (includes parent company or majority owner) qualifies as a resident bidder whose principal place of business is in the state of Texas.
- ☐ Bidder qualifies as a nonresident bidder whose principal place of business or residency is in the state of: _____

Any determination of state bidder preference law is based on the Texas Comptroller’s annual summary of other state bidder preference laws.

Bidder: _____
(typed or printed name of organization)

Signature: _____
(individual’s signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Business Address: _____

Phone: _____ Email: _____

(Attach evidence of authority to sign if Bidder is a corporation, partnership, or a joint venture.)

END OF SECTION

CERTIFICATE OF INTERESTED PARTIES (FORM 1295)

A proponent that will be awarded a contract that is greater than \$25,000 is required to electronically create a Certificate of Interested Parties Form 1295 through the Texas Ethics Commission (“TEC”) website: https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm and submit a signed copy of the form to the City prior to the award of the contract. A contract, including a City- issued purchase order, will not be enforceable or legally binding until the City receives and acknowledges receipt of the properly completed Form 1295 from the vendor.

**City of Copperas Cove – Northwest WWTP Clarifier Rehabilitation Project
(Copperas Cove Bid No. PW 2025-03-84)**

VENDOR CERTIFICATIONS

The Proposer is required to submit the following information to Owner for consideration:

Provide responses that are clear and comprehensive.

Company name: _____

Permanent main
office address:

Street

City, ST

ZIP

Tax ID No.: _____

1. Provide a list of officers of the firm who, while in the employ of the firm or the employ of previous firms, were associated with contracts which resulted in lawsuits, contracts defaulted or filed for bankruptcy.

2. Form of ownership: ☐ Proprietorship ☐ Partnership ☐ Corporation ☐ Other (specify)

DEBARMENT/SUSPENSION INFORMATION:

1. Has the Respondent or any of its principals been debarred or suspended from contracting with any public entity? ☐ Yes ☐ No

If yes, identify in an attachment the public entity and the name and current phone number of a representative of the public entity familiar with the debarment or suspension, and state the reason for or circumstances surrounding the debarment or suspension, including but not limited to the period of time for such debarment or suspension.

CERTIFICATIONS:

1. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. ☐ Yes ☐ No

A. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the solicitation process or in the Contract execution;

B. "fraudulent practice" means an intentional misrepresentation of facts made

1. to influence the solicitation process or the execution of the Contract to the detriment of Owner,

2. to establish Cost Estimate or Contract prices at artificial non-competitive levels, or

3. to deprive Owner of the benefits of free and open competition;

C. "collusive practice" means a scheme or arrangement between two or more Respondents, with or without the knowledge of Owner, a purpose of which is to establish Cost Estimates at artificial, non-competitive levels; and

D. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the solicitation process or affect the execution of the Contract.

**City of Copperas Cove – Northwest WWTP Clarifier Rehabilitation Project
(Copperas Cove Bid No. PW 2025-03-84)**

2. HOUSE BILL 89 VERIFICATION

- A. Contractor shall verify that its named company, under the provisions of Subtitle F Title 10 Government Code Chapter 2270: ☐ Yes ☐ No
1. Does not boycott Israel currently; and
 2. Will not boycott Israel during the term of the contract.

Pursuant to Section 2270.001, Texas Government Code:

1. "Boycott Israel" means refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on or limit commercial relations specifically with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory, but does not include an action made for ordinary business purposes; and
2. "Company" means a for-profit sole proprietorship, organization, association, corporation, partnership, joint venture, limited partnership, limited liability partnership, or any limited liability company, including a wholly owned subsidiary, majority-owned subsidiary, parent company or affiliate of those entities or business associations that exist to make a profit.

3. SENATE BILL 252 VERIFICATION

- A. Contractor acknowledges they are not listed by the Comptroller of the State of Texas, per 85(R) SB252 concerning the listing of companies that have ties to the Government of Sudan, the Government of Iraq, ties with foreign terrorist organizations, or a foreign terrorist organization: ☐ Yes ☐ No

4. SENATE BILL 13 VERIFICATION

Pursuant to Texas Government Code Section 2274.002, as added by Acts of the 87th Legislature as Senate Bill 13 (SB13), this section only applies to a contract between the City and a Contractor with at least ten (10) full-time employees that has a value of at least \$100,000.

- A. Contractor, following review of Texas Government Code Chapter 2274 (SB13 Version), hereby verifies that Contractor: 1) does not boycott energy companies; and 2) will not boycott energy companies during the term of the contract: ☐ Yes ☐ No

5. SENATE BILL 19 VERIFICATION

Pursuant to Texas Government Code Section 2274.002, as added by Acts of the 87th Legislature as Senate Bill 19 (SB19), this section only applies to a contract between the City and a Contractor with at least ten (10) full-time employees that has a value of at least \$100,000.

- A. Contractor, following review of Texas Government Code Chapter 2274 (SB19 Version), hereby verifies that Contractor: 1) does not have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association; and 2) will not discriminate during the term of the contract against a firearm entity or firearm trade association: ☐ Yes ☐ No

SEE NEXT PAGE FOR ACKNOWLEDGEMENT

ACKNOWLEDGEMENT

THE STATE OF TEXAS
COUNTY OF _____

I certify that I have read all of the specifications and general requirements and do here by certify that all items submitted meet specifications. I certify that my responses and the information provided are true and correct to the best of my personal knowledge and belief and that I have made no willful misrepresentations in this Questionnaire, nor have I withheld any relevant information in my statements and answers to questions. I am aware that any information given by me in this questionnaire may be investigated and I hereby give my full permission for any such investigation and I fully acknowledge that any misrepresentations or omissions in my responses and information may cause my response to this solicitation to be rejected.

Company's Name

Signature, Authorized Representative of Respondent

Title

Capital Improvement Project Construction Agreement Between Owner and Contractor

THE STATE OF TEXAS §
 §
COUNTY OF CORYELL §

THIS AGREEMENT (“Contract”) is made by and between the City of Copperas Cove (“Owner”) and _____ (“Contractor”). Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

Northwest WWTP Clarifier Rehabilitation Project.

ARTICLE II – THE PROJECT

2.01 The Project of which the Work under the Contract Documents is generally described as follows:

Northwest WWTP Clarifier Rehabilitation Project:

1. Retrofitting two existing 85-foot-diameter clarifiers with suction-header-type clarifier mechanisms.
2. Construction of a new at-grade RAS/WAS pumping station.
3. Construction of a new elevated walkway along the exterior of the existing clarifiers.

ARTICLE III – ENGINEER

- 3.01 The Project has been designed by Strand Associates, Inc.[®]
- 3.02 The Owner will assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE IV – CONTRACT TIMES

- 4.01 *Time is of the Essence:* All time limits for Milestones, if any, Substantial Completion and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

- 4.02 *Contract Times: Days:* The work shall be substantially completed **within 365 Calendar days** after the date when the Contract Times commence to run as provided in Paragraph 5.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 9.06 of the General Conditions within **425 Calendar days** after the date when the Contract Times commence to run.
- 4.03 *Liquidated Damages:* Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration preceding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty) shall be in such amount as stated in Section 5.06 of the General Conditions.

ARTICLE V – CONTRACT PRICE

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents the amounts that follow, in accordance with the General Conditions:
- A. For all Work, at the unit prices stated in Contractor's Bid, attached hereto as an exhibit.

ARTICLE VI – PAYMENT PROCEDURES

- 6.01 Submittal and Processing Payments. Owner shall make payments and Contractor shall be entitled to receive payments under this Agreement as specified in Sections 9.04, 9.05, 9.06, 9.07, 9.08, 9.09 and 9.10 of the General Conditions.

ARTICLE VII – INTEREST

- 7.01 All amounts not paid when due shall bear interest at the rate determined in accordance with the Texas Prompt payment Act, Texas Government Code, Chapter 2251.025.

ARTICLE VIII – CONTRACTOR’S REPRESENTATIONS

- 8.01 In order to Induce Owner to enter into this Contract, Contractor makes the following representations:
- A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified In the Contract Documents.
- B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Contractor is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Contract Documents, especially with respect to Technical Data in such reports and drawings.

E. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings Identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (3) Contractor's safety precautions and programs.

F. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

J. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

ARTICLE IX – CONTRACT DOCUMENTS

9.01 *Contents*

A. The Contract Documents consist of the following:

1. This Agreement (pages __ to __ inclusive).
2. Performance bond.
3. Payment bond.
4. General Conditions (pages __ to __ inclusive).
5. Supplementary Conditions (pages __ to __ inclusive).

6. Specifications and all other documents as listed in the table of contents of the Project Manual.
 7. The Drawings listed on the attached sheet index.
 8. Addenda (numbers __ to __ inclusive).
 9. Exhibits to this Agreement (enumerated as follows):
 - a. Contractor's Bid (pages __ to __ inclusive).
 - b. Prevailing Wage Determination.
 10. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice to Proceed.
 - b. Work Change Directives.
 - c. Change Orders.
 - d. Field Orders.
 - e. Special Supplements.
- B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article IX.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

ARTICLE – X – MISCELLANEOUS

10.01 *Terms.*

A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.

10.02 *Assignment of Contract.*

A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary In any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.03 *Successors and Assigns.*

A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 *Severability.*

A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.05 *Jurisdiction and Venue.*

A. This Contract shall be governed by, and construed in accordance with, the laws of the state of Texas, without regard to principles or conflict of laws; and shall be fully performable in Coryell County, Texas.

10.06 *No Waiver.*

A. The failure of OWNER or Contractor to enforce any provision of this Contract does not constitute a waiver of that provision, affect the enforceability of that provision, or the enforceability of the remainder of this Contract.

10.07 *Survival of Obligations.*

A. Representations, indemnifications, warranties, guarantees, and continuing obligations required by the Contract Documents survive completion and acceptance of the work or termination of the Contract.

10.08 *No Third-Party Beneficiaries.*

A. Nothing in this Contract can be construed to create rights in any entity other than the OWNER and Contractor. Neither the OWNER nor Contractor intends to create third party beneficiaries by entering into this Contract.

10.09 *No Waiver of Sovereign Immunity.*

A. Except to the extent provided by State law, the OWNER has not waived its sovereign immunity by entering into and performing its obligations under this Contract.

10.10 *Execution.*

A. This Contract may be executed in one or more counterparts and may be exchanged by facsimile or other electronic means. It is stipulated and agreed that any counterpart containing a signature or facsimile signature of the authorized representatives of OWNER and Contractor will be deemed an original for all purposes.

10.11 *Non-Exclusivity.*

A. Contractor acknowledges and agrees that this Contract constitutes a non-exclusive agreement for the provision of the work to OWNER. Contractor further acknowledges and agrees that OWNER has not made any representations that Contractor will be the sole or exclusive provider of any related work to OWNER during the course of the Project. Due

to the extensiveness and complexity of the project, OWNER, in its sole and absolute discretion, reserves the right to award multiple contracts for the provision of the related work, if any.

10.12 *Conflicts of Interest.*

A. Neither Contractor, nor any agent or subcontractor thereof, will have other interests which conflict with the interests of OWNER, specifically including, but not limited to, a connection with the sale or promotion of equipment or material which may be used on the project. Contractor agrees to make reasonable inquiry of all agents or subcontractors concerning the existence of or potential for such conflicts.

10.13 *Due Authorization; Good Standing.*

A. Contractor represents and warrants that Contractor has the power and authority to enter into this Contract. The execution and delivery of this Contract and the performance of the work hereunder has been duly authorized by all necessary corporate action. Upon execution, this Contract will constitute the binding and valid obligations of Contractor enforceable in accordance with its terms. Contractor further warrants that he is in good standing in and qualified to do business in the State of Texas.

10.14 *Conflict.*

A. In the event any document submitted by the Contractor conflicts with the terms of these Contract Documents, it is understood and agreed that the terms of the Contract Documents will prevail.

Executed to be effective on _____, 20____ (which is the Effective Date of this Contract).

CITY OF COPPERAS COVE TEXAS:

ATTEST:

Ryan Haverlah, City Manager
City of Copperas Cove, Texas

Lisa Wilson, City Secretary
City of Copperas Cove, Texas

CONTRACTOR:

By:
Title:

GENERAL CONDITIONS OF THE AGREEMENT

City of Copperas Cove

1. DEFINITIONS
2. GENERAL PROVISIONS
 - 2.01 Engineer's Status and Authority
 - 2.02 Right of Engineer to Modify Methods and Equipment
 - 2.03 Changes and Alterations
 - 2.04 Damages
 - 2.05 Losses from Natural Causes
 - 2.06 Laws and Ordinances
 - 2.07 Licenses, Permits, and Certificates
 - 2.08 Royalties and Patents
 - 2.09 Keeping of Plans and Specifications Accessible
 - 2.10 Discrepancies and Omissions
 - 2.11 Contractor's Understanding
 - 2.12 Extra Work
 - 2.13 Payment for Extra Work
 - 2.14 Assignment and Subletting
 - 2.15 Subcontractors
 - 2.16 Owner's Status
 - 2.17 Completed Portions of Work
 - 2.18 Materials
 - 2.19 Receiving and Storage of Materials
 - 2.20 "Or Equal" Clause
 - 2.21 Completed Work
 - 2.22 Materials Furnished by the Owner
 - 2.23 Protection of Property
 - 2.24 Shelters for Workmen and Materials
 - 2.25 Sanitary Facilities
3. CONTRACTOR'S OBLIGATIONS AND RESPONSIBILITIES
 - 3.01 Labor, Equipment, Materials and Construction Plant
 - 3.02 Performance and Payment Bonds
 - 3.03 Contractor's Ability to Perform
 - 3.04 Superintendence and inspection
 - 3.05 Character of Employees
 - 3.06 Contractor's Duty to Protect Persons and Property
 - 3.07 Safety Codes
 - 3.08 Barricades
 - 3.09 Minimum Wages
 - 3.10 Unsuitable Work or materials
 - 3.11 No Waiver of Contractor's Obligation
 - 3.12 Site Clean Up
 - 3.13 Guarantee
4. OWNER'S OBLIGATIONS AND RESPONSIBILITIES
 - 4.01 Lines and Grades
 - 4.02 Right of Entry
 - 4.03 Owner's Inspectors

- 4.04 Collateral Work
- 4.05 Environmental Assessment
- 4.06 Right-of-Way
- 4.07 Adequacy of Design

- 5. SCHEDULING AND PROGRESS OF WORK
 - 5.01 Order and Execution of the Work
 - 5.02 Rate of progress
 - 5.03 Sunday, Holiday and Night Work
 - 5.04 Hindrances and Delays
 - 5.05 Extensions of Time
 - 5.06 Liquidated Damages for Failure to Complete on Time

- 6. INDEMNITY
 - 6.01 Contractor's Indemnity Provision
 - 6.02 Workmen's Compensation Insurance
 - 6.03 Comprehensive General Liability Insurance
 - 6.04 Owner's Protective Insurance
 - 6.05 Comprehensive Automobile Liability insurance
 - 6.06 Insurance Certificate

- 7. TERMINATION OF CONTRACT
 - 7.01 Right of Owner to Terminate
 - 7.02 Right of Contractor to Terminate
 - 7.03 Removal of Equipment

- 8. ABANDONMENT OF CONTRACT BY CONTRACTOR
 - 8.01 Notification of Contractor
 - 8.02 Retention of Contractor's Equipment and Materials by Owner
 - 8.03 Methods of Completing the Work
 - 8.04 Final Acceptance
 - 8.05 Disposition of Contractor's Equipment

- 9. MEASUREMENT AND PAYMENT
 - 9.01 Character of Measurements
 - 9.02 Estimated vs. Actual Quantities
 - 9.03 Payment
 - 9.04 Monthly Estimates and Payments
 - 9.05 Certificates of Completion
 - 9.06 Final Estimate and Payment
 - 9.07 Notarized Affidavit
 - 9.08 Release of Liability
 - 9.09 Contractor's Obligation
 - 9.10 Payments Withheld

- 10. CLAIMS
 - 10.01 Claims Process

GENERAL CONDITIONS OF THE AGREEMENT

City of Copperas Cove

1. DEFINITIONS

1.01 Calendar Day. A calendar day shall be the 24-hour period from one midnight to the next consecutive midnight.

1.01.1 Change Directive. A written directive issued to Contractor on or after the Effective Date of the Contract ordering an addition, deletion, or revision in the work. The work Change Directive serves as a memorandum of understanding regarding the Change Directive until a Change Order can be issued.

1.01.2 Change Order. A document issued on or after the Effective Date of the Contract and signed by OWNER and Contractor which modifies the work, Contract price, Contract times, or terms and conditions of the Contract.

1.02 Contract Documents. The Contract Documents shall consist of the Notice to contractors; the Instructions to Bidders; the proposal and Bidding Sheets; the executed Agreement; the Performance and Payment Bonds; the General Conditions of the Agreement; the Supplemental General Conditions of the Agreement; the Governmental Contract and Purchasing Rider, the Specifications; the Plans; the Standard Drawings; Addenda; duly authorized Change Orders; and executed Special Supplements, if any. The Contract Documents are complementary, and what is called for by any one shall be as binding as if called for by all. In case of conflict between the contract Documents, unless otherwise specifically provided in the Contract Documents, the most stringent provision shall control.

1.03 Contractor. "Contractor" shall mean the business organization or individual named and designated in the Contract Agreement as the "party of the Second Part," who has entered into this contract for the performance of the work covered thereby, and its, his, or their duly authorized agents and other legal representatives.

1.04 Engineer. "Engineer" shall mean Owner's Representative or such other Engineer, supervisor, or inspector who has been designated, appointed, or otherwise employed or delegated by the OWNER for this work, or their duly authorized agents, such agents acting within the scope of the particular duties entrusted to them in each case.

1.05 Extra Work. The term "extra work" as used in this contract shall be understood to mean and include all work that may be required by the Engineer or OWNER to be done by the Contractor to accomplish any change, alteration, or addition to the work shown on the Plans, or reasonably implied by the Specifications, and not covered by the Contractors Proposal, except as provided under "Changes and Alterations," herein.

1.05.1 Field Order. A document issued by the Engineer requiring changes in the work that do not change the Contract price or the Contract times.

1.06 OWNER. "OWNER" shall mean CITY OF COPPERAS COVE, named and designated in the Agreement as the "Party of the First Part" acting through its duly authorized officers and agents.

1.07 Plans. "Plans" shall mean and include (a) all drawings prepared by the OWNER as a basis for proposal, (b) all supplementary drawings furnished by Engineer as and when required to clarify the intent and meaning of the drawings submitted by the OWNER to the Contractor, and (c) drawings submitted by the Contractor to the OWNER when and as approved by the Engineer.

1.08 Specifications. "Specifications" shall mean (a) all written descriptions, methods and instructions prepared by the OWNER as a basis for proposals, (b) all supplementary written material furnished by the Engineer as and when required to clarify the intent or meaning of all written descriptions, methods and instructions submitted by the OWNER to the contractors, and (c) written descriptions submitted by the Contractor to the OWNER when and

as approved by the Engineer.

1.09 Subcontractor. “Subcontractor” shall mean and refer only to a business organization or individual having a direct contract with the Contractor for (a) performing a portion of the Contract work, of (b) furnishing material worked to a special design according to the Contract plans or specifications; it does not, however, include one who merely furnishes material not so worked.

1.10 Substantially Completed. The term “substantially completed” shall mean that the structure or facility has been made suitable for use and is in condition to serve its intended purpose, but still may require minor miscellaneous work and adjustments. Substantial completion shall be considered the date that the OWNER accepts the work as substantially complete in accordance with this Agreement.

1.11 Work. “Work” shall mean the work to be done and the equipment, supplies, material, and services to be furnished under the Contract unless some other meaning is indicated by the context.

1.12 Working Day. A “working day” is defined as any day not including Sundays or legal holidays, in which weather or other conditions, not under the control of the Contractor, will permit construction of the principal units of the work for a continuous period of not less than seven (7) hours between 7:00 a.m. and 6:00 p.m.

1.13 Written Notice. “Written Notice” shall be deemed to have been duly served if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by certified or registered mail to the last business address known to him who gives the notice.

2. GENERAL PROVISIONS

2.01 Engineer’s Status and Authority. It is mutually agreed by and between the parties to this Contract that the Engineer shall have general oversight and direction of the work included herein. In order to prevent delays and disputes and to discourage litigation it is further agreed by and between the parties of this Contract that the Engineer shall in all cases determine the amounts and quantities of the several kinds of work which are to be paid for under the Contract; that he shall determine all questions in relation to said work and the construction thereof, that he shall in all cases decide every question which may arise relative to the execution of the Contract on the part of the contractor, that his decisions and findings shall be the conditions precedent to the right of the parties hereto to proceed with the claim process provided in Section 10.01, including dispute resolution or to any action on the Contract and to the rights of the Contractor to receive any money under this Contract; provided, however, that should the Engineer render any decision or give any direction which in the opinion of either party hereto is not in accordance with the meaning and intent of this Contract, either party may file with the Engineer within 7 days a written objection to the decision or direction so rendered in conformance with Section 10.01. It is the intent of this Agreement that there shall be no delay in the execution of the work, and the decision or directions of the Engineer as rendered shall be promptly carried out.

2.02 Right of Engineer to Modify Methods and Equipment. If at any time the methods or equipment used by the Contractor are found to be unsafe or inadequate to secure the quality of the work or the rate of progress required under this Contract, the Engineer may direct the Contractor in writing to increase their safety or improve their character and efficiency and to cease operations under this Contract until such direction is complied with. No claims shall be made against the OWNER for damages caused by any delay resulting from such order.

2.03 Changes and Alterations.

A. The Contractor agrees that the OWNER, through the Engineer and via a Change Order, Change Directive or Field Order, may make such changes and alterations as the OWNER may see fit in the line, grade, form, dimensions, plans, or materials for the work herein contemplated or any part thereof either before or after the beginning of the construction without affecting the validity of this Contract and the accompanying bonds. If such changes or alterations diminish the quantity of the work to be done, they shall not constitute the basis for a claim for damages or anticipated profits on the work that may be dispensed with. If they increase the amount of work and the increased work can fairly be classified under the specifications, such increase shall be paid for according to the quantity actually done and at the unit price established for such work under this contract;

otherwise such work shall be paid for as provided under Section 2.12 "Extra Work." In the event the OWNER shall make such changes or alternations which will make useless any work already done or material already furnished or used in said work, then the OWNER shall compensate the Contractor for any materials or labor so used, for any actual loss occasioned by such change, and for the actual expense incurred in preparation for the work as originally planned, unless OWNER has already paid for the work.

B. The Contract Documents may be modified by a Change Order, Change Directive, or Field Order.

1. Change Order: All changes to the Contract Documents that include a change in the Contract price or times for previously authorized work, or changes to the work requiring Engineer's approval must be made by Change Order. A Change Order may also be used to establish modifications of the Contract Documents that do not affect the Contract price or times.

2. Change Directive: A Change Directive authorized by the OWNER does not change the Contract price or times but is evidence that the parties expect that the modifications ordered or documented by a Change Directive are to be incorporated in a subsequently issued Change Order following negotiations on the Contract price and/or times. Contractor must submit a Change Order proposal seeking an adjustment of the Contract price or times no later than 30 days after the completion of the changes set out in the Change Directive if negotiations are unsuccessful under the terms of the Contract Documents.

3. Field Order: The Engineer may authorize minor changes in the work that do not change the Contract price or times using a Field Order. Contractor shall submit a Change Order if Contractor believes that a Field Order justifies an adjustment in the Contract price or times and secure approval from the OWNER before proceeding with the work described in the Field Order.

C. Added or revised work shall be provided by Contractor under the applicable provisions of the Contract Documents for the same or similar work unless different Drawings, Specifications or directions are provided in the Change Order, Change Directive, or Field Order.

2.04 Damages. The right of general oversight by the Engineer or OWNER shall not make the Contractor an agent of the Engineer or OWNER, and the liability of the Contractor for all damages to persons, firms, and corporations arising from the Contractor's execution of the work shall not be lessened because of such general supervision. The Contractor is an independent contractor in regard to work under this Contract, and as such is solely liable for all damages to any persons, firms, corporations, or their property as a result of the execution of the work.

2.05 Losses from Natural Causes. All loss or damage arising out of the nature of the work to be done or from the action of the elements or from any unforeseen circumstances in the prosecution of the work or from unusual obstructions or difficulties which may be encountered in the execution of the work shall be sustained and borne by the Contractor at his own costs and expense.

2.06 Laws and Ordinances. The Contractor shall at all times observe and comply with all Federal, State, and local laws, ordinances, rules and regulations which in any manner affect the Contract or the work and SHALL INDEMNIFY AND SAVE HARMLESS THE OWNER AGAINST ANY CLAIM ARISING FROM THE VIOLATION OF ANY SUCH LAWS AND ORDINANCES WHETHER BY THE CONTRACTOR OR HIS EMPLOYEES OR HIS SUBCONTRACTORS AND THEIR EMPLOYEES.

2.07 Licenses, Permits and Certificates. Except as hereinafter stipulated, all licenses, permits, certificates, etc. required for and in connection with the work to be performed under the provisions of these Contract Documents shall be secured by the Contractor at his own expense. In the event a building permit is required, such permit will be obtained by the OWNER at no cost to the Contractor.

2.08 Royalties and Patents. THE CONTRACTOR SHALL PROTECT, INDEMNIFY AND SAVE HARMLESS THE OWNER FROM ALL AND EVERY DEMAND FOR DAMAGES, ROYALTIES, OR FEES ON ANY PATENTED INVENTION USED BY HIM IN CONNECTION WITH THE WORK DONE OR MATERIAL FURNISHED UNDER THIS CONTRACT; provided, however, that if any patented material, machinery, application, or invention is clearly specified in this Contract, the cost of procuring the rights of use and the legal release or indemnity shall be borne and paid by the OWNER direct unless such cost is determined and directed to be included in the bid price at the time the Proposal is submitted.

2.09 Keeping of Plans and Specifications Accessible. The Engineer shall furnish the Contractor with three (3) sets of executed Plans and Specifications without expense to him, and the Contractor shall keep one (1) copy of the same constantly accessible on the work, with the latest revisions noted thereon.

2.10 Discrepancies and Omissions. It is further agreed that it is the intent of this Contract that all work must be done and all material must be furnished in accordance with the generally accepted practice, and in the event of any discrepancies between the separate contract documents, the priority of interpretation defined under "Contract Documents" shall govern. In the event that there is still any doubt as to the meaning and intent of any portion of the Contract, Specifications or Drawings, the Engineer shall define which is intended to apply to the work.

2.11 Contractor's Understanding. It is understood and agreed, and Contractor warrants that the Contractor has, by careful examination, satisfied himself as to the nature and location of the work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the character of equipment and facilities needed preliminary to and during the execution of the work, the general and local conditions, and all other matters which can in any way affect the work, price or time provided under this Contract, and that no claim shall be advanced by Contractor for any unforeseen conditions or circumstances. No verbal agreement or conversation with any officer, agent, or employee of the OWNER, either before or after the execution of this Contract, shall affect or modify any of the terms or obligations herein contained.

2.12 Extra Work. The term "extra work" as used in this Contract shall be understood to mean and include all work that may be required by the OWNER through the Engineer to be done by the Contractor to accomplish any change, alteration, or addition to the work shown by the Plans or reasonably implied by the Specifications and not covered by the contractor's Proposal, except as provided in Section 2.03 - "Changes and Alterations."

It is agreed that the Contractor shall perform all extra work under the direction of the Engineer when presented with a written Change Order, Change Directive or Field Order signed by the OWNER or Engineer, as applicable.

No claim for extra work or any additional Contract time extension associated with said extra work of any kind will be allowed unless extra work is ordered in writing by the OWNER. In case any orders or instructions, either oral or written, appear to the Contractor to involve extra work for which he should receive compensation and/or an extension of Contract time, he shall make a written request to the OWNER for a written Change Order authorizing such extra work and shall not proceed with such extra work until so authorized by OWNER through a signed Change Order. Should a difference of opinion arise as to what does or does not constitute extra work or concerning the payment thereof and the OWNER insists upon its performance, the Contractor shall proceed with the work after making a written request for a written Change Order and shall keep an accurate account of the "actual field cost" thereof as provided under Method "C" below. Contractor shall also promptly proceed with a claim in accordance with Section 10.01.

2.13 Payment for Extra Work. It is agreed that the compensation to be paid the Contractor for performing extra work shall be determined by one or more of the following methods:

Method "A" - By agreed unit prices;

Method "B" - By agreed lump sum; or

Method "C". If neither Method "A" nor Method "B" can be agreed upon before the extra work is commenced, then the Contractor shall be paid the "actual field cost" of the work plus 15%, subject to the claims process provided in Section 10.01.

Where extra work is performed under Method "C", the term "actual field cost" of such extra work is hereby defined to be and shall include: (a) the payroll cost for all workman, such as foreman, mechanics, craftsmen, and laborers; (b) the cost of all materials and supplies not furnished by the OWNER; (c) rental for all power-driven equipment at agreed-upon rates for the time actually employed or used in the performance of the extra work; (d) transportation charges necessarily incurred in connection with any equipment authorized by the Engineer for use on said extra work and which is not already on the job; (e) all power, fuel, lubricants, water, and similar operating expenses; (f) all incidental expenses incurred as a direct result of such extra work including sales or use taxes on materials, payroll taxes, and the additional premiums for construction bonds, workmen's

compensation, public liability and property damage, and other insurance required by the Contract where the premiums therefore are based on payroll and material costs. The Engineer may direct the form in which accounts of the “actual field costs” shall be kept and may also specify in writing before the work commences the method of doing the work and they type and kind of machinery and equipment to be used; otherwise these matters shall be determined by the Contractor. Unless otherwise agreed upon, the prices for the use of machinery and equipment shall be incorporated in the written extra work Change Order. The 15% of the “actual field cost” to be paid the Contractor shall cover and compensate him for his profit, overhead, and general superintendence.

2.14 Assignment and Subletting. The Contractor shall not assign or sublet the work or any part thereof without the previous written consent of the OWNER, nor shall he assign, by power of attorney or otherwise, any of the money payable under this Contract unless by and with the consent of the OWNER to be signified in like manner. If the Contractor assigns all or any part of any monies due or to become due under this Contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due to the Contractor shall be subject to all prior liens of all persons, firms, and corporations for services rendered or materials supplied for the performance of the work called for in this Contract.

2.15 Subcontractors. The Contractor shall be as fully responsible to the OWNER for the acts and omissions of his subcontractors and of persons either directly or indirectly employed by him. Should any subcontractor fail to perform the work undertaken by him in a satisfactory manner, his subcontract shall be immediately terminated by the Contractor upon written notice from the OWNER.

2.16 OWNER’s Status. Nothing contained in this Contract shall create any contractual relation between any subcontractor and the OWNER.

2.17 Completed Portions of Work. The OWNER shall have the right to take possession of and to use any completed or partially completed portions of the work prior to completion of the entire work, but such use shall not constitute an acceptance of any of the work not completed in accordance with the Contract Documents. If the Engineer determines that taking possession of and using partially completed work substantially increases the cost of or delays construction, the Contractor shall be entitled to extra compensation, extension of time or both as determined by the Engineer.

2.18 Materials. All materials furnished by the contractor shall be as required by the Plans and Specifications or as otherwise stipulated. The Contractor shall not start delivery of materials which he is to furnish until the Engineer has approved the source of supply of such materials.

2.19 Receiving and Storage of Materials. The Contractor shall make arrangements for receiving and storing materials. The OWNER will not sign for or receive shipments of materials consigned to the Contractor. The OWNER will not furnish storage space for materials except where the written permission of the Engineer is given.

2.20 “Or Equal” Clause. Whenever a material, product, or article is specified or shown on the Plans by using the name of the proprietary product or of a particular manufacturer or vendor and is followed by the term “or equal,” the Contractor may submit a written request to the Engineer requesting approval of the use of a material, product, or article he feels is truly equal to the one specified. The Engineer will evaluate the request to determine if the material, product, or article is of equal substance and function and if it will perform identically the duties imposed by the general design. Written approval of an “or equal” material, product, or article must be obtained from the Engineer before it may be incorporated into the work as a substitute for that specified in the contract Documents.

2.21 Completed Work. The Contractor shall maintain continuous adequate safeguards to protect all completed work from damage, loss, or the intrusion of foreign elements and shall be liable for any such damage or loss until the work is finally accepted by OWNER.

2.22 Materials Furnished by the OWNER. The contractor shall assume responsibility for and safeguard against loss or injury, any and all materials supplied by the OWNER. This provision shall extend to the taking of all necessary sanitary precautions to avoid contamination of such materials that must be maintained and

incorporated into the work in a sanitary condition.

2.23 Protection of Property. The Contractor shall give prompt notice to the OWNER or other owners of public or private property and utilities when such property is subject to injury or damage through the performance of the work and he shall make all necessary arrangements with such OWNER or owners relative to the removal and replacement or protection of such property or utilities.

The Contractor shall satisfactorily shore, support, and protect any and all structures, and all pipes, sewers, drains, conduits, and the facilities belonging to the OWNER, and he shall be responsible for any damage resulting thereto. The Contractor shall not be entitled to any damages or extra pay as a result of any postponement, interference, or delay caused by any such structures and facilities being on the line of the work whether they are shown on the Plans or not.

2.24 Shelters for Workmen and Materials. The building or structures for housing men or the erection of tents or other forms of protection for workmen or materials will be permitted only as the Engineer shall authorize or direct. The sanitary conditions of the grounds in or about such structures shall at all times be maintained in a manner satisfactory to the Engineer.

2.25 Sanitary Facilities. Necessary sanitary toilet facilities for the use of all employees on the work shall be of a type complying with State and local sanitary regulations and shall be constructed and maintained by the Contractor in such manner and at such points as shall be approved by the Engineer. Their use shall be strictly enforced.

3. CONTRACTOR'S OBLIGATIONS AND RESPONSIBILITIES

3.01 Labor, Equipment, Materials and Construction Plant. The Contractor shall provide all labor, tools, equipment, machinery, supplies, and materials necessary for the execution and completion of this Contract where it is not specifically provided that the OWNER shall furnish them. The OWNER shall not be held responsible for the care, preservation, conservation, or protection of any material, tools, or machinery on any part of the work until it is finally completed and accepted. The contractor shall maintain on the job at all times sufficient labor, material, and equipment to adequately prosecute the work.

3.02 Performance and Payment Bonds. It is further agreed by the Parties to this Contract that the contractor will execute separate performance and payment bonds, each in the sum of 100% of the total Contract price in standard forms for this purpose, guaranteeing faithful performance of the work and the fulfillment of any guarantees required and further guaranteeing payment to all persons supplying labor and materials of furnishing him any equipment in the execution of the Contract. These bonds shall also be subject to any provisions in the Supplemental General Conditions to this Contract. It is agreed that the Contract shall not be in effect until such performance and payment bonds are furnished and approved by the OWNER. The cost of the premium for the performance and payment bonds shall be included in the price bid by the Contractor for the work under this Contract, and no extra payment for such bonds will be made by the OWNER.

The surety company or companies underwriting the performance and payment bonds shall be acceptable according to the latest list of companies holding certificates of authority from the secretary of the Treasury of the United States, shall be duly authorized to act under the laws of the State of Texas as SURETY, and shall be approved by the OWNER.

3.03 Contractor's Ability to Perform. Upon receipt by the OWNER the Contractor shall furnish sufficient evidence of his ability to perform the work which is outlined in this document. This shall include an equipment inventory and records showing the satisfactory completion of projects of equal magnitude in the past. It shall be the prerogative of the OWNER to terminate the contract as outlined in Section 7 "Termination of contract," if job progress indicates that the contractor lacks either appropriate experience or ability.

3.04 Superintendence and Inspection. The Contractor shall give personal attention to the faithful execution and completion of the contract and shall keep a competent superintendent and any necessary assistants, all of whom are satisfactory to the Engineer, on the work continuously during its progress. The superintendent shall

represent the Contractor in his absence, and all directions given to him by the OWNER'S representative shall be as binding as if given to the Contractor.

In the event that the Contractor and the superintendent are both absent from the site of the work for prolonged periods of time, the Engineer may order any or all work under this Contract to be stopped until the Contractor provides continuous and proper supervision of the work. Such stoppage shall not constitute a basis for any claim against the OWNER for damages caused by delay for such work stoppage.

3.05 Character of Employees. The Contractor agrees to employ only orderly, competent, and skillful persons to do the work, and whenever the Engineer shall inform him that the work being accomplished is of substandard character by reason of carelessness, incompetence, or inexperience on the part of the workers the installation of such work shall be immediately suspended and shall not be resumed until the Engineer is satisfied that the conditions causing such faulty work have been corrected.

3.06 Contractor's Duty to Protect Persons and Property. In the performance of this Contract, the Contractor shall protect the public and the OWNER fully by taking reasonable precaution to safeguard persons from death or bodily injury and to safeguard property of any nature whatsoever from damage. Where any dangerous condition or nuisance exists in and around construction sites, equipment and supply storage areas, and other areas in anyway connected with the performance of this Contract, the Contractor shall not create excavations, obstructions, or any dangerous condition or nuisance of any nature whatsoever in connection with the performance of this Contract unless necessary to its performance, and in that event the contractor shall provide and maintain at all times reasonable means of warning of any danger or nuisance created. The duties of the Contractor in this paragraph shall be non-delegable, and the Contractor's compliance with the specific recommendations and requirements of the OWNER as to the means of warning shall not excuse the Contractor from the faithful performance of these duties should such recommendations and requirements not be adequate or reasonable under the circumstances.

3.07 Safety Codes. The Contractor shall comply with all applicable provisions of any Federal, State, and Municipal safety laws and building and construction codes. All machinery, equipment, and other physical hazards shall be guarded in accordance with Federal, State, or Municipal laws or regulations.

3.08 Barricades. When barricades are used to satisfy safety requirements, such barricades shall be properly identified with the Contractor's name prominently stenciled on both sides of the barricades with letters at least 2 inches high.

3.09 Minimum Wages. All employees directly employed on the work shall be paid not less than the established prevailing wage scale for work of a similar character in this locality. A prevailing wage determination for the work has been included with this contract and is incorporated herein for all purposes. The Contractor shall pay not less than the general prevailing wages as established by the U.S. Department of Labor and shall keep accurate wage records accessible in accordance with Chapter 2258, Texas Government Code.

3.10 Unsuitable Work or Materials. It is understood and agreed that if the work or any part thereof or any material furnished by the Contractor for use in the work or selected for the same shall be deemed by the Engineer as unsuitable or not in conformity with the specifications, the Contractor shall, after receipt of written notice thereof from the Contracting Officer, forthwith remove such material and replace, rebuild, or otherwise remedy such work so that it shall be in full accordance with this Contract. Should the Contractor fail to initiate compliance with the above provision within 72 hours or should he fail to properly execute and complete correction of such faulty work, the Engineer may direct that the work be done by others and that the cost of the work be deducted from monies due the Contractor.

3.11 No Waiver of Contractor's Obligations. The Engineer, supervisor, or inspector shall have no power to waive the obligations of this contract for the furnishing by the Contractor of good material and of his performing good work as herein described and in full accordance with the plans and specifications. No failure or omission of the Engineer, supervisor, or inspector to condemn any defective work or material shall release the Contractor from the obligation to at once tear out, remove, and properly replace the same at any time prior to final acceptance upon the discovery of said defective work or material; provided, however that that Engineer, supervisor, or inspector shall upon request of the Contractor inspect and accept or reject any

material furnished, and once the material has been accepted by the Engineer, supervisor, or inspector such acceptance shall be binding on the OWNER unless it can be clearly shown that such material furnished was not as represented and does not meet the specifications for the work. Any questioned work may be ordered taken up or removed for re-examination by the Engineer prior to final acceptance, and if found not in accordance with the specifications for the work. Any questioned work may be ordered taken up or removed for re-examination by the Engineer prior to final acceptance, and if found not in accordance with the specifications for said work, all expense of removing, re-examination, and replacement shall be borne by the Contractor; otherwise the expense thus incurred shall be allowed as "Extra Work" and shall be paid for by the OWNER.

3.12 Site Clean-Up. The Contractor shall not allow the site of the work to become littered with trash and waste material but shall maintain the site in a neat and orderly condition throughout the construction period. The Engineer shall have the right to determine what is waste material or rubbish and the manner and place of disposal. On or before the completion of the work the Contractor shall, without charge therefore, carefully clean out all pits, pipes, chambers, or conduits, shall tear down and remove all temporary structures built by him, shall remove all rubbish of every kind from the tracts or grounds which he has occupied, and shall leave them in a condition satisfactory to the Engineer.

3.13 Guarantee/Warranty Bond. During a period of 12 months from and after the date of the final acceptance by the OWNER of the work embraced by this Contract, the Contractor shall make all needed repairs arising out of defective workmanship, materials, or both, which in the judgment of the OWNER shall become necessary during such period. As a condition to final acceptance and payment, Contractor shall provide OWNER with a warranty bond for said 12-month period in the penal sum of thirty-five (35%) percent of the total work project cost. If within 10 days after the mailing of a notice in writing to the Contractor or his agent the said Contractor shall neglect to make or to undertake with due diligence the aforesaid repairs, the OWNER is hereby authorized to make such repairs at the Contractor's expense; provided, however, that in case of an emergency where, in the sole judgment of the OWNER, delay would cause serious loss or damage, repairs may be made without notice being sent to the Contractor, and the contractor shall pay the cost thereof.

4. OWNER'S OBLIGATIONS AND RESPONSIBILITIES

4.01 Lines and Grades. All necessary lines and grade shall be furnished by the Engineer. Whenever necessary, work shall be suspended to permit performance of this work, but such suspension will be as brief as practicable, and the Contractor shall be allowed no extra compensation therefore. The Contractor shall give the Engineer ample notice of the time and place where lines and grades will be needed. All stakes, marks, etc. shall be carefully preserved by the Contractor, and in case of destruction or removal by him or his employees, or any third party, such stakes, marks, etc. shall be replaced by the Engineer at the Contractor's expense.

4.02 Right of Entry. The OWNER reserves the right for its personnel or its agents to enter the property or location on which the work herein contracted is being constructed on installed for the purpose of supervising and inspection the work for the purpose of construction or installing such collateral work as the OWNER may desire.

4.03 OWNER's Inspectors. It is agreed by the Contractor that the OWNER shall appoint such Engineer, supervisors, or inspectors as the said OWNER may deem necessary to inspect the material furnished and the work done under this Contract, to see that the said material is furnished, and to see that said work is done in accordance with the plans and specifications therefore. The Contractor shall furnish all reasonable aid and assistance required by the Engineer, supervisors, or inspectors for the proper inspection and examination of the work and all parts thereof. The Contractor shall regard and comply with the directions and instructions of the Engineer, supervisors, or inspectors so appointed when such directions and instructions are consistent with the obligations of this Contract.

4.04 Collateral Work. The OWNER reserves the right to provide all labor and material essential to the completion of work that is not included in this Contract either by a separate contract or otherwise. Any collateral work shall be executed in such a manner that it will not unreasonably damage the Contractor nor unreasonably delay the progress of the work being accomplished under this Contract. The respective rights of and operations of the various interests involved shall be established and coordinated by the Engineer.

4.05 Environmental Assessment. The OWNER will provide completed and approved Environmental Information Documents, if any, to the Contractor for each job site concurrent with the issuance of the Notice To Proceed. The Contractor may proceed with the preparation of submittal and site design upon receipt of the Notice of Award.

4.06 Right-of-Way. Easements across private property and lands needed for construction under this Contract will be provided by the OWNER.

4.07 Adequacy of Design. It is agreed that the OWNER shall be responsible for the adequacy of the design, sufficiency of the Contract Documents, the safety of the structure and practicability of the operations of the completed project; provided the Contractor has complied with the requirements of the said Contract Documents, all approved modifications thereof, and additions and alterations thereto approved in writing by the OWNER. The burden of proof of such compliance shall be upon the Contractor to show that he has complied with said requirements of the Contract Documents, approved modifications thereof and all approved additions and alterations thereto.

5. SCHEDULING AND PROGRESS OF WORK

5.01 Commencement of Contract Time, Order and Execution of the Work. Contract time shall commence in accordance with the terms of a Notice to Proceed issued to Contractor following award of this Contract. It is the meaning and intent of this Contract, unless otherwise herein specifically provided, that the Contractor shall be allowed to execute his work at such times and seasons in such order of precedence and in such manner as shall be most conducive to economy of construction; provided however, that the order and time of execution shall be such that the work shall be completed as a whole or in part in accordance with this Contract within the time of completion hereafter designated; provided also that the Engineer may direct the time and manner of constructing any part or parts of the work when in his opinion such should be given priority due to the needs of the OWNER, or to lessen the probability of danger to the public or to anticipate seasonal hazards from the elements or to coordinate with other work being done for or by the OWNER.

5.02 Rate of Progress. The Contractor shall give the Engineer full information in the form of project schedules in advance as to his plans for carrying on any part of the work. If at any time prior to the start or during the progress of the work any part of the Contractor's plant or equipment or any of his methods of executing the work appear to the Engineer to be unsafe, inefficient, or inadequate to insure the required quality or rate of progress of the work, the Engineer may order the contractor to increase or improve his facilities or methods, and the Contractor shall promptly comply with such orders but shall not be eligible for any adjustment to contract time or cost as a result of such acceleration; failure to comply will result in placing Contractor in abandonment per Section 8 "Abandonment of Contract by Contractor," but neither compliance with such orders nor failure of the Engineer to issue such orders shall release the Contractor from his obligation to secure the degree of safety, the quality of work, and the rate of progress required by this Contract. The Contractor alone shall be responsible for the safety, adequacy, and efficiency of his plant, equipment, and methods. Contractor shall be required to submit updated progress schedules with each pay application submitted throughout the duration of the work.

5.03 Sunday, Holiday and Night Work. Except in connection with the care, maintenance, or protection of equipment or of work already done, no work shall be done between the hours of 6:00 p.m. and 7:00 a.m. or on Sundays or legal holidays without the written consent of the Engineer.

5.04 Hindrances and Delays. No claims shall be made by the Contractor for damages, hindrances, cumulative impacts or delays from any cause during the progress of any portion of the work embraced by this Contract except where the work is stopped by formal order of the OWNER. If the OWNER stops the work for just cause because the Contractor is not complying with the plans and specifications or the intent thereof or circumstances arise outside the reasonable control of either party that necessitate such stoppage, the Contractor shall have no claim for damages, hindrances, cumulative impacts or delays. However, if the OWNER stops the work for any other reason, the Contractor shall be entitled to an extension of Contract time incurred which in the judgment of the Engineer occurred as a result of the work stoppage.

Should delays repeatedly occur due to the Contractor's failure to provide adequate plant, equipment, or personnel, or where the Engineer determines that unreasonable inconvenience to the public is due to such failure, the Contractor's operations shall be suspended until he shall have provided adequate plant, equipment, and personnel to properly resume and continually execute the work and no extension of contract time shall be granted Contractor as a result of such suspension.

5.05 Extensions of Time. Should the Contractor be delayed in the final completion of the work by an act or neglect of the OWNER or Engineer, or of any employee of either, or by any other contractor employed by the OWNER, or by strikes, fire or other cause or caused outside of and beyond the control of the Contractor and which the Engineer determines could have been neither anticipated nor avoided, then an extension of time sufficient to compensate for the delay as determined by the Engineer shall be granted by the OWNER; provided, however, that the Contractor shall give the OWNER prompt notice in writing via a Change Order of the cause of delay in each case. Extensions of time will not be granted for delays caused by unfavorable weather, unsuitable ground conditions or inadequate construction force. Said extensions of Contract time shall be the Contractor's exclusive remedy for delay.

5.06 Liquidated Damages for Failure to Complete on Time. The Contractor agrees that time is of the essence on this Contract and that the definite value of damages which would result from delay would be incapable of ascertainment and uncertain, so that for each day of delay beyond the number of days herein agreed upon for the Substantial or Final completion of the work herein specified and contracted for, after due allowance for such extension of time as is provided for under the provisions of the preceding paragraph, the OWNER may withhold permanently from the Contractor's total compensation, not a penalty but as liquidated damages, the sum per day given in the following schedule:

<u>Amount of Contract</u>			<u>Amount of Liquidated Damages per Day</u>
Less than		\$5,000.00	\$100.00
\$5,001.00	to	15,000.00	150.00
15,001.00	to	25,000.00	175.00
25,001.00	to	50,000.00	200.00
50,001.00	to	100,000.00	350.00
100,001.00	to	500,000.00	500.00
500,001.00	to	1,000,000.00	750.00
1,000,001.00	to	2,000,000.00	1,000.00
2,000,001.00	to	5,000,000.00	2,000.00

6. INDEMNITY

6.01 Contractor's Indemnity Provision. TO PROTECT THE OWNER AND ENGINEER FROM THE CONTRACTOR'S FAILURE TO PERFORM ANY OF THE FOREGOING DUTIES OR ANY OF THE TERMS OF THIS CONTRACT, THE CONTRACTOR SHALL INDEMNIFY AND SAVE HARMLESS THE OWNER AND ENGINEER AND THE OWNER'S AND ENGINEER'S RESPECTIVE OFFICERS, ELECTED OFFICIALS, INSURERS, AGENTS AND EMPLOYEES (THE "INDEMNIFIED PARTIES") FROM ALL LOSSES, JUDGMENTS, DECREES, AND EXPENSES OR COSTS OF ANY NATURE WHATSOEVER ARISING OUT OF OR IN ANY WAY CONNECTED WITH ANY CLAIMS OR ACTIONS AT LAW OR IN EQUITY BROUGHT AGAINST THE INDEMNIFIED PARTIES FOR THE DEATH OR INJURY TO PERSONS OR FOR DAMAGE TO PROPERTY CAUSED, OR ALLEGEDLY CAUSED, BY ANY WILLFUL ACTS, NEGLIGENCE, NUISANCE, OR BREACH OF ANY TERM OR CONDITION OF THIS CONTRACT BY THE CONTRACTOR, HIS AGENTS, SERVANTS, SUBCONTRACTORS, OR EMPLOYEES. THE CONTRACTOR SHALL FURTHERMORE INDEMNIFY AND SAVE HARMLESS THE INDEMNIFIED PARTIES FROM ALL DEMANDS OF SUBCONTRACTORS, WORKERS, MATERIAL PERSONS, OR SUPPLIERS OF MACHINERY AND PART THEREOF, EQUIPMENT, POWER TOOLS, AND SUPPLIES

INCURRED IN CONNECTION WITH WORK TO BE PERFORMED UNDER THIS CONTRACT, PROPERTY OF ANY DESCRIPTION, INCLUDING PROPERTY OF THE OWNER, WHICH SHALL BE DAMAGED IN THE PERFORMANCE OF THIS CONTRACT BY THE CONTRACTOR, HIS AGENTS, EMPLOYEES, SUBCONTRACTORS OR THEIR EMPLOYEES AND SUBCONTRACTORS SHALL BE RESTORED TO ITS CONDITION PRIOR TO DAMAGE BY THE CONTRACTOR AT THE CONTRACTOR'S EXPENSE.

6.02 Workmen's Compensation Insurance. The Contractor agrees to comply with the Workmen's Compensation Act of the State of Texas, and to pay or cause to be paid all compensation, medical or other benefits, which may become due or payable thereunder, and to PROTECT, HOLD HARMLESS AND INDEMNIFY THE OWNER AND THE OWNER'S AGENTS AND EMPLOYEES FROM AND AGAINST ANY AND ALL LIABILITIES BY REASON OF ACCIDENTAL INJURY, DISEASE, OR DEATH SUSTAINED BY SUBCONTRACTOR'S EMPLOYEES. The Contractor shall furnish the OWNER with a certificate from the industrial Accident Board evidencing the contractor's and subcontractor's compliance with said statute.

6.03 Comprehensive General Liability Insurance. The Contractor shall provide and maintain during the life of this Contract and until all work under said Contract has been completed and accepted by the OWNER, a Comprehensive General Liability insurance policy, said policy and the issuing carrier approved by the OWNER, which specifically insures the contractual liability of the contractor assumed under Paragraph 6.01 above entitled "Contractor's Indemnity Provision." The Liability limits for the Comprehensive General Liability insurance coverage under this policy shall be in accordance with and not be less than the limits provided in the Supplemental General Conditions.

6.04 OWNER'S Protective Insurance. The Contractor shall provide and maintain during the life of this Contract and until all work under said Contract has been completed and accepted by the OWNER, and OWNER'S, Engineer's and Contractor's Protective Policy which co-insures the OWNER, Engineer, and the OWNER'S agents and employees with the same comprehensive General Liability coverage as described in Paragraph 6.03 above entitled "Comprehensive General Liability Insurance."

6.05 Comprehensive Automobile Liability Insurance. The Contractor shall provide and maintain during the life of this Contract and until all work under said Contract has been completed and accepted by the OWNER, a Comprehensive Automobile Liability insurance policy, said policy and issuing carrier approved by the OWNER, covering the operation on or off the site of the work of all motor vehicles licensed for highway use, whether they are owned, non-owned, or hired by the Contractor, in which shall specifically insure contractual liability of the Contractor assumed under the above Paragraph 6.1 entitled "Contractor's Indemnity Provision." The liability limits for the comprehensive Automobile Liability insurance coverage shall be in accordance with and not be less than the limits provided in the Supplemental General Conditions.

6.06 Insurance Policy and Certificate. In connection with the insurance coverage set out in Sections 6.02, 6.03, 6.04, and 6.05 above, the Contractor shall furnish the OWNER with a copy of the insurance policy and endorsements. The Owner shall be listed as the Certificate holder, and the Owner and Engineer shall be named as additional insured. Said policy or certificate shall state the OWNER shall be given 30 days advance written notice before any provision of the policy is changed or in the event said policy shall be canceled. This Policy and Certificate of Insurance shall be provided to the OWNER prior to starting any construction work in connection with this Contract.

7. TERMINATION OF CONTRACT

7.01 Right of OWNER to Terminate. The City reserves the right to cancel the contract for convenience without penalty by providing 30 days prior written notice to the contracting party. In addition, if the Contractor should be guilty of material breach or violation of the Contract or any provision thereof, the OWNER, upon certification by the Engineer as to the nature and extent of such violation, may without prejudice to any other resources or remedy give the contractor written notice of termination of the employment of the Contractor 10 days subsequent to such notice. Immediately following such date the OWNER may take possession of the site of the work and all material, equipment, tools, and appliances thereon and may finish the work in accordance with the provisions of Section 8 "Abandonment of Contract by Contractor," of these General Conditions.

- a. The occurrence of one or more of the following events constitutes a default by Contractor and justifies termination for cause:
1. Failure to provide or progress with the work in accordance with the Contract Documents;
 2. Failure to adhere to the progress schedule;
 3. Failure to provide a satisfactory replacement bond or insurance in the event either is lost or canceled;
 4. Failure to maintain financial solvency to adequately perform the Contract as indicated by one or more of the following:
 - a. A petition of bankruptcy is filed by or against Contractor,
 - b. Contractor is adjudged as bankrupt or insolvent,
 - c. Contractor or SURETY makes a general assignment for the benefit of creditors,
 - d. A receiver is appointed for the benefit of Contractor's creditors, or
 - e. A receiver is appointed on account of Contractor's insolvency;
 5. Contractor's disregard of Laws or Regulations;
 6. Contractor's repeated disregard of the authority of Engineer;
 7. Wrongful repudiation of the Contract; or
 8. Violation of any provisions of the Contract Documents.
- b. Contractor and SURETY must provide adequate assurance of future performance of the Contract in accordance with the Contract Documents that is satisfactory to OWNER if Contractor is believed to be in financial distress due to the existence of one or more of the indicators listed in Section 7.01.a.4. OWNER may terminate this Contract if Contractor and SURETY fail to provide adequate documentation satisfactory to OWNER within 10 days of Engineer's request for this information.
- c. OWNER may declare Contractor to be in default, give notice to Contractor and SURETY that the Contract is terminated, and enforce the rights available to OWNER under the performance bond after giving Contractor and SURETY 10 days' notice that one or more of the events identified in Section 7.01.a. has occurred.
- d. OWNER may take possession of the work, incorporate the materials stored, and complete the work as OWNER may deem expedient if OWNER has terminated the Contract for cause.
- e. OWNER may elect not to proceed with termination of the Contract under this paragraph if Contractor begins to cure the cause for termination within 7 days of receipt of notice of intent to terminate.
- f. Contractor is not entitled to receive further payments until the work is provided if OWNER proceeds as provided in this Section. The amount of the Contract Price remaining is to be paid to the Contractor if the unpaid balance exceeds the cost to complete the Contract. This cost to complete the Contract may include related claims, costs, losses, damages, and the fees and charges of design professionals, attorneys, and other professionals retained by OWNER. Contractor, upon written demand from OWNER, shall promptly pay the difference to OWNER if the cost to complete the Contract including related claims, costs, losses, and damages exceeds the unpaid balance of the Contract Price. Claims, costs, losses, and damages incurred by OWNER are to be reviewed as to their reasonableness and incorporated in a Change Order by Engineer. OWNER is not required to obtain the lowest price to complete this Contract when exercising its rights or remedies under this Section.
- g. Termination does not affect the rights or remedies of OWNER against Contractor or against SURETY under the payment bond or performance bond. OWNER does not release Contractor or SURETY from liability or waive any rights OWNER may have by paying or retaining money due Contractor.

7.02 Right of Contractor to Terminate. If work should be stopped by order of any public authority or court through no act or fault of the Contractor for a period of three (3) months or if the OWNER should materially fail to perform the provisions of the Contract with regard to OWNER'S obligations to the Contractor, then the Contractor may, upon 10 days written notice to the OWNER, terminate this Contract and recover from the OWNER payment for all completed work, subject to the following:

- a. Contractor may terminate the Contract or suspend performance after 10 days' notice to OWNER provided that, through no act or fault of Contractor:
1. OWNER suspends performance of the Contract for more than three (3) months;
 2. Engineer fails to act on a payment application within 30 days after it is submitted; or

3. OWNER fails to pay Contractor sums determined to be due, other than the final payment, within 30 days after payment is recommended by Engineer; and
4. OWNER does not remedy this suspension or failure within 10 days after receipt of the notice.

7.03 Removal of Equipment. In the event that the Contract should be terminated for any reason whatsoever, the OWNER may request the Contractor in writing to remove any or all of his equipment, tools, and supplies, and the contractor shall comply with the request within 10 days after receipt of the notice. Should he fail to do so within 10 days after receipt of such notice, the OWNER shall have the right to remove such equipment and supplies at the expense of the Contractor and to place such equipment, tools and supplies in storage at the risk and expense of the Contractor.

8. ABANDONMENT OF CONTRACT BY CONTRACTOR

8.01 Notification of Contractor. If the Contractor should abandon and fail or refuse to resume work within 10 days after written notification from the OWNER or the Engineer of if the Contractor fails to comply with the orders of the Engineer when such orders are consistent with this contract or with the specifications hereto attached, then the Contractor shall be deemed as having abandoned the Contract. In such event the SURETY on the bond shall be notified in writing and directed to complete the work, and a copy of said notice shall be delivered to the Contractor.

8.02 Retention of Contractor's Equipment and Materials by OWNER. After receiving said notice of abandonment the contractor shall not remove from the work any machinery, equipment, tools, materials, or supplies then on the job, but the same together with any materials and equipment under contract for the work may be held for use on the work by the OWNER or the SURETY on the performance bond or another contractor in completion of the work; and the Contractor shall not receive any rental or credit therefore except when used in connection with extra work where credit shall be allowed as provided for under Section 2.12 entitled "Extra Work," it being understood that the use of such equipment and materials will ultimately reduce the cost to complete the work and will be reflected in the final settlement.

8.03 Methods of Completing the Work. If the SURETY should fail to commence in compliance with the notice for completion provided within 10 days after service of such notice, or in accordance with the provisions of the applicable bond, then the OWNER may provide for completion of the work in either of the following elective manners:

- a. The OWNER may employ such force of workers and use such machinery, equipment, tools, materials, and supplies as said OWNER may deem necessary to complete the work and charge the expense of such labor, machinery, equipment, tools, material, and supplies to said Contractor, and the expense so charged shall be deducted and paid by the OWNER out of such monies as may be due or that may thereafter at any time become due to the Contractor under and by virtue of this Contract. In case such expense is less than the sum which would have been payable under this Contract if the same had been completed by the Contractor, then said Contractor shall receive the difference. In case such expense is greater than the sum which would have been payable under this contract if the same had been completed by said Contractor, then the Contractor or his SURETY shall pay the amount of such excess to the OWNER.

- b. The OWNER under sealed bids, after 14 days' notice published two or more times in a newspaper having a general circulation in the county of location of the work, may let the contract for the completion of the work under substantially the same terms and conditions which are provided in this Contract. In case of any increase in cost to the OWNER under the new contract as compared to what would have been the cost under this Contract, such increase shall be charged to the Contractor, and the SURETY shall be and remain bound therefore. However, should the cost to complete any such new contract prove to be less than what would have been the cost to complete under this Contract, the Contractor or his SURETY shall be credited therewith.

8.04 Final Acceptance. When the work has been completed the Contractor and his SURETY shall be

so notified and a Final Contract Completion Certificate as hereinafter provided shall be issued. A complete itemized statement of the Contract amounts certified by the Engineer as being correct shall then be prepared and delivered to the Contractor and his SURETY, whereupon the contractor, his SURETY, or the OWNER, as the case may be, shall pay the balance due as reflected by said statement within 15 days after the date of such Contract Completion certificate.

8.05 Disposition of Contractor's Equipment. In the event the statement of accounts shows that the cost to complete the work is less than that which would have been the cost to the OWNER had the work been completed by the Contractor under the terms of this Contract or when the Contractor or his SURETY pay the balance shown to be due by them to the OWNER, then all machinery, equipment, tools, materials, or supplies left on the site of the work shall be turned over to the Contractor or his SURETY. Should the cost to complete the work exceed the contract price, and the contractor or his SURETY fail to pay the amount due the OWNER within the time designated, and there remains any machinery, equipment, tools, materials, or supplies on the site of the work, notice thereof together with an itemized list of such equipment and materials shall be mailed to the Contractor and his SURETY as the respective addresses designated in this Contract; provided, however, that actual written notice given in any manner will satisfy this condition. After mailing or other giving of such notice such property shall be held by the OWNER at the risk of the Contractor or his SURETY subject only to the duty of the OWNER to exercise ordinary care to protect such property. After 15 days from the date of said notice the OWNER may sell such machinery, equipment, tools, equipment, or supplies and apply the sum derived from such sale to the credit of the Contractor and his SURETY. Such sale may be made at either public or private sale, with or without notice, as the OWNER may elect. The OWNER shall release any machinery, equipment, tools, materials, or supplies which remain on the work and belong to persons other than the Contractor or his SURETY to their proper OWNERS.

9. MEASUREMENT AND PAYMENT

9.01 Character of Measurements. No extra or customary measurements of any kind will be allowed, but the actual length, area, solid contents, number, and weight only shall be considered unless otherwise specifically provided.

9.02 Estimates vs. Actual Quantities. Any and all estimated quantities stipulated in the proposal form under unit price items are approximate and are to be used only (a) as a basis for estimating the probable cost of the work and (b) for the purpose of comparing the proposals submitted for the work. It is understood and agreed that the actual amounts of work done and materials furnished under unit price items may differ from such estimated quantities and that the basis of payment for such work and materials shall be for the actual amount of such work done and the actual quantity of materials furnished.

The Contractor agrees that he will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work actually performed and materials actually furnished and the amounts estimated therefore in the proposal or other Contract Documents.

9.03 Payment. In consideration of the furnishing of all the necessary labor, equipment, and material and the completion of all work by the Contractor, and on the completion of all work and the delivery of all material embraced in this Contract in full conformity with the specifications and stipulations contained herein, the OWNER agrees to pay the Contractor the amounts set forth in the proposal attached hereto which has been made a part of this Contract. The Contractor hereby agrees to receive such amounts in full payment for furnishing all material and all labor required for the aforesaid work, for all expense incurred by him, and for well and truly performing the same and the whole thereof in the manner and according to this Contract, the attached specifications, and requirements of the Engineer.

9.04 Monthly Estimates and Payments. On or about the fifth day of each month the Contractor will make an approximate estimate of the value of work done in conformity with the plans and specifications during the previous calendar month, said estimate to be subject to the validation of the Engineer. The Contractor shall furnish to the Engineer such detailed information as he may request to aid him as a guide in the preparation of monthly estimates. After each such estimate shall have been approved by the OWNER, the OWNER shall pay to the Contractor 95 percent of the amount of such estimated sum, withholding 5 percent as retainage, in

accordance with the Texas Prompt Payment Act. It is understood, however, that in case the whole work is near to completion and some unexpected or unusual delay occurs due to no fault or neglect on the part of the Contractor, the OWNER upon written recommendation of the Engineer, pay a reasonable and equitable portion of the retained percentage to the Contractor.

9.05 Certificates of Completion. Within 10 days after the Contractor has given the Engineer notice that the work has been substantially or finally completed, the Engineer shall inspect the work and satisfy himself by examination and test that the work has been substantially or finally and fully completed, as the case may be, in accordance with the plans, specifications and contract. If so, the Engineer shall issue a Contract Substantial or Final Completion Certificate, as applicable, to the OWNER and the Contractor. Such Final Contract Completion Certificate when issued shall constitute final acceptance of the work covered under this Contract but shall not be considered a waiver of OWNER'S rights for defective or substandard work subsequently discovered, warranty or indemnity claims, or any other matter previously communicated to Contractor by OWNER.

9.06 Final Estimate and Payment. After the Final Contract Completion Certificate has been issued, the Engineer shall proceed to make final measurements and to prepare a final estimate of the work done and materials furnished under this Contract and the value thereof with the cooperation of the Contractor. The Engineer shall certify the Final Estimate and submit it to the OWNER within five (5) days from the date of the Final Contract Completion Certificate.

The OWNER shall pay the Contractor within 15 days from the date of the Final Contract Completion Certificate the entire sum shown due on the certified Final Estimate prepared by the Engineer after deducting all amounts to be kept and retained under any provision of this Contract. However, it is to be specifically understood that the final payment will not be paid by the OWNER to the Contractor under any circumstances until the Notarized Affidavit required by Section 9.07 entitled "Notarized Affidavit" and "Warranty Bond" have been submitted to the Engineer.

All prior estimates and payments shall be subject to correction in the final estimate and payment; but in the absence of error or manifest mistake, it is agreed that all estimates, when approved by the OWNER, shall be conclusive evidence of the work done and materials furnished.

9.07 Notarized Affidavit/Warranty Bond. Before final payment for the work by the OWNER, the Contractor shall submit to the Engineer a notarized affidavit in duplicate stating under oath that all subcontractors, vendors, and other persons or firms who have furnished or performed labor or furnished materials for the work have been fully paid or satisfactorily secured. Such affidavit shall bear or be accompanied by a statement, signed by the SURETY Company who provided the performance bond for the work, to the effect that said SURETY Company consents to final payment to the contractor being made by the OWNER. Contractor shall also provide OWNER with the one-year Warranty Bond required by Section 3.13 in a form approved by the OWNER prior to said final payment.

9.08 Release of Liability. The acceptance by the Contractor of the last payment shall operate as and shall be a release to the OWNER and every officer and agent thereof from all claims and liability hereunder for anything done or furnished for or relating to the work or for any act or neglect of the OWNER or of any person relating to or affecting the work.

9.09 Contractor's Obligation. Neither the Final Contract Completion Certificate nor the final payment nor any provision in the Contract Documents shall relieve the contractor of the obligation for fulfillment of any warranty, indemnity obligation or any other continuing obligation which may be required in the Contract Documents.

9.10 Payments Withheld. The OWNER may on account of subsequently discovered evidence, withhold or nullify the whole or part of any payment to such extent as may be necessary to protect himself from loss on account of:

- a. Defective work not remedied.
- b. Claims filed or reasonable evidence indicating probable filing of claims.
- c. Failure of the Contractor to make payments properly to subcontractors or for material or labor.
- d. Damage to another contractor or property owner.

When the above grounds are removed or the Contractor provides a SURETY Bond satisfactory to the OWNER, which will protect the OWNER in the amount withheld, payment shall be made for amounts withheld because of

them.

10.01 Claims Process

a. For disputes arising under this Contract, parties shall follow the Claims process described in this Section for the following disputes between Contractor and OWNER:

1. A demand or assertion by Contractor to OWNER, submitted in accordance with the requirements of the Contract Documents:

- i. Seeking an adjustment of Contract Price or Contract Times;
- ii. Contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of work under the Contract Documents;
- iii. Contesting Engineer's decision regarding a Change Order or Field Order;
- iv. Seeking resolution of a contractual issue that Engineer has declined to address;

or

v. Seeking other relief with respect to the terms of the Contract;

2. A demand or assertion by OWNER to Contractor, submitted in accordance with the requirements of the Contract Documents:

- i. Contesting Engineer's decision regarding a Change Order or Field Order; or
- ii. Seeking resolution of a contractual issue that Engineer has declined to address.

b. Deliver notice of the Claim to the Engineer no later than 7 days after the start of the event giving rise to the Claim or, in the case of appeals regarding the Engineer's decision, within 7 days of the decision under appeal. The responsibility to substantiate a Claim rests with the entity making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Price or Times, Contractor must certify that the Claim is made in good faith, that the supporting data is accurate and complete, and that to the best of Contractor's knowledge and belief, the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

c. Following the Engineer's receipt of the Claim, the Engineer shall forward such Claim along with Engineer's opinion regarding merits of the same to the entity receiving such Claim, who shall then review the Claim giving full consideration to its merits. The Contractor and OWNER are to seek to resolve the Claim through the exchange of information and direct negotiations. The Contractor and OWNER may extend the time for resolving the Claim by mutual agreement. The parties shall notify the Engineer of actions taken on a Claim.

d. Contractor and OWNER may mutually agree to mediate the underlying dispute at any time after initiation of a Claim.

1. The agreement to mediate suspends the Claim submittal and response process.

2. Contractor or OWNER may unilaterally terminate the mediation process after 60 days from the agreement to mediate and resume the Claim submittal and decision process as of the date of the termination. The Claim process resumes as of the date of the conclusion of the mediation, as determined by the mediator, if the mediation is unsuccessful in resolving the dispute.

3. Contractor and OWNER shall each pay one-half of the mediator's fees and costs.

e. If the entity receiving a Claim approves the Claim in part or denies it in part, this action is final and binding unless the other entity invokes the procedure described in Section 10.01.h. for final resolution of disputes within 30 days of this action.

g. The results of the agreement or action on the Claim is to be incorporated in a Change Order by the Engineer to the extent they affect the Contract Documents, the Contract price, or the Contract times if the Contractor and OWNER reach an agreement regarding a Claim.

h. The Contractor or OWNER may appeal a Claim, approved or denied in part or in full by the other party, by:

1. Electing to invoke the dispute resolution process if one is provided for in the Supplementary Conditions;
2. Agreeing with the other party to submit the dispute to a dispute resolution process; or
3. Notifying the other party of the intent to submit the dispute to a court of competent jurisdiction if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to.

END OF SECTION

CITY OF COPPERAS COVE

SUPPLEMENTAL GENERAL CONDITIONS

The following items shall be a part of the Contract as Supplemental General Conditions:

I. Sections 6.02 through 6.06 of the General Conditions shall be modified, supplemented and amended, to the extent of any conflict, with the following provisions:

A. Insurance

The Contractor shall carry insurance in the following types and amounts for the duration of the Contract, which shall include items owned by the City in care, custody and control of the Contractor prior and during construction and warranty period, and furnish copies of policy declaration pages and all policy endorsements to be furnished concurrently with execution of this Contract.

1. Worker's Compensation Insurance Coverage.

a. Definitions:

Certificate of coverage ("certificate") - A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory worker's compensation insurance coverage for the person's or entity's employees providing services in a project, for the duration of the project.

Duration of the project - includes the time from the beginning of the work on the project until the Contractor's/person's work on the project has been completed and accepted by the City.

Persons providing services on the project ("subcontractor" in Section 406.096) - includes all persons or entities performing all or part of the services the Contractor has undertaken to perform on the project, regardless of whether that person contracted directly with the Contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the project. "Services" include, without limitation, providing, hauling or delivering equipment or materials, or providing labor, transportation, or other service related to the project. "Services" does not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

b. The contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.01(44) for all employees of the Contractor providing services on the project, for the duration of the project.

c. The Contractor must provide a certificate of coverage to the City prior to being awarded the contract.

d. If the coverage period shown on the Contractor's current certificate of coverage ends during the duration of the project, the Contractor must, prior to the end of the coverage period, file a new certificate of coverage with the City showing that coverage has been extended.

e. The Contractor shall obtain from each person providing services on a project, and provide to the City:

(1) a certificate of coverage, prior to that person beginning work on the project, so the City will have on file certificates of coverage showing coverage for all persons providing services on the project, and

(2) no later than seven days after receipt by the Contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project.

f. The Contractor shall retain all required certificates of coverage for the duration of the project and for one year thereafter.

g. The Contractor shall notify the City in writing by certified mail or personal delivery, within 10 days after the Contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project.

h. The Contractor shall post on each project site a notice, in the text, form and manner prescribed by the Texas Workers' Compensation Commission, informing all persons providing services on the project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.

i. The Contractor shall contractually require each person with whom it contracts to provide services on a project, to:

(1) provide coverage based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code Section 401.011(44) for all of its employees providing services on the project, for the duration of the project;

(2) provide to the Contractor, prior to that person beginning work on the project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the project, for the duration of the project;

(3) provide the Contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(4) obtain from each other person with whom it contracts, and provide to the Contractor:

- (a) a certificate of coverage, prior to the other person beginning work on the project; and
- (b) a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project;
- (5) retain all required certificates of coverage on file for the duration of the project and for one year thereafter;
- (6) notify the City, in writing, by certified mail or personal delivery, within 10 days after the Contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project;
- (7) contractually require each person with whom it contracts, to perform as required by paragraphs (1) - (7), with the certificates of coverage to be provided to the person for whom they are providing services.
- j. By signing this contract or providing or causing to be provided a certificate of coverage, the Contractor who will provide services on the project will be covered by workers' compensation coverage for the duration of the project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with appropriate insurance carrier, or in case of a self-insured, with the commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the Contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.
- k. The Contractor's failure to comply with any of these provisions is a breach of contract by the Contractor which entitles the City to declare the contract void if the Contractor does not remedy the breach within 10 days after receipt of notice of breach from the City.

2. Commercial General Liability Insurance with minimum limits of:

General Aggregate	\$1,000,000
Products & Completed Operations Aggregate	\$1,000,000
Personal & Advertising Injury	\$500,000
Each Occurrence	\$500,000
Fire Damage (Any One Fire)	\$50,000
Medical Expense (Any One Person)	\$1,000

3. City and Contractor's protective liability insurance policy naming the City of Copperas Cove as insured. Coverage shall be on an "occurrence" basis, and the policy shall be issued by the same insurance company that carries the Contractor's liability insurance. Minimum limits of liability shall be as follows:

Per Occurrence	\$500,000
Aggregate	\$1,000,000

4. Automobile Liability Insurance for all owned, non-owned and hired vehicles with minimum limits for Bodily Injury of \$250,000 for each person and \$500,000 for each occurrence and Property Damage limits of \$100,000 or a Combined Single Limit of \$600,000.

5. On all new or remodeling building projects, All Risk Builders Risk Insurance for insurable building projects shall be insured in the amount of the contract price for such improvements. The City and Contractor waive all rights against each other for damages caused by fire or other perils to the extent covered by Builders Risk Insurance required under this section, except as to such rights as they may have in the proceeds of such insurance. Contractors shall require similar waivers by Subcontractors and Sub-subcontractors.

If insurance policies are not written for amount specified in 2 and 3 above, Contractor is required to carry an Excess Liability Insurance Policy for any difference in amounts specified.

Contractors shall be responsible for deductibles and self-insured retentions, if any, stated in policies. Any self-insured retention shall not exceed ten percent (10%) of minimum required limits. All deductibles or self-insured retentions shall be disclosed on Certificate of Insurance required above.

Contractor shall not commence work at site under this Contract until he has obtained required insurance and until such insurance has been reviewed by the City's Project Manager. Contractor shall not allow any Subcontractor to commence work until insurance required has been obtained and approved. Approval of insurance by the City shall not relieve or decrease liability of Contractor hereunder.

Insurance to be written by a company licensed to do business in the State of Texas at the time policy was issued and acceptable to the City.

Contractor shall produce an endorsement to each affected policy:

1. Naming City of Copperas Cove, P.O. Box 1449, Copperas Cove, TX 76522, as additional insured (except Workers' Compensation and Builders Risk).
2. To provide a waiver of subrogation to the City of Copperas Cove.

3. That obligates the insurance company to notify Finance Department, City of Copperas Cove, P.O. Box 1449, Copperas Cove, TX 76522, that no policies will be canceled or reduced, restricted or limited until thirty (30) days after the City has received written notice as evidenced by return receipt of registered or certified letter.

4. That the "other" insurance clause shall not apply to the City where City of Copperas Cove is an additional insured shown on policy. It is intended that policies required in the agreement, covering both the City and Contractor, shall be considered primary coverage as applicable.

Contractor shall not cause any insurance to be canceled nor permit any insurance to lapse during term of this Contract or as required in the Contract

If Contractor is underwritten on a claim-made basis, the retroactive date shall be prior to, or coincident with, the date of this Contract and the Certificate of Insurance shall state that coverage is claims made and also the retroactive date. Contractor shall maintain coverage for duration of this Contract. Contractor shall provide the City annually a Certificate of Insurance as evidenced of such insurance. It is further agreed that Contractor shall provide the City a 30-day notice of aggregate erosion, an advance of the retroactive date, cancellation and/or renewal.

It is also agreed that Contractor will invoke the tail option of the City and that Extended Reporting Period (ERP) premium shall be paid by the Contractor.

The City reserves the right to review and renegotiate the insurance requirements of this section during effective period of the Contract and to make reasonable adjustments to insurance and their limits when deemed necessary and prudent by the City based upon changes in statutory law, court decisions or the claims history of the industry as well as Contractor.

The City shall be entitled, upon request, and without expense, to receive copies of policies and all endorsement thereto and may make any reasonable requests for deletion or revision or modification of particular policy terms, conditions, limitations or exclusions, except where policy provisions are established by law or regulation binding upon either of the parties hereto or the underwriter on any of such policies.

Actual losses not covered by insurance as required by this section shall be paid by Contractor.

II. Section 3.02 of the General Conditions shall be modified, supplemented and amended, to the extent of any conflict, with the following provisions:

Performance and Payment Bonds

1. In accordance with Texas Government Code, Chapter 2253, in the event the Bid amount is more than \$50,000, the bidder is required to provide a Payment Bond. If the Bid amount is more than \$100,000, the bidder is also required to provide a Performance Bond. Payment for the Project will be made by the City of Copperas Cove only upon completion and acceptance of the work on the Project by the City of Copperas Cove.

2. If the Performance and Payment Bonds are to be provided, the successful bidder must furnish the bonds from a surety company authorized to do business in the State of Texas and appearing on the U.S. Treasury list. Such bonds must be in the amount of one hundred percent (100%) of the contract price, conditioned that the Contractor will faithfully perform the contract executed, in accordance with Chapter 2253, Texas Government Code.

III. Section 1 of the General Conditions shall be modified, supplemented and amended, to the extent of any conflict, with the following provisions:

1.14 CONSULTANT. “CONSULTANT” shall mean the firm of Strand Associates, Inc.[®], 1906 Niebuhr Street, Brenham, TX 77833. CONSULTANT provided design services and will provide construction-related services including construction contract administration and part-time construction observation, as defined in their agreement with City. CONSULTANT is not the Engineer as referred to in this document. OWNER shall be indemnified and added as an additional insured in the same manner as CONSULTANT for this project, as indicated in Section 6.

Prevailing Wage Determination
Northwest WWTP Clarifier Rehabilitation Project

Superseded General Decision Number: TX20240279

State: Texas

Construction Type: Building

Counties: Coryell and Lampasas Counties in Texas.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$17.75 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2025.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$13.30 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2025.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number	Publication Date
0	01/03/2025
1	03/14/2025

BOIL0074-003 01/01/2025

	Rates	Fringes
BOILERMAKER.....	\$ 33.17	24.92

ENGI0178-005 06/01/2020		

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
(1) Tower Crane.....	\$ 32.85	13.10
(2) Cranes with Pile Driving or Caisson Attachment and Hydraulic Crane 60 tons and above.....	\$ 28.75	10.60
(3) Hydraulic cranes 59 Tons and under.....	\$ 32.35	13.10

IRON0084-011 06/01/2024		

	Rates	Fringes
IRONWORKER, ORNAMENTAL.....	\$ 28.26	8.13

* PLUM0286-011 03/03/2025		

	Rates	Fringes
PIPEFITTER (Excludes HVAC Pipe Installation).....	\$ 37.15	15.92

* SUTX2014-059 07/21/2014		

	Rates	Fringes
BRICKLAYER.....	\$ 19.09	0.00
CARPENTER, Excludes Drywall Hanging, and Metal Stud Installation.....	\$ 17.54 **	1.80
CEMENT MASON/CONCRETE FINISHER...	\$ 14.00 **	0.00
DRYWALL HANGER AND METAL STUD INSTALLER.....	\$ 14.08 **	0.00
ELECTRICIAN (Low Voltage Wiring Only).....	\$ 28.28	2.44
ELECTRICIAN, Excludes Low Voltage Wiring.....	\$ 20.50	2.71
HVAC MECHANIC (HVAC Pipe Installation Only).....	\$ 15.50 **	0.00
HVAC MECHANIC (Installation of HVAC Unit Only).....	\$ 16.01 **	1.56
INSULATOR - MECHANICAL (Duct, Pipe & Mechanical System Insulation).....	\$ 19.77	7.13

IRONWORKER, REINFORCING.....	\$ 13.35 **	0.00
IRONWORKER, STRUCTURAL.....	\$ 18.35	4.90
LABORER: Common or General.....	\$ 10.53 **	0.00
LABORER: Mason Tender - Brick...	\$ 9.98 **	0.00
LABORER: Mason Tender - Cement/Concrete.....	\$ 9.93 **	0.00
LABORER: Pipelayer.....	\$ 12.49 **	2.13
LABORER: Roof Tearoff.....	\$ 11.28 **	0.00
OPERATOR: Backhoe/Excavator/Trackhoe.....	\$ 13.10 **	1.24
OPERATOR: Bobcat/Skid Steer/Skid Loader.....	\$ 13.93 **	0.00
OPERATOR: Bulldozer.....	\$ 18.29	1.31
OPERATOR: Drill.....	\$ 16.22 **	0.34
OPERATOR: Forklift.....	\$ 14.00 **	0.00
OPERATOR: Grader/Blade.....	\$ 14.34 **	1.68
OPERATOR: Loader.....	\$ 13.88 **	0.44
OPERATOR: Mechanic.....	\$ 17.52 **	3.33
OPERATOR: Paver (Asphalt, Aggregate, and Concrete).....	\$ 16.03 **	0.00
OPERATOR: Roller.....	\$ 13.11 **	0.00
PAINTER (Brush, Roller, and Spray).....	\$ 15.00 **	0.81
PLUMBER, Excludes HVAC Pipe Installation.....	\$ 21.18	7.57
ROOFER.....	\$ 13.75 **	0.00
SHEET METAL WORKER (HVAC Duct Installation Only).....	\$ 18.71	4.90
SHEET METAL WORKER, Excludes HVAC Duct Installation.....	\$ 14.89 **	1.55
SPRINKLER FITTER (Fire Sprinklers).....	\$ 15.46 **	0.00
TILE FINISHER.....	\$ 11.22 **	0.00
TILE SETTER.....	\$ 14.74 **	0.00
TRUCK DRIVER: Dump Truck.....	\$ 11.50 **	1.10
TRUCK DRIVER: Flatbed Truck.....	\$ 19.65	8.57
TRUCK DRIVER: Semi-Trailer Truck.....	\$ 12.50 **	0.00

TRUCK DRIVER: Water Truck.....\$ 12.00 ** 4.11

WELDERS - Receive rate prescribed for craft performing
operation to which welding is incidental.

=====

** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$17.75) or 13658 (\$13.30). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

Union Rate Identifiers

A four-letter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in

processing the wage determination. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE:

UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The ""SU"" identifier indicates that either a single non-union rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

?SU? wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The ""SA"" identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

1) Has there been an initial decision in the matter? This can be:

- a) a survey underlying a wage determination
- b) an existing published wage determination
- c) an initial WHD letter setting forth a position on a wage determination matter
- d) an initial conformance (additional classification and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

Branch of Wage Surveys
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

Regarding any other wage determination matter such as conformance decisions, requests for initial decisions should be directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to BCWD-Office@dol.gov or by mail to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210.

=====

END OF GENERAL DECISION"

Superseded General Decision Number: TX20240023

State: Texas

Construction Types: Heavy (Sewer/Water Treating Plant and Sewer/Incid. to Hwy.)

Counties: Bell, Bosque, Coryell, Falls, Freestone, Hamilton, Hill, Lampasas, Leon, Limestone, McLennan, Milam, Mills, Navarro, Robertson and Williamson Counties in Texas.

WATER & SEWAGE TREATMENT PLANTS AND LIFT PUMP STATIONS

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$17.75 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2025.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$13.30 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2025.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

SUTX1990-003 02/09/1990

	Rates	Fringes
CARPENTER.....	\$ 9.00 **	
CEMENT MASON/CONCRETE FINISHER...	\$ 8.00 **	
ELECTRICIAN.....	\$ 13.45 **	.80+8 1/2%
Form Builder.....	\$ 7.25 **	
Form Setter.....	\$ 7.25 **	
LABORER.....	\$ 7.25 **	
Pipelayer.....	\$ 7.50 **	
Power equipment operators:		
Bulldozers.....	\$ 7.25 **	
Cranes, Clamshells,		
Backhoes, Derricks,		
Dragline, Shovels.....	\$ 7.25 **	
Front End Loaders.....	\$ 10.00 **	
Scrapers.....	\$ 7.25 **	
Steel Setter.....	\$ 9.50 **	
Steel Worker.....	\$ 7.25 **	
Truck drivers:		
Tandem Axles.....	\$ 7.25 **	
Transit Mix.....	\$ 7.25 **	
Utility Laborer.....	\$ 7.25 **	

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

=====

** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$17.75) or 13658 (\$13.30). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours

they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

Union Rate Identifiers

A four-letter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE: UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The ""SU"" identifier indicates that either a single non-union rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

?SU? wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The ""SA"" identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

----- WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can be:

- a) a survey underlying a wage determination
- b) an existing published wage determination
- c) an initial WHD letter setting forth a position on a wage determination matter
- d) an initial conformance (additional classification and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

Branch of Wage Surveys
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

Regarding any other wage determination matter such as conformance decisions, requests for initial decisions should be

directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to BCWD-Office@dol.gov or by mail to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210.

=====

END OF GENERAL DECISION"

BOND

CITY OF COPPERAS COVE

§

(hereafter referred to as “Contractor” or “Principal”) have entered into a Contract (hereafter referred to as “the Contract”) dated the ____ day of _____, 20__ for the _____ Project (hereafter referred to as “the Project”). Said Contract is incorporated by reference into this Statutory Payment Bond, pursuant to Chapter 2253 of the Texas Government Code (hereafter referred to as “this Bond”).

Surety (hereafter referred to as "Surety") do hereby acknowledge each to be bound to City as an Obligee in the maximum penal amount of _____ Dollars (\$_____), which represents one hundred percent (100%) of the Contract amount (hereafter referred to as the "Bond Sum"). Contractor and Surety hereby further bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally for payment of this Bond, as provided herein.

2. **SURETY OBLIGATION.** Surety's obligation under this Bond is for the benefit and sole protection of all persons supplying labor, services, materials and equipment in the prosecution

of said Contract (collectively, the "Claimant(s)"). Surety's obligation to the Claimant(s) shall not exceed the Bond Sum.

3. **QUALIFICATION.** Surety companies executing this Bond must appear on the United States Treasury Department's most current list (Circular 570, as amended) and be authorized to transact business in the Texas, hold a certificate of authority from the United States Secretary of the Treasury to qualify as a surety on obligations permitted or required under federal law, and/or be otherwise qualified to act as a Surety under Texas Insurance Code, Chapter 3503.
4. **VENUE.** The obligations of the parties under this Bond shall be performable in Coryell County, Texas and shall be construed under the laws of the State of Texas. If legal action, such as civil litigation, is necessary in connection with this Bond, exclusive venue shall be in Coryell County, Texas.

THIS BOND is entered into this ____ day of _____, 20__.

SURETY (seal)

By: _____
(Signature)

(Print Name)

(Print Title)

[ATTACH POWER OF ATTORNEY]

ATTEST: _____

CONTRACTOR

By: _____
(Signature)

(Print Name)

(Print Title)

[Additional signatures, if any,
appear on attached page]

ATTEST: _____

STATUTORY PERFORMANCE BOND

STATE OF TEXAS §
COUNTY OF CORYELL §
CITY OF COPPERAS COVE §

The **City of Copperas Cove**, a municipal corporation in the State of Texas (hereafter referred to as “City” or “Owner”) and _____, a _____ with its principal place of business located at _____ (hereafter referred to as “Contractor” or “Principal”) have entered into a Contract (hereafter referred to as “the Contract”) dated _____, 20__ for the _____ Project (hereafter referred to as “the Project”). Said Contract is incorporated by reference into this Statutory Performance Bond, pursuant to Chapter 2253 of the Texas Government Code (hereafter referred to as “this Bond”).

By virtue of this Bond, Contractor as Principal and _____ with its physical address at _____, a mailing address of _____ and a business telephone number of _____ as Surety (hereafter referred to as “Surety”) do hereby acknowledge each to be bound to Owner as an Obligatee in the maximum penal amount of _____ Dollars (\$_____), which represents one hundred percent (100%) of the Contract amount (hereafter referred to as the “Bond Sum”). Contractor and Surety hereby further bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally for payment of this Bond, to City as provided herein.

1. **GENERAL CONDITIONS.** It is a condition of this Bond that if Contractor promptly performs its Contract obligations (hereafter referred to as the “Work”), Surety’s obligations pursuant to this Bond are null and void. Otherwise, Surety’s obligations shall remain in full force and effect. Surety waives any requirement to be notified of alterations or extensions of time, or any other duly authorized modifications, made by City to the Contract. Surety acknowledges and agrees that this Bond is being furnished to comply with Texas Government Code, Chapter 2253 and that any and all provisions provided in said statute are incorporated herein by reference. Any conflicts between this Bond and Texas Government Code, Chapter 2253 shall be resolved in favor of said statute. Upon making demand on this Bond, City shall make the Contract balance (equal to the total amount payable by City to Contractor pursuant to the Contract less amounts paid by City to Contractor) available to Surety for completion of the Work.
2. **SURETY OBLIGATION.** If Contractor does not faithfully construct and complete said work, as defined in the Scope of Work under its contract with City, and City invokes its contractual rights and declares Contractor in default, Surety promptly shall remedy the default and, at City’s sole option, Surety shall:
 - A. Within a reasonable time (but not later than thirty (30) days after Surety receives written notice of Contractor’s/Principal’s Default), with written notice to City, step into and assume the role, all rights and all obligations of the defaulting Contractor/Principal under the Contract, including without limitation, responsibilities for the correction of defective work completed by the Contractor, additional legal, design professional and delay costs resulting from Contractor’s default or resulting from Surety’s actions or failure to act under the terms of this Bond, and liquidated damages provided under the Contract. Upon assumption of this role, Surety and all sureties directly shall contract with a Completion Contractor hired/engaged by Surety and all sureties to complete the structure(s), Work and improvements, pursuant to the Scope of Work in the Contract with Contractor/Principal. The selection of the Completion

DNRBZ 2017 907

Contractor must be approved in writing by City and such approval shall not be unreasonably delayed, conditioned or withheld. Surety and all sureties solely shall be responsible for any and all costs incurred, up to the Bond Sum, to complete the structure(s), Work and improvements, pursuant to the Scope of Work in the Contract with Contractor/Principal; or

- B. In the event Surety fails to contract with a Completion Contractor within ninety (90) days of receipt of City's written notice of Default, City may, at City's sole discretion, select a Completion Contractor in accordance with Texas Law. In this event of Surety and all sureties failing to contract with a Completion Contractor within ninety (90) days of receipt of City's written notice of Default, Surety and all sureties then shall pay City any and all costs, up to the Bond Sum, for City's selected Completion Contractor to complete the structure(s), Work and improvements, as defined in the Scope of Work in the Contract with Contractor/Principal; or
- C. At City's sole discretion, Surety and all sureties shall pay to the City the City's estimated amount for the City to execute a Project Completion Contract with a Completion Contractor, selected by City in accordance with Texas Law, solely to complete the structure(s), Work and improvements, pursuant to the Scope of Work in the Contract with Contractor/Principal. Surety and all sureties shall pay City any and all costs, up to the Bond Sum, for the City-selected Completion Contractor to complete the structure(s), Work and improvements, as defined in the Scope of Work in the contract with Contractor/Principal.
3. **QUALIFICATION.** Surety companies executing this Bond must appear on the United States Treasury Department's most current list (Circular 570, as amended) and be otherwise authorized to transact business in the State of Texas.
4. **VENUE.** The obligations of the parties under this Bond shall be performable in Coryell County, Texas and shall be construed under the laws of the State of Texas. If legal action, such as civil litigation, is necessary in connection with this Bond, exclusive venue shall be in Coryell County, Texas.

THIS BOND is entered into this _____ day of _____, 20_____.

SURETY (seal)

By: _____
(Signature)

(Print Name)

(Print Title)

[ATTACH POWER OF ATTORNEY]

ATTEST: _____
DNRBZ 2017 907

CONTRACTOR

By: _____
(Signature)

(Print Name)

(Print Title)

[Additional signatures, if any, appear on
attached page]

ATTEST: _____

WARRANTY BOND

KNOW ALL BY THESE PRESENTS:

THAT _____ as Principal, and _____, a corporation organized under the laws of _____, as Surety, do hereby expressly acknowledge themselves to be held and firmly bound to pay unto the City of Copperas Cove, a municipal corporation of the County of Coryell and the State of Texas, the sum of _____ dollars (\$ _____) (35% of Contract Price), for the payment of which sum will truly be made unto said City of Copperas Cove, and its successors, and said Principal and Surety do hereby bind themselves, their heirs, administrators, executors, assigns and successors jointly and severally firmly by these presents.

Principal has agreed to complete the **Northwest WWTP Clarifier Rehabilitation Project**, and the associated improvements, in conformance with the standards established by that certain contract ("Contract") between the City of Copperas Cove and Principal, which is hereby expressly made a part of this bond as though the same were written embodied herein.

WHEREAS, under the Contract, it is provided that the Principal, warrants and guarantees the work therein contracted to be done and performed, for a period of one (1) year from the date of the acceptance of said work, and to do all necessary repairing and/or reconstructing in whole or in part of said work that should be occasioned by defective workmanship or materials furnished in the construction or any part thereof or any of the accessories thereto. It is understood that the purpose of this section is to cover all defective conditions arising by reason of defective material, labor or workmanship, and charge the same against the Principal and Surety on this obligation and that both Principal and Surety shall be subject to liquidation damages for each day's failure to correct any defective conditions in accordance with the Contract. Now, therefore, if the Principal shall keep and perform its obligations for said warranty work for a period of one (1) year then this bond shall be null and void and have no further effect, but if default shall be made by the Principal in the performance of its duty to so complete said work, then this bond shall have full force and effect, and the City of Copperas Cove shall have and recover from the Principal and Surety damages resulting from such default; and it is further agreed that this obligation shall be a continuing one against the Principal and Surety and that successive recoveries may be made until the full amount shall have been exhausted; and it is further understood that the obligation herein to complete such work shall continue throughout said period, and the same shall not be changed, diminished or in any manner affected from any cause during said time.

Principal and Surety both acknowledge that this agreement is entered into in Copperas Cove, Coryell County, State of Texas. The construction of this agreement and the rights remedies, and obligations arising there under are governed by the laws of the State of Texas. Both Principal and Surety hereby agree that the Texas conflicts of law rules do not control this agreement and will not be used to cause the application of the laws of a jurisdiction other than the State of Texas. The obligations performable by both Principal and Surety are performable in Copperas Cove, Coryell County, Texas.

Additionally, Surety agrees that the City of Copperas Cove will satisfy any legal or contractual requirements arising from or in connection with this warranty bond by directing such action to the Texas office listed below. Surety shall not waive or amend this office without the prior consent in writing of the City of Copperas Cove.

IN WITNESS WHEREOF, said Principal has caused this bond to be executed and Surety has caused this bond to be executed by its attorney in fact and said attorney in fact, _____ (print name), has hereunto set his or her hand, the _____ day of _____, 20 _____.

Name of Principal: _____ Name of Surety: _____

By: _____ By: _____
(print name) (print name)

Title: _____ Title: _____

Address: _____ Address: _____

Phone: _____ Phone: _____

The name, address and phone number of the Resident Agent of Surety is: (must be Texas office)

*Power of Attorney attached

SPECIFICATIONS

SECTION 01 11 00

SUMMARY OF WORK

PART 1—GENERAL

1.01 DIVISION ONE

- A. The requirements of Division 01 apply to all sections of the Contract.

1.02 PROJECT SCOPE

- A. CONTRACTOR shall provide all items, articles, materials, operations or methods mentioned or scheduled on the Drawings or herein specified: including all labor, supervision, equipment, incidentals, taxes, and permits necessary to complete the Work as described within the Contract Documents. CONTRACTOR shall install all items provided by OWNER as mentioned or scheduled on the Drawings or herein specified.

1.03 CONTRACT DOCUMENTS—INTENT AND USE

- A. Intent of Documents:
 - 1. Singular notations and Specifications shall be considered plural where application is reasonably inferred.
 - 2. Mention or indication of extent of work under any division or Specification section is done only for convenience of CONTRACTOR and shall not be construed as describing all work required under that division or section.
 - 3. Some individual sections may contain a list of related sections. The list of related sections in individual sections is provided for the convenience of CONTRACTOR and is not necessarily all-inclusive. CONTRACTOR may not rely upon this listing for determination of scope of work. Other sections of the Specifications not referenced in individual sections shall apply as required for proper performance of the Work.
 - 4. Command type sentences may be used in the Contract Documents. These sentences refer to and are directed to CONTRACTOR.
 - 5. Symbols for various elements and systems are shown on the Drawings. Should there be any doubt regarding the meaning or intent of the symbols used, a written interpretation shall be obtained from CONSULTANT.
- B. Use of Documents:
 - 1. CONTRACTOR shall examine all Specifications and Drawings for the Work, including those that may pertain to Work CONTRACTOR does not normally perform with its own forces.
 - 2. CONTRACTOR shall use all of the Project Drawings and Specifications:
 - a. For a complete understanding of the Project.
 - b. To determine the type of construction and systems required.
 - c. For coordination with other contractors.
 - d. To determine what other work may be involved in various parts or phases.
 - e. To anticipate and notify others when work by others will be required.
 - f. And all other relevant matters related to the project.
 - 3. CONTRACTOR is also bound by all requirements of the Contract Documents which are applicable to, pertain to, or affect its Work as may be shown or inferred by the entire set of Project Drawings and Specifications.

1.04 CONTRACT ROLES

- A. In addition to contract roles defined previously in the Contract Documents, the following roles are identified throughout the Specifications:
 - 1. Geotechnical Engineer—The individual or entity that prepared the geotechnical report that is referenced in this Section and the provides geotechnical engineering services, if any, during construction of the Project.
 - 2. Testing Firm—The individual or entity that performs materials testing during construction of the Project.

1.05 CONSTRUCTION REQUIREMENTS

- A. General Information and Requirements:
 - 1. Currently, wastewater treatment at the City of Copperas Cove Northwest Wastewater Treatment Plant consists of influent pumping and screening, activated sludge aeration followed by clarification, and ultraviolet disinfection of the final effluent. Waste activated sludge is pumped to the thickener pre-mix basin, followed by gravity thickening and aerobic digestion. Digested biosolids are dewatered on a belt filter press and trucked to a landfill for disposal.
 - 2. Wastewater treatment during construction must be continuous and the treatment efficiency must be equal to that achieved prior to the start of construction.
 - 3. It shall be the responsibility of CONTRACTOR to not in any way impair the normal treatment or operating efficiency of the facilities, regardless of the work underway. No bypassing of raw or partially treated wastewater to receiving stream shall occur at any time as a result of construction. In general, this requires that new facilities be complete and ready for service or that temporary facilities be provided prior to removing existing units from service for modification or repair. CONTRACTOR shall provide all temporary piping, bypass pumping, and temporary construction required to complete the Work.
 - 4. Operation of existing treatment facilities will be the responsibility of OWNER. CONTRACTOR shall cooperate with OWNER's staff at all times. A minimum of 48 hours prior to making any process or electrical connections to existing facilities or modification or demolition of existing facilities, CONTRACTOR shall notify OWNER in writing. At the time of notification, CONTRACTOR shall submit a schedule for completion of the Work, including a description of measures that will be taken to minimize the impact to existing facilities.
 - 5. Except as specified, OWNER will drain existing tanks to the level of the lowest existing drain line or will remove tank contents using existing piping and pumping equipment. Subsequent cleaning or further draining and/or pumping shall be provided by CONTRACTOR. If there exists sludge, grit, or other residue that cannot be drained or pumped in its present state, it shall be the responsibility of CONTRACTOR to remove and dispose of this material.
 - 6. Access: CONTRACTOR shall maintain roadways open at all times to meet OWNER's requirements, including access for sludge hauling vehicles. CONTRACTOR shall be responsible for maintaining roadways in drivable condition, including placement of temporary stone and gravel and providing drainage as necessary. OWNER's roadways around the treatment facility shall be cleaned of construction site materials, soil, and debris as necessary.
- B. Construction Sequence:
 - 1. The following construction sequence is provided as a general guideline for the information and for the benefit of CONTRACTOR. This construction sequence is not intended to dictate means, method of construction, or direct construction activities. This

construction sequence is a conceptual general construction sequence with minimum recommended outage, shutdowns, and operating units to be maintained in service. The general construction sequence is projected to allow the Work to be completed while maintaining treatment of the wastewater treatment plant. It is not intended to be all inclusive and does not list all work elements or details that are required to complete the Work, complete treatment processes, or place unit processes in service. CONTRACTOR shall be responsible for implementing any additional details required, including temporary piping, bypass pumping, or temporary construction at no additional cost to OWNER.

2. CONTRACTOR may propose alternate sequence or modifications to this sequence. OWNER will review the proposed modification and determine if such modification of the sequence interferes with the proper operation of the treatment activities. Any modifications to this general construction sequence shall be proposed in writing and shall be approved by OWNER prior to their implementations.
3. At any time following the Notice to Proceed, CONTRACTOR may begin work on the new elevated walkway on the exterior of Final Clarifier Nos. 1 and 2. CONTRACTOR shall drain tanks as necessary for installation of the walkway sections on the interior of the tanks. CONTRACTOR shall provide OWNER a minimum of 3 days' notice to allow OWNER to drain the aerobic digester.
4. At any time following the Notice to Proceed, construction activity may commence as described herein for the RAS/WAS Pumping Station (Structure 43). Contractor shall fully construct the pumping station, including, but not limited to, concrete base slab, pumps, piping, valves, flowmeters, VFDs, control panels, conduit, and all associated electrical modifications prior to beginning any work in the Aeration Basins or Final Clarifiers.
5. Following completion of the RAS/WAS Pumping Station, CONTRACTOR shall isolate and remove from service Aeration Basin No. 1 and Final Clarifier No. 1. OWNER shall provide operational assistance for the opening and closing of gates in the Aeration Basin Splitter Structure, Final Clarifier No. 1 Loading Box, and Final Clarifier No. 1 Effluent Box. OWNER shall drain Aeration Basin No. 1, Final Clarifier No. 1, and the Final Clarifier No. 1 Loading and Effluent Boxes to the lowest possible levels with gates and drain valves. CONTRACTOR is responsible for providing pumps to transfer the remainder of tank contents to the adjacent Aeration Basin No. 2 and Final Clarifier No. 2. CONTRACTOR shall not begin Work within the structures until the structures are fully drained and cleaned.
6. After Aeration Basin No. 1 is fully drained, CONTRACTOR shall perform piping modifications within Aeration Basin No. 1 as shown on the Drawings.
7. After Final Clarifier No. 1 Loading Box has been removed from service and fully drained, CONTRACTOR shall remove the existing 6-inch WAS piping to the extents possible, and abandon the remaining pipe with nonshrink grout as indicated on the Drawings.
8. The CONTRACTOR may begin work in Final Clarifier No. 1, as shown on the Drawings, once the clarifier is fully drained and cleaned.
9. The CONTRACTOR shall remove the existing gate and install a new downward opening weir gate in the Final Clarifier No. 1 Effluent Box following complete drainage of the structure and removal from service.
10. Following completion of all modifications in Aeration Basin No. 1, Final Clarifier No. 1, and Final Clarifier No. 1 Loading and Effluent Boxes, CONTRACTOR shall open all gates to return Aeration Basin No. 1 and Final Clarifier No. 1 to service. CONTRACTOR shall begin operation of the RAS/WAS Pumping Station to pump RAS to Aeration Basin No. 1 and WAS to the Pre-Thickening Tank (Structure 45).
11. Once operation has been re-established in Aeration Basin No. 1, Final Clarifier No. 1, and the RAS/WAS Pumping Station for a minimum of 5 days, CONTRACTOR shall isolate and remove from service Aeration Basin No. 2 and Final Clarifier No. 2 following

the above steps. CONTRACTOR shall complete all work on Aeration Basin No. 2, Final Clarifier No. 2, and the Final Clarifier No. 2 Loading and Effluent Boxes as shown on the Drawings, and shall then return the units to service.

12. Once all treatment units have been returned to service, CONTRACTOR shall remove the two existing WAS airlift pumps from the Pre-Thickening Tank to the extents possible, and abandon the remainder of the WAS piping with nonshrink grout, as indicated on the Drawings.
13. Operations Buildings:
 - a. Notify the OWNER a minimum of two weeks prior to taking MCC-A out of service. The CONTRACTOR shall be limited to a maximum of four outages, with a maximum time duration for each outage of two hours.
 - b. Work associated with MCC-A shall be limited to Mondays, Tuesdays, Wednesdays, and Thursdays.
 - c. The OWNER shall be able to cancel any outage time in the event of wet weather.

1.06 CONTRACTOR USE OF SITE

A. General:

1. The "area of the site" referred to in these Specifications shall be as shown on the Drawings. If the "area of the site" is not shown, OWNER's property lines, the Project right-of-way and/or any easements obtained for the Project shall be considered the "area of the site."
2. Construction activities shall be confined within the "area of the site" limits.
3. From the start of work to completion CONTRACTOR is responsible for the care of the site and the premises which are affected by operations of Work of this Contract.
4. Except for permanent site improvements provided under the Contract, CONTRACTOR shall restore property disturbed during the Work, to the conditions which previously existed.
5. Work in occupied spaces shall be restricted to specified Work and essential activities, such as making necessary connections and extending services or constructing temporary access ways. Such work shall be scheduled in advance with OWNER.

B. Parking and Deliveries:

1. CONTRACTOR is responsible for control of traffic by vehicles and persons within the limits of its operations.
2. Parking for employees, subcontractors, and agents of CONTRACTOR shall be in areas subject to approval of OWNER.
3. Access to the site for delivery of construction material or equipment shall be subject to approval of OWNER.

1.07 EXISTING SERVICES, OVERHEAD UTILITIES, AND UNDERGROUND FACILITIES INCLUDING STRUCTURES

- A. Interruption of existing services and systems including heating, ventilating, air conditioning, water, sanitary, lighting and power, signal and security will not be permitted unless specifically indicated otherwise. Provide temporary facilities to maintain services.
- B. If deemed necessary by OWNER, such work shall be accomplished after OWNER's normal office hours.

- C. Work shall not commence until all labor, materials, and equipment are available so Work can continue without interruption or delay.
- D. Should uncharted or incorrectly charted services or Underground Facilities be encountered during installation, notify OWNER and consult with utility owner immediately.
- E. Cooperate with OWNER and utility companies in keeping respective services and Underground Facilities in operation and repair any damage.
- F. CONTRACTOR shall not interrupt existing services and Underground Facilities occupied and used by OWNER or others, except when permitted in writing by OWNER.
- G. Any accidental interruption of services and Underground Facilities shall be repaired immediately, including provision of temporary facilities until permanent repairs can be made.
- H. Texas Utilities Code Section 251 requires, among other provisions, that before excavation or demolition begins, reasonable advance notice not less than three working days prior to the start of the excavation or demolition of the intent to excavate or demolish and the commencement date be provided to the owners of the Underground Facilities in and near the construction area whose facilities may be affected by the excavation or demolition. As part of this notification requirement, CONTRACTOR shall contact the City of Copperas Cove Utility Administration and Texas 811 (811 or 1-800-344-8377). A call to this agency shall not absolve CONTRACTOR of the requirements of this statute. CONTRACTOR shall comply with all other provisions of the statute though not enumerated herein.
- I. Locations and elevations of services and Underground Facilities as shown on the Drawings are approximate. It shall be CONTRACTOR's responsibility to determine their exact location when in their vicinity. To this end, CONTRACTOR shall proceed with caution in the excavation and preparation of the Site so the exact location of services and Underground Facilities can be determined. CONTRACTOR shall include in the Contract Price any costs for temporary or permanent relocations of such services and Underground Facilities required to complete the Work unless specifically indicated otherwise in the Specifications.
- J. Where potential grade conflicts might occur with existing services and Underground Facilities, CONTRACTOR shall uncover such services and Underground Facilities sufficiently in advance of construction so that elevations may be determined to allow any necessary adjustments to be made.
- K. CONTRACTOR shall coordinate with overhead utility companies prior to the Work. CONTRACTOR shall provide all necessary temporary and permanent support relocation or temporary and permanent restraint to maintain overhead utilities in service.
- L. CONTRACTOR shall keep an accurate and complete record of all such services and Underground Facilities encountered and shall provide OWNER a copy of this record. The record shall include a description of the item encountered, opinion as to conditions, and adequate measurements and depths so that the item can be located in the future.
- M. CONTRACTOR shall inspect all services and Underground Facilities for condition and soundness. Unsound conditions shall be reported to OWNER immediately after exposing. CONTRACTOR shall not proceed with the Work until the service or facility owner has been notified. Service or facility owner shall then be given time to inspect and correct, if required,

the service or Underground Facility. CONTRACTOR may make claim under the provisions of the General Conditions should CONTRACTOR feel a price or time adjustment is justified.

- N. Any additional costs incurred because of failure of CONTRACTOR to report the condition of any and all existing services and Underground Facility encountered shall be paid for by CONTRACTOR.

1.08 PROTECTION OF WORK AND IMPROVEMENTS

- A. CONTRACTOR shall protect the property of OWNER, existing improvements, and the Work installed by CONTRACTOR and others from abuse, damage, dust, debris, and other objectionable materials resulting from construction activities.
- B. CONTRACTOR shall provide suitable covers, partitions, or other dust and fume containment devices to suit construction operations.
- C. CONTRACTOR shall keep property, existing improvements, and the Work including structures, mains, fittings, and accessories free from dirt and foreign matter at all times.
- D. CONTRACTOR shall provide temporary plugging of openings, holes, and pipe ends that are existing or that CONTRACTOR has installed.
- E. Property, improvements, and Work damaged by CONTRACTOR shall be repaired or replaced by CONTRACTOR to the satisfaction of OWNER.
- F. CONTRACTOR is cautioned that existing public and private streets, alleyways, and roads may not hold up to typical construction traffic or activities. CONTRACTOR shall repair or replace streets, alleyways, roads, and shoulders damaged by its construction activities to their original condition at CONTRACTOR's expense.

1.09 AVAILABILITY OF LANDS

- A. Easements were not obtained for this Project. CONTRACTOR shall confine its operations, equipment and storage areas to the lands and rights-of-way in which the Project is to be located. CONTRACTOR may enter into written agreements with property owners for use of other lands during construction. Copies of such agreements shall be provided to OWNER.

1.10 SUBSURFACE CONDITIONS

- A. Underground Facilities: Underground facilities are shown or indicated on the Drawings. Information and data regarding the presence or location of underground facilities are not intended to be categorized, identified, or defined as Technical Data, which is identified as such below with respect to existing subsurface conditions at our adjacent to the site.
- B. Reliance by CONTRACTOR on Technical Data: CONTRACTOR may rely upon the accuracy of the Technical Data expressly identified below with respect to such reports and drawings, but such reports and drawings are not Contract Documents.
- C. Limitations of Other Data and Documents: CONTRACTOR may not rely upon or make any claim against OWNER or CONSULTANT, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. The completeness of such reports and drawings for CONTRACTOR's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by CONTRACTOR, and safety precautions and programs incident thereto;
 2. Other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;
 3. The contents of other Site-related documents made available to CONTRACTOR such as record drawings from other projects at or adjacent to the Site, or OWNER's archival documents concerning the Site; or
 4. Any CONTRACTOR interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.
- D. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data, and specifically identifies the Technical Data in the report upon which CONTRACTOR may rely:

Report Title	Date of Report	Technical Data
Northwest WWTP In-Line Pump Additions Geotechnical Engineering Report, prepared by Terracon	August 15, 2025	Boring Methods, Level of Subsurface Water, Boring Logs, Laboratory Test Methods and Results, and Boring Locations

CONSULTANT accepts no responsibility for accuracy of the soil data or water level information. Soil information, included with these Contract Documents, was not obtained for the purposes of designing excavations and trenches. Soil information was used by CONSULTANT for design purpose only. CONTRACTOR shall assure itself by personal examination as to subsurface conditions and shall provide its own investigations and make its own assumptions to comply with OSHA and any other applicable laws and regulations regarding excavation and trenching requirements.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 29 00

CONTRACT CONSIDERATIONS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Measurement and Payment–Unit Prices.
 - 2. Measurement and Payment–Lump Sum for Bid Item No. 1.

1.02 MEASUREMENT AND PAYMENT–UNIT PRICES

- A. Measurement methods are delineated in the individual Specification sections.
- B. CONTRACTOR shall take measurements and compute quantities. CONSULTANT will check measurements and quantities.
- C. Incidental Items of Work: Any items of Work shown on the Drawings or called for in the Specifications, but not included in the Bid Form, shall be considered incidental items of Work. The cost of incidental items of Work shall be included in the prices bid for adjacent Work.

1.03 MEASUREMENT AND PAYMENT–LUMP SUM FOR BID ITEM NO. 1

- A. Payment for the Lump Sum Bid Item No. 1 will be based on the accepted schedule of values for that Bid item.
- B. An acceptable schedule of values will include the following features:
 - 1. Schedule shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during construction. Schedule shall be subdivided as necessary by Specification section and work area.
 - 2. Identify each line item with the number and title of the respective Specification Section.
 - 3. For each major line item list sub-values of major products or operations under the item.
 - 4. For the various portions of the work:
 - a. Each item shall include a directly proportional amount of CONTRACTOR's overhead and profit.
 - b. For items on which progress payments will be requested for stored materials, break down the value into:
 - (1) The cost of the materials, delivered and unloaded, with taxes paid. Paid invoices are required for materials upon request by CONSULTANT.
 - (2) The total installed value.
 - 5. The sum of all values listed in the schedule shall equal the Lump Sum value of Bid Item No. 1.
 - 6. Schedule shall include a separate listing of general items such as bonds, insurance, mobilization, demobilization, field supervision, record documents, and cash allowances.
- C. Once a schedule of values is accepted, it shall not be revised, except for changes associated with subsequently executed change orders.
- D. No separate measurement for payment will be performed for Lump Sum Work.

- E. CONTRACTOR shall estimate percentage of Work completed. CONSULTANT will review CONTRACTOR's estimate of quantity of Work completed.
- F. Payment will be made based on the percentage of the Contract completed less retainage and/or liquidated damages.
- G. Unless noted otherwise, all Work described in the Specifications and/or shown on the Drawings for Bid Item No. 1 shall be included in the Lump Sum Bid item.
- H. Some technical specification sections may include payment provisions. These provisions are in addition to the provisions of this section which apply to all of the Work.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 31 00

COORDINATION, FIELD ENGINEERING, AND MEETINGS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Coordination.
 - 2. Field Engineering.
 - 3. Progress Meetings.

1.02 COORDINATION

- A. CONTRACTOR shall coordinate scheduling, submittals, and work of the various sections of the work to provide an efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later. See Section 01 11 00—Summary of Work for specific construction sequence.
- B. CONTRACTOR shall verify utility requirements and characteristics of operating equipment are compatible with building utilities and coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing in service such equipment.
- C. CONTRACTOR shall coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on the Drawings and shall follow routing shown for pipes, ducts, and conduit as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas, except as otherwise indicated, CONTRACTOR shall conceal pipes, ducts, and wiring within the construction and coordinate locations of fixtures and outlets with finish elements.
- E. CONTRACTOR shall coordinate completion and cleanup of Work of separate sections in preparation for substantial completion and for portions of Work designated for OWNER's occupancy.
- F. After OWNER occupancy of premises, CONTRACTOR shall coordinate access to Site for correction of defective Work and Work not in accordance with Contract Documents to minimize disruption of OWNER's activities.

1.03 FIELD ENGINEERING

- A. CONTRACTOR shall locate and protect property stakes, legal survey monuments, benchmarks, and survey control and reference points. CONTRACTOR shall pay for replacement of disturbed property stakes and legal survey monuments by a Registered Land Surveyor acceptable to OWNER and for replacement of benchmarks and survey control and reference points provided by CONSULTANT.

- B. CONTRACTOR shall provide field engineering services as required to establish elevations, lines, and levels utilizing recognized engineering survey practices.
- C. CONTRACTOR shall furnish all required plummets and graduated poles to check all Work.
- D. If stakes and boards have to be reset because of negligence of CONTRACTOR, CONTRACTOR shall bear the cost of such work.
- E. If laser beam is used, CONTRACTOR shall check its Work against intermediate grade stakes provided between manholes. Prior to initial use of the laser, CONTRACTOR shall set up laser on ground surface and check line and gradient controls. Lasers not functioning properly shall be immediately removed.
- F. CONTRACTOR shall be responsible for all lines, elevations, and measurements of buildings, structures, piping, utilities, and other work executed by CONTRACTOR under the Contract. CONTRACTOR must exercise proper precaution to verify figures before laying out the Work and will be held responsible for any error resulting from its failure to exercise such precaution.

1.04 PROGRESS MEETINGS

- A. Progress meetings will be held throughout progress of the Work at intervals agreed to by OWNER, CONSULTANT, and CONTRACTOR. Interval will generally be monthly.
- B. CONTRACTOR's project manager, job superintendent, major subcontractors, and suppliers shall attend as appropriate to address agenda topics for each meeting. CONTRACTOR's representatives shall have authority to bind CONTRACTOR to decisions at the meetings.
- C. The project schedule shall be updated monthly and shall be reviewed at each progress meeting.
- D. CONTRACTOR shall also provide the following information in written form at each meeting.
 - 1. Construction progress, including:
 - a. Activities completed this reporting period.
 - b. Activities in progress this reporting period.
 - c. Activities scheduled to commence this reporting period.
 - 2. Description of problem areas.
 - 3. Current and anticipated delays.
 - a. Cause of the delay.
 - b. Corrective action and schedule adjustments to correct the delay.
 - c. Impact of the delay on other activities, on milestones, and on completion dates.
 - 4. Changes in construction sequence.
- E. CONSULTANT will prepare and distribute minutes to all attending parties.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 33 00

SUBMITTALS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Whenever possible throughout the Contract Documents, the minimum acceptable quality of workmanship and materials has been defined either by manufacturer's name and catalog number or by reference to recognized industry standards.
 - 2. To facilitate CONTRACTOR's understanding of the design intent, procedures have been established for advance submittal of design data and for its review or rejection by CONSULTANT.
 - 3. The type of submittal requirements specified in this section include construction progress schedule, submittal schedule, shop drawings, product data, samples, maintenance manuals, and other miscellaneous work-related submittals.
- B. Related work described elsewhere: More detailed requirements for submittals are described in other sections of these Specifications for some materials and equipment. They are to be considered additional requirements to supplement the requirements specified in this section. Submittals shall conform to the General Conditions.
- C. Definitions: "Electronic Submittal" is defined as any submittal transmitted electronically to CONSULTANT for review.

1.02 IDENTIFICATION OF SUBMITTALS

- A. CONTRACTOR shall completely identify each submittal and resubmittal by showing at least the following information:
 - 1. Name and address of submitter, plus name and telephone number of the individual who may be contacted for further information.
 - 2. Name and location of project and identification number.
 - 3. Drawing number and Specifications section number to which the submittal applies.
 - 4. Include the date of each submittal or resubmittal.

1.03 GROUPING OF SUBMITTALS

- A. Unless otherwise specifically permitted by CONSULTANT, CONTRACTOR shall make all submittals in groups containing all associated items so that information is available for checking each item when it is received.
- B. Partial submittals may be rejected as not complying with the provisions of the Contract Documents.

1.04 TIMING OF SUBMITTALS

- A. CONTRACTOR shall make all submittals far enough in advance of scheduled dates of installation to provide required time for reviews, for securing necessary approval, for possible revision and resubmittal, and for placing orders and securing delivery.

- B. The review period for submittals that are received after 3 P.M. shall commence on the following business day.

1.05 CONSTRUCTION PROGRESS AND SUBMITTAL SCHEDULES

- A. Submit preliminary schedules within 10 days of the Effective Date of the Contract.
- B. Revise schedules incorporating any comments provided at the schedule review conference and resubmit.
- C. As a minimum, the construction progress schedule shall consist of a horizontal bar chart with a separate line for each major portion of Work or operation, identifying first workday of each week.
- D. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration for each activity. Identify activities that are on the critical path.
- E. Include line items for milestones (if any), Substantial, and Final Completion.
- F. Submit updated schedules with each Application for Payment, identifying changes since previous version.
- G. Indicate estimated percentage of completion for each item of Work at each submission.
- H. Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates.

1.06 SHOP DRAWINGS

- A. Shop drawings shall include specially prepared technical data for this project including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements, and similar information not in standard printed form for general application to a range of similar projects. Shop drawings shall be submitted for all manufactured or fabricated items. See individual technical sections for special requirements.
- B. CONTRACTOR shall make all shop drawings accurately to scale and sufficiently large to show all pertinent aspects of the item and its method of connection to the work.
- C. Shop drawings shall be checked, approved, and stamped by CONTRACTOR in accordance with the General Conditions before transmittal to CONSULTANT for review and approval.
- D. Complete shop drawings and descriptive data shall be submitted on all manufactured or fabricated items prior to 50% completion of the Work. Applications for payment beyond 50% of the Contract amount will not be recommended for payment until all shop drawings are submitted, including color hard copies if requested by OWNER, or a revised schedule for any remaining submittals is agreed to by OWNER and CONSULTANT.
- E. CONTRACTOR shall submit shop drawings following the electronic submittal procedure described below.

- F. Shop drawings submitted to CONSULTANT will be reviewed and stamped “Approved,” “Approved as Noted,” “Approved as Noted-Resubmit,” or “Not Approved.” CONTRACTOR shall resubmit shop drawings stamped “Approved as Noted-Resubmit” and “Not Approved,” and will continue this process until shop drawings are stamped “Approved” or “Approved as Noted.” If Drawings are stamped “Approved as Noted-Resubmit,” fabrication may proceed in accordance with the marked-up shop drawings. Installation shall not proceed until shop drawings have been resubmitted and stamped “Approved” or “Approved as Noted.”
- G. If shop drawings are stamped “Approved as Noted” or “Approved as Noted-Resubmit” and CONTRACTOR does not agree with revisions or cannot conform with revisions, fabrication shall not proceed and shop drawings shall be resubmitted with explanation of CONTRACTOR’s position.
- H. All shop drawings used for construction site activities shall bear the “Approved” or “Approved as Noted” stamp of CONSULTANT.
- I. PDF Submittal Procedures:
 - 1. Summary:
 - a. Shop drawing and product data submittals shall be transmitted to CONSULTANT in electronic (PDF) format.
 - b. The intent of PDF submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
 - c. The PDF submittal process is not intended for color samples, color charts, or physical material samples.
 - 2. Procedures:
 - a. CONTRACTOR shall review and apply a stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer/product, dimensions and coordination of information with other parts of the work.
 - b. CONTRACTOR shall transmit each cover letter and submittal to CONSULTANT as an e-mail attachment.
 - c. CONSULTANT will return the reviewed shop drawing via e-mail with a transmittal letter, after review, indicating the status of the shop drawing review.
 - d. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of CONTRACTOR.
 - e. Electronically submitted shop drawings shall follow the following format:
 - (1) Filenames for the shop drawing submittals shall follow a XX XX XX.YYY-Z. Description convention where XX XX XX is the Specification section number, YYY is the submittal number, .Z is the resubmittal number, and description is a short description of what the submittal includes. Submittals shall be consecutively numbered in direct sequence of submittal. Resubmittals shall be consecutively numbered with the first submittal numbered with a -0 and the first resubmittal numbered with a -1. Example file name: 03 20 00.016-1. Structure 10 Concrete Reinforcement. This would be the first revision of the sixteenth submittal and contain information on concrete reinforcement.
 - (2) All files shall be delivered in PDF format with a minimum resolution of 300 dpi unless otherwise requested by CONSULTANT. Scanned in material shall be scanned in color and any markings by CONTRACTOR shall be made in red. Pages shall be rotated to the appropriate position for easy reading on a computer monitor such that the majority of text is vertical.
 - (3) Files shall be delivered without security features activated.

- (4) Shop Drawings shall be uploaded as individual files. All pages of one submittal should be contained in one file.
- (5) The file shall open to a cover page containing, at a minimum, the following information:
 - (a) CONTRACTOR's stamp.
 - (b) Name, e-mail, and telephone number of the individual who may be contacted for further information.
 - (c) Project number.
 - (d) Submittal number.
 - (e) Submission date, if resubmittal, all previous submission dates.
 - (f) Index detailing contents and the total number of pages in the submittal.
- f. Once a shop drawing has been "Approved" or "Approved as Noted," CONTRACTOR shall provide three hard color copies of the "Approved" or "Approved as Noted" shop drawings to CONSULTANT. CONTRACTOR is responsible for the hard copy color replication of CONSULTANT's "Approved" or "Approved as Noted" shop drawings for use by CONTRACTOR. Hard copy shop drawings shall be submitted in 3-ring binders or 3-tab report covers.

J. Shop drawings shall include verification that the item meets applicable codes and standards.

1.07 COLORS AND PATTERNS

- A. Unless the precise color and pattern is specifically described in the Contract Documents, whenever a choice of color or pattern is available in a specified product, CONTRACTOR shall submit accurate color charts and pattern charts to CONSULTANT for OWNER's review and selection.
- B. Unless all available colors and patterns have identical wearing capabilities and are identically suited for the installation, CONTRACTOR shall completely describe the relative capabilities of each.

1.08 SAMPLES AND FIELD MOCKUPS

- A. CONTRACTOR shall provide samples and field mockups where noted or specified.
- B. Samples are physical examples which illustrate materials, equipment, or workmanship and establish standards by which the work will be judged.
- C. Samples shall be of sufficient size and quantity to clearly illustrate the functional characteristics of the product and full range of color, texture, and pattern.
- D. Samples shall have labels firmly attached, bearing the following information:
 - 1. Name of project.
 - 2. Description of product and finish.
 - 3. Name of CONTRACTOR.
 - 4. Trade name and number of product.
 - 5. Standards met by the product.
- E. Approval of samples must be obtained prior to proceeding with any work affected by material requiring sample approval.
- F. Samples, unless otherwise noted, become the property of OWNER.

- G. In situations specifically approved by CONSULTANT, the retained sample may be used in the construction as one of the installed items.
- H. Field Mockups:
 - 1. CONTRACTOR shall erect field mockups at the project site in a location acceptable to CONSULTANT and OWNER.
 - 2. When accepted by CONSULTANT, the mockup will become the basis for comparison of the actual work.
 - 3. Remove mockup at conclusion of the work if it was not incorporated into the work.

1.09 PRODUCT DATA

- A. CONTRACTOR shall provide product data as required to supplement shop drawings.
- B. Product data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by CONTRACTOR to illustrate a material, product, or system for some portion of the work.
- C. CONTRACTOR shall collect required product data into one submittal for each unit of work or system.
- D. CONTRACTOR shall include manufacturer's standard printed recommendations for application and use, compliance with standards, performance characteristics, wiring and piping diagrams and controls, component parts, finishes, dimensions, required clearances, and other special coordination requirements.
- E. CONTRACTOR shall mark each copy of standard printed data to identify pertinent products, models, options, and other data.
- F. CONTRACTOR shall supplement manufacturer's standard data to provide information unique to the work.

1.10 RESUBMISSION REQUIREMENTS

- A. Make any corrections or changes in the submittals required by CONSULTANT.
- B. Shop Drawings and Product Data:
 - 1. Revise initial drawings or data and resubmit as specified for initial submittal.
 - 2. Itemize in a cover letter any changes which have been made other than those requested by CONSULTANT.
- C. CONTRACTOR shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than three submittals. CONSULTANT will record CONSULTANT's time for review subsequent submittals of shop drawings, samples, or other items required for approval and CONTRACTOR shall reimburse OWNER and CONSULTANT's charges for such time.
- D. In the event that CONTRACTOR requests a substitution for previously approved item, CONTRACTOR shall reimburse OWNER for CONSULTANT's charges for its review time unless the need for such change is beyond control of CONTRACTOR.

1.11 MANUFACTURER'S DIRECTIONS

- A. Manufactured articles, materials, and equipment shall be stored, commissioned, operated, applied, installed, connected, erected, used, cleaned, and conditioned as directed by the manufacturer, unless specified to the contrary.
- B. Wherever Specifications call for work to be performed or materials to be installed in accordance with the manufacturer's printed instructions or directions, CONTRACTOR shall furnish copies as required for shop drawings of those instructions or directions to CONSULTANT before installing the material or performing the work.

1.12 MAINTENANCE MANUAL

- A. Prior to 75% completion of the Contract or at a minimum of 45 days prior to the scheduled start-up date of any individual item of equipment, whichever is earlier, CONTRACTOR shall furnish to CONSULTANT two complete color hard copies of a maintenance manual for all equipment furnished. Applications for payment beyond 75% of the contract amount will not be recommended for payment until all maintenance manuals are submitted or a revised schedule for remaining maintenance manuals is agreed to by OWNER and CONSULTANT.
- B. The manuals shall include manufacturer's instructions for maintenance and operation for each item of mechanical and electrical equipment. Manuals shall be specific for the equipment as installed; provide project specific inserts as required. Manuals shall contain: operation instructions, lubrication schedules, types and quantities, preventative maintenance program, spare parts list, parts lists, I.D. No. and exploded views, assembly instructions, parts supplier location, trouble shooting and startup procedures and, where applicable, test data and curves.
- C. All sheets shall have reduced dimensions as described for shop drawings, and shall be furnished in 3-ring binders or 3-tab report covers.
- D. CONTRACTOR is responsible for producing an electronic version of the Equipment Operations and Maintenance (O&M) Manuals Manual. The Electronic Equipment O&M Manual shall be delivered in Portable Document Format (PDF). The entire manual may be converted to PDF via scanning or other method of conversion. Drawings or other graphics must be converted to PDF format and made part of the PDF document. CONTRACTOR shall provide all Equipment O&M Manuals in the electronic format as defined below.
- E. The filename for the Equipment O&M Manual submittal will be provided with the request for final Equipment O&M Manuals. Filenames use the "eight dot three" convention (XX XX XX_YY.PDF) where XX XX XX is the Specification section number and YY is an ID number. No one file shall be larger than 10 MB. If technical problems require that the submittal be divided into more than one file, a letter extension shall be added to the end of each filename.
- F. The number of files shall be kept to a minimum. Equipment O&M Manuals that span more than one file shall have the final Bookmark "Return to Table of Contents" which shall take the User to the first file on the Equipment O&M Manual.
- G. All text (word processed), spreadsheets, and electronic graphics shall be delivered in portable document format (*.PDF). The resolution of all scanned images shall be a minimum of 300 dpi unless otherwise requested by CONSULTANT. Scanned images shall be processed with the "original image with hidden text" option (Adobe Acrobat 6 or higher). This

results in a clear image and provides for optical character recognition (OCR) and word search functionality. Graphical files shall be fully searchable. All submittals must be indexed with the Adobe Catalog feature. Placement and structure of index files shall be in accordance with Adobe's recommendations to minimize problems when transferring files. Successful searches for words or strings in the PDF document shall demonstrate proof of OCR.

- H. Rotate pages viewed in landscape to the appropriate position for easy reading on a computer monitor.
- I. Bookmarks shall be created in the navigation frame for each entry in the Table of Contents. Three levels deep is usually enough (i.e., "Chapter," "Section," "Subsection"); however, complex submittals like instrumentation and electrical may be required at the discretion of CONSULTANT. When setting bookmarks for Chapter level heading, the page shall be displayed at Full Page. Section and Subsection level heading pages shall be displayed as a magnified view. Bookmarks shall be displayed as subordinate to other bookmarks in their hierarchy set so that only the Chapter level headings are displayed.
- J. Thumbnails shall be generated and embedded in each PDF file.
- K. Files shall be delivered without Security features activated. Password protected files will be unacceptable.
- L. The opening view for PDF files shall be set as follows:
 - 1. Initial View: Bookmarks and Page
 - 2. Magnification: Fit In Window
 - 3. Page Layout: Single Page
- M. The file shall open to the cover page of the Equipment O&M Manual with bookmarks to the left. The first bookmark shall be the name of Equipment O&M Manual.
- N. O&M Manual PDFs shall be delivered electronically.
- O. CONTRACTOR shall reprocess any portion of the document that does not view or print to OWNER's satisfaction.
- P. CONTRACTOR is fully responsible for obtaining any and all copyright permissions associated with conversion of this information to electronic format.
- Q. Each maintenance manual shall include a completed equipment maintenance summary form for each type and size of equipment being furnished that requires power, lubrication, or maintenance. Equipment Summary forms are located at the end of this section.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

Section 01 33 00-7

1157.001/1-2025

EQUIPMENT MAINTENANCE SUMMARY FORM⁽¹⁾

Equipment	No.:		
_____	_____		
_____	_____		
_____	_____		
Specification Section: _____			
Equipment Name: _____			
Building Name: _____	Room No.: _____		
Plant Location: _____			
Manufacturer: _____			
Address: _____			
Phone: _____			
Service Representative: _____			
Address: _____			
Phone: _____	Fax: _____		
Make: _____	Model: _____		
Serial No.: _____	Type: _____		
Size: _____	_____		
Equipment Speed: _____			
Capacity: _____			
Operating Range: _____			
Material: _____			
Alarms: _____			

Drive Ratio: _____			
Motor Speed: _____	Service Factor: _____		
Volts: _____	Phase: _____	hp: _____	Efficiency: _____
Motor Type: _____			
Motor Sensors: _____			
Motor Manufacturer: _____			
Model: _____	Motor Frame: _____		
Insulation Class: _____			
FLA: _____		LRA: _____	

(1) Complete as applicable; attach supplementary pages as necessary.

Maintenance Requirements

(Use additional sheets if more space is needed.)

LUBRICATION

<u>Item</u>	<u>Generic Type of Lubricant</u>	<u>Supplier</u>	<u>Estimated Frequency</u>	<u>Annual Quantity</u>

PREVENTIVE MAINTENANCE

<u>Item</u>	<u>Action</u>	<u>Frequency</u>	<u>Reference</u>

SUGGESTED MINIMUM SPARE PARTS LIST

<u>Manufacturer</u>	<u>Part No.</u>	<u>Quantity Unit</u>	<u>Description</u>

The following information is included in O&M Manual:

Check or mark N/A

1.	Recommended installation, adjustment, calibration, and troubleshooting.	_____
2.	Complete internal and connection wiring diagrams.	_____
3.	Complete parts lists, by generic title and identification number, with exploded views of each assembly.	_____
4.	Disassembly, overhaul, and reassembly instructions.	_____
5.	Recommended prestart checks.	_____
6.	Recommended start procedure.	_____
7.	Recommended shutdown procedure for both short and long term.	_____
8.	Recommended operating precautions that include safety for personnel and equipment.	_____
9.	Recommended standing maintenance procedure.	_____

END OF SECTION

SECTION 01 41 00
REGULATORY REQUIREMENTS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. OSHA Requirements.
 - 2. Roadway Limits.
 - 3. Permits.
 - 4. Wage Rates.

1.02 OSHA REQUIREMENTS

- A. All work including site safety, equipment, materials, and fabricated items provided under the Contract shall comply with the provisions of the “Occupational Safety and Health Act.”

1.03 ROADWAY LIMITS

- A. CONTRACTOR shall comply with roadway weight restrictions including seasonal weight restrictions.

1.04 PERMITS

- A. No permits were obtained by OWNER for this Project. CONTRACTOR shall obtain required permits. Where the requirements of any permit are more restrictive than the Drawings or the Specifications, the permit requirements shall govern.
- B. Any permits required for dewatering operations shall be obtained and paid for by CONTRACTOR.

1.05 WAGE RATES

- A. Wage rates not less than these rates must be paid on this Project, including fringe benefits. CONTRACTOR shall post the Prevailing Wage Rate Determination in a prominent and easily accessible location at the project site and shall abide by all associated laws and regulations pertaining thereto.
- B. CONTRACTOR shall also comply with the attached Federal Wage Rates.
- C. Not less than the prevailing wage rates for this area shall be paid to the workers employed to do the Work under this Contract.
- D. See Wage Rates in OWNER front ends.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 42 00

REFERENCE STANDARDS AND DEFINITIONS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Reference Standards:
 - a. Throughout the Contract Documents, reference is made to codes and standards which establish qualities and types of workmanship and materials, and which establish methods for workmanship and materials, and which establish methods for testing and reporting on the pertinent characteristics.
 - b. Where materials or workmanship are required by these Contract Documents to meet or exceed the specifically named code or standard, it is CONTRACTOR's responsibility to provide materials and workmanship which meet or exceed that specifically named code or standard.
 - c. It is also CONTRACTOR's responsibility, when so required by the Contract Documents, to deliver to CONSULTANT all required proof that the material or workmanship, or both, meet or exceed the requirements of the specifically named code or standard.
 - 2. Definitions:
 - a. A substantial amount of specification language constitutes definitions for terms found in other Contract Documents, including the Drawings which must be recognized as diagrammatic in nature and not completely descriptive of requirements indicated thereon.
 - b. Certain terms used in the Contract Documents are defined generally in this section to supplement definitions of the Agreement, General Conditions, Supplementary Conditions, and other general contract documents.
 - c. Definitions and explanations of this section are not necessarily either complete or exclusive, but are general for the Work.
- B. Related Work Described Elsewhere: The specific naming of codes or standards occurs on the Drawings and in other sections of these Specifications.

1.02 QUALITY ASSURANCE

- A. Familiarity with Pertinent Codes and Standards:
 - 1. It is CONTRACTOR's responsibility to verify the requirements of the specifically named codes and standards and to verify that the items procured for use in this Work meet or exceed the specified requirements.
 - 2. When required by individual sections of these Specifications, CONTRACTOR shall obtain a copy of each pertinent code or standard and maintain the copies at the job site during submittals, planning, and progress of the Work until Substantial Completion of the Work is attained.
- B. Overlapping or Conflicting Requirements:
 - 1. Where compliance with two or more industry standards or sets of requirements are specified, and the overlapping of those standards or requirements establishes different or conflicting minimums or levels of quality, the most stringent requirement (which is

generally recognized to be also most costly) is intended and will be enforced, unless more detailed language written directly into Contract Documents clearly indicates that a less stringent requirement is acceptable.

2. Refer all uncertainties to CONSULTANT for decision before proceeding.

1.03 REFERENCE STANDARDS

- A. Applicable standards of the construction industry are made a part of the Contract Documents by reference as if copied directly into the Contract Documents, or as if published copies were bound herewith.
- B. Standards referenced directly in the Contract Documents or by governing regulation, have precedence over nonreferenced standards which are recognized in industry for applicability to the Work.
- C. Nonreference standards are hereby defined to have no particular applicability to the Work except as a general measurement of whether the Work complies with standards recognized in the construction industry.
- D. Reference standards and codes listed in these Specifications may include, but are not necessarily limited to, standards or codes published by the following agencies and organizations:

1. AA Aluminum Association
1525 Wilson Boulevard, Arlington, VA 22209
2. AAMA American Architectural Manufacturer's Association
1827 Walden Office Square Suite 550, Schaumburg, IL 60173-4268
3. AASHTO American Association of State Highway & Transportation Officials
444 North Capitol Street NW Suite 249, Washington, DC 20001
4. ACI American Concrete Institute
38800 Country Club Drive, Farmington Hills, MI 48331-3439
5. AI Asphalt Institute
2696 Research Park Drive, Lexington, KY 40511-8480
6. AISC American Institute of Steel Construction
One East Wacker Drive Suite 700, Chicago, IL 60601-1802
7. AISI American Iron and Steel Institute
25 Massachusetts Avenue NW Suite 800, Washington, DC 20001
8. ANSI American National Standards Institute
25 West 43rd Street, New York, NY 10036
9. APA American Plywood Association
7011 South 19th, Tacoma, WA 98466-5333

10. API American Petroleum Institute
1220 L Street NW, Washington, DC 20005-4070
11. ARI Air-Conditioning & Refrigeration Institute
4100 North Fairfax Drive Suite 200, Arlington, VA 22203
12. ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
1791 Tullie Circle NE, Atlanta, GA 30329
13. ASME American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990
14. ASSE American Society of Sanitary Engineering
901 Canterbury Suite A, Westlake, OH 44145
15. ASTM ASTM International
100 Barr Harbor Drive, West Conshohocken, PA 19428-2959
16. AWI Architectural Woodwork Institute
46179 Westlake Drive Suite 120, Potomac Falls, VA 20165-5874
17. AWPA American Wood Protection Association
P.O. Box 361784, Birmingham, AL 35236-1784
18. AWS American Welding Society
8669 Doral Boulevard Suite 130, Doral, FL 33166
19. AWWA American Water Works Association
6666 West Quincy Avenue, Denver, CO 80235
20. BHMA Builder's Hardware Manufacturers Association
355 Lexington Avenue 15th floor, New York, NY 10017
21. BIA Brick Industry Association
1850 Centennial Park Drive Suite 301, Reston, VA 20191
22. CRSI Concrete Reinforcing Steel Institute
9333 North Plum Grove Road, Schaumburg, IL 60173
23. DOT U.S. Department of Transportation
1200 New Jersey Avenue, SE, Washington, DC 20590
24. EJMA Expansion Joint Manufacturers Association
25 North Broadway, Tarrytown, NY 10591
25. FM FM Global
FM Global Corporate Offices, 270 Central Avenue, Johnston, RI 02919

26. FTI Facing Tile Institute
Box 8880, Canton, OH 44711
27. GA Gypsum Association
6525 Belcrest Road Suite 480, Hyattsville, MD 20782
28. GANA Glass Association of North America
800 SW Jackson Street Suite 1500, Topeka, KS 66612-1200
29. ICC International Code Council
500 New Jersey Avenue NW 6th Floor, Washington, DC 20001
30. IES Illuminating Engineering Society
120 Wall Street, Floor 17, New York, NY 10005-4001
31. MIL Military Specifications
Naval Publications and Forms Center
5801 Tabor Avenue, Philadelphia, PA 19120
32. NAAMM National Association of Architectural Metal Manufacturers
800 Roosevelt Road Building C Suite 312, Glen Ellyn, IL 60137
33. NCMA National Concrete Masonry Association
13750 Sunrise Valley Drive, Herndon, VA 20171-4662
34. NECA NECA
National Electrical Contractors Association
3 Bethesda Metro Center Suite 1100, Bethesda, MD 20814
35. NEMA National Electrical Manufacturers Association
1300 North 17th Street Suite 1752, Rosslyn, VA 22209
36. NFPA National Fire Protection Association
1 Batterymarch Park, Quincy, MA 02169-7471
37. NIST National Institute of Standards and Technology
(U.S. Department of Commerce), 100 Bureau Drive, Stop 1070
Gaithersburg, MD 20899-1070
38. NRCA National Roofing Contractors Association
10255 West Higgins Road Suite 600, Rosemont, IL 60018-5607
39. NSF National Sanitation Foundation International
P.O. Box 130140, 789 North Dixboro Road, Ann Arbor, MI 48113-0140
40. OSHA Occupational Safety & Health Administration
200 Constitution Avenue NW, Washington, DC 20210
41. PCA Portland Cement Association
5420 Old Orchard Road, Skokie, IL 60077

- 42. PCI Prestressed Concrete Institute
200 West Adams Street Suite 2100, Chicago, IL 60606

- 43. SAE Society of Automotive Engineers
SAE World Headquarters
400 Commonwealth Drive, Warrendale, PA 15096-0001

- 44. SDI Steel Deck Institute
P.O. Box 25, Fox River Grove, IL 60021

- 45. SDI Steel Door Institute
30200 Detroit Road, Westlake, OH 44145-1987

- 46. SIGMA Sealed Insulating Glass Manufacturers Assoc.
401 North Michigan Avenue Suite 2400, Chicago, IL 60611

- 47. SJI Steel Joist Institute
234 Cheves Street, Florence, SC 29501

- 48. SMACNA Sheet Metal and Air Conditioning
Contractor's National Association
4201 Lafayette Center Drive, Chantilly, VA 20151-1219

- 49. SSPC Society for Protective Coatings
40 24th Street 6th Floor, Pittsburgh, PA 15222-4656

- 50. TCA Tile Council of America
100 Clemson Research Boulevard, Anderson, SC 29625

- 51. UL Underwriters Laboratories
333 Pfingston Road; Northbrook, IL 60062

1.04 SUBMITTALS

- A. For OWNER's records, CONTRACTOR shall submit copies of permits, licenses, certifications, inspection reports, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

1.05 DEFINITIONS

- A. Indicated:
 - 1. The term "indicated" is a cross-reference to details, notes, or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in the Contract Documents.
 - 2. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for the purpose of helping the reader locate cross-reference, and no limitation is intended except as specifically noted.

- B. Approve (or Words of Similar Nature):
1. Where used in conjunction with CONSULTANT's response to submittals, requests, applications, inquiries, reports, and claims by CONTRACTOR, the meaning of the term "approve" will be held to the limitation of CONSULTANT's responsibilities and duties as specified in the Supplementary Conditions.
 2. In no case will "approval" by CONSULTANT be interpreted as a release of CONTRACTOR from responsibility to fulfill requirements of the Contract Documents.
- C. Minimum Requirements:
1. Indicated requirements are for a specific minimum acceptable level of quality or quantity, as recognized in the industry.
 2. Actual work must comply with (or within specified tolerances) or exceed minimums.
 3. CONTRACTOR shall refer uncertainties to CONSULTANT before proceeding.
- D. Abbreviations: Abbreviations, where not defined in the Contract Documents, will be interpreted to mean the normal construction industry terminology.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

PART 1—GENERAL

1.01 SUMMARY

- A. Work Includes:
 - 1. Quality Assurance—Control of Installation.
 - 2. Tolerances.
 - 3. Manufacturers' Field Services and Reports.

1.02 QUALITY ASSURANCE—CONTROL OF INSTALLATION

- A. CONTRACTOR shall monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality.
- B. CONTRACTOR shall comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, CONTRACTOR shall request clarification from CONSULTANT before proceeding.
- D. CONTRACTOR shall comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Work shall be performed by persons qualified to produce workmanship of specified quality.
- F. CONTRACTOR shall secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.03 TOLERANCES

- A. CONTRACTOR shall monitor tolerance control of installed products to produce acceptable work and shall not permit tolerances to accumulate.
- B. CONTRACTOR shall comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, CONTRACTOR shall request clarification from CONSULTANT before proceeding.
- C. CONTRACTOR shall adjust products to appropriate dimensions; position before securing products in place.

1.04 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual Specification sections or when requested by CONSULTANT, CONTRACTOR shall require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, and quality of workmanship.

- B. CONTRACTOR shall submit qualifications of observer to CONSULTANT 30 days in advance of required observations.
- C. CONTRACTOR shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. CONTRACTOR shall submit report in duplicate within 30 days of observation to CONSULTANT for information.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Temporary Utilities.
 - 2. Temporary Stairs and Access.
 - 3. Temporary Support Facilities.
 - 4. Removal of Temporary Facilities.
- B. CONTRACTOR shall arrange for and provide temporary facilities as required for proper and expeditious prosecution of the Work.
- C. CONTRACTOR shall pay all costs, except as otherwise specified, until final acceptance of the Work unless OWNER makes arrangements for use of completed portions of the Work after substantial completion in accordance with the provisions of the General Conditions.
- D. CONTRACTOR shall make all temporary connections to utilities and services in locations acceptable to OWNER and local authorities having appropriate jurisdiction.
 - 1. Furnish all necessary labor and materials.
 - 2. Make all installations in a manner subject to the acceptance of such authorities and OWNER.
 - 3. Maintain such connections.
 - 4. Remove temporary installation and connection when no longer required.
 - 5. Restore services and sources of supply to proper operating conditions.

1.02 TEMPORARY UTILITIES

- A. Temporary Toilets: CONTRACTOR shall provide and maintain sanitary temporary chemical toilets located where approved by OWNER and in sufficient number required for the work force employed by CONTRACTOR.
- B. Temporary Electrical Services:
 - 1. CONTRACTOR shall make all necessary arrangements, furnish, install, and maintain necessary temporary electrical services at the Site. CONTRACTOR shall remove all temporary services when Project is complete.
 - 2. All utility charges for installation of the temporary services shall be paid for by CONTRACTOR. All metering installation charges and all energy charges for electric current used for temporary lighting and power are to be paid by CONTRACTOR.
 - 3. No permanent electrical equipment or wiring shall be used without express written permission of OWNER. Such approval, if given, shall not affect guarantee period. If OWNER authorizes use of permanent service facilities, CONTRACTOR shall pay all metering costs until acceptance or occupancy (whichever occurs first) of building by OWNER.

- C. Weather Protection and Temporary Heat: CONTRACTOR shall provide weather protection to protect the Work from damage because of freezing, rain, snow, and other inclement weather.
- D. Temporary Water: CONTRACTOR shall supply its own water during construction. CONTRACTOR shall also provide its own piping, valves, and appurtenances for its requirements. Connection to the existing water system shall be coordinated with OWNER and shall meet all code requirements including disinfection and backflow prevention.
- E. Temporary Fire Protection: CONTRACTOR and Subcontractor(s) who maintain or provide an enclosed shed or trailer shall provide and maintain in operating order in each shed or trailer a minimum of one fire extinguisher. More extinguishers shall be provided as necessary. Fire extinguishers shall be minimum dry chemical, nonfreezing-type, UL rating 2A-30BC, with 10-pound capacity for Class A, B, and C fires.
- F. CONTRACTOR's and Subcontractor(s)' personnel shall refrain from smoking during excavation, laying pipe, backfilling, and other work at the Site which may involve potential contact with explosive vapors or gasoline products.

1.03 TEMPORARY STAIRS AND ACCESS

- A. CONTRACTOR shall provide and maintain all equipment such as temporary stairs, ladders, ramps, runways, chutes, and so on as required for proper execution of the Work. CONTRACTOR shall be responsible for providing its own scaffolds, hoists, etc.
- B. All such apparatus, equipment, and construction shall meet all requirements of OSHA, the labor laws, and other applicable State and local laws. Provide stairs with handrails. As soon as possible and where applicable, permanent stairs shall be installed.
- C. As soon as permanent stairs are created, provide temporary protective treads, handrails, and shaft protection.
- D. Provide barricades at hazardous locations, complete with signs, temporary general lighting, warning lights, and similar devices as required.

1.04 TEMPORARY SUPPORT FACILITIES

- A. CONTRACTOR shall provide whatever facilities and services which may be needed to properly support primary construction process and meet compliance requirements and governing regulations.
- B. CONTRACTOR shall not use permanent facilities except as otherwise indicated, unless authorized by OWNER.

1.05 REMOVAL OF TEMPORARY FACILITIES

- A. Remove temporary materials, equipment, services, and construction as soon as practicable but no later than just prior to final completion inspection.
- B. Clean and repair damage caused by installation or use of temporary facilities and restore existing facilities used during construction to specified, or to original, condition.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 52 13
FIELD OFFICES AND SHEDS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Materials, Equipment, and Furnishings.
 - 2. Construction.
 - 3. Environmental Control.
 - 4. CONTRACTOR Office and Facilities.
 - 5. Storage Areas and Sheds.
 - 6. Preparation.
 - 7. Maintenance and Cleaning.
 - 8. Removal.

PART 2—PRODUCTS

2.01 MATERIALS, EQUIPMENT, AND FURNISHINGS

- A. Materials, equipment, and furnishings shall be serviceable, new or used, and adequate for required purpose.

2.02 CONSTRUCTION

- A. Portable or mobile buildings or buildings shall be constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.
- B. CONTRACTOR shall provide structurally sound, secure, weathertight enclosures for office and storage spaces.
- C. Temperature transmission resistance of floors, walls, and ceilings shall be compatible with occupancy and storage requirements.
- D. Exterior materials shall be weather resistant.
- E. Interior materials in offices shall consist of sheet type materials for walls and ceilings, prefinished or painted; resilient floors and bases.
- F. Lighting for offices shall be 50 footcandles minimum at desk top height, with exterior lighting at entrance doors.
- G. Provide appropriate type fire extinguisher at each office and each storage area.
- H. Interior materials in storage sheds shall be as required to provide specified conditions for storage of products.

2.03 ENVIRONMENTAL CONTROL

- A. Heating, cooling, and ventilating for offices shall consist of automatic equipment to maintain comfort conditions; 70°F heating and 78°F cooling.
- B. Heating and ventilation for storage spaces shall be as needed to maintain products in accordance with Contract Documents and to provide adequate lighting for maintenance and observation of products.

2.04 CONTRACTOR OFFICE AND FACILITIES

- A. CONTRACTOR shall provide facilities to meet CONTRACTOR's needs and to provide space for Project meetings.
- B. Provide telephone as required for CONTRACTOR's needs.
- C. Provide furnishings in meeting area. As a minimum, provide conference table and chairs to seat at least eight persons; racks and files for Contract Documents, submittals, and project record documents.

2.05 STORAGE AREAS AND SHEDS

- A. Provide storage areas and sheds of size to meet storage requirements for products of individual sections, allowing for access and orderly provision for maintenance and for observation of products to meet requirements of Section 01 60 00—Materials and Equipment.

PART 3—EXECUTION

3.01 PREPARATION

- A. CONTRACTOR shall fill and grade sites for temporary structures to provide drainage away from buildings.

3.02 MAINTENANCE AND CLEANING

- A. CONTRACTOR shall maintain approach walks free of mud, water, and snow.

3.03 REMOVAL

- A. Upon final acceptance and completion of the Work, CONTRACTOR shall remove field offices, foundations, utility services, and debris and shall restore areas.

END OF SECTION

SECTION 01 57 00

TEMPORARY CONTROLS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Dust Control.
 - 2. Water, Erosion, and Sediment Control.
 - 3. Noise Control.
 - 4. Traffic Control.
 - 5. Site Security.
 - 6. Daily Cleanup.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 DUST CONTROL

- A. CONTRACTOR shall execute the Work by methods to minimize raising dust from construction operations.
- B. CONTRACTOR shall provide positive means to prevent airborne dust from dispersing into atmosphere.
- C. CONTRACTOR shall provide partitions, enclosures, etc., within buildings as necessary to confine dust and protect adjacent areas.

3.02 WATER, EROSION, AND SEDIMENT CONTROL

- A. CONTRACTOR shall grade site to drain and shall maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. CONTRACTOR shall protect Site from puddling or running water.
- C. CONTRACTOR shall provide erosion control measures as necessary to control discharge of sediment laden water to surface waters and wetlands.
- D. Except as provided for in the document, overland discharge of water from dewatering operations shall not be allowed. Depending on water quality, such water shall either be piped directly to the surface water or shall be directed to sedimentation basins or other such structures or features prior to discharge to surface waters so as not to cause damage to existing ground and improvements, erosion, or deposition in the discharge area.

- E. CONTRACTOR shall use jute or synthetic netting, silt fences, straw bales, dikes, channels, and other applicable measures to prevent erosion of soils disturbed by its construction operation.
- F. Restoration of the Site shall proceed concurrently with the construction operation. See Drawings and Specifications for erosion control measures in addition to that which may be required above.

3.03 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise produced by construction operations.

3.04 TRAFFIC CONTROL

- A. CONTRACTOR shall be responsible for providing all signs, barricades, flagmen, and other traffic control devices in the construction zone.
- B. Conduct operations with minimum interference to roadways.
- C. Do not close or obstruct roadways without approval of OWNER.
- D. Maintain one-way traffic on streets at all times.

3.05 SITE SECURITY

- A. CONTRACTOR shall have the sole responsibility of safeguarding the Site perimeter to prevent unauthorized entry to the Site throughout the duration of the Project. CONTRACTOR shall at all times provide such permanent and temporary fencing or barricades or other measures as may be necessary to restrict unauthorized entry to its construction area including construction in public rights-of-way or easements. Site security measures shall include safeguards against attractive nuisance hazards as a result of construction activity.
- B. CONTRACTOR shall at all times be responsible for the security of the Work including materials and equipment. OWNER will not take any responsibility for missing or damaged equipment, tools, or personal belongings. CONTRACTOR shall have the sole responsibility of safeguarding the Work and the Site throughout the duration of the Project.

3.06 DAILY CLEANUP

- A. CONTRACTOR shall clean up the Site and remove all rubbish on a daily basis.
- B. CONTRACTOR shall clean up public streets and highways and remove any dirt, mud, or other materials due to project traffic on daily basis and shall comply with all local and state ordinances and permit requirements.

END OF SECTION

SECTION 01 60 00

MATERIALS AND EQUIPMENT

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: CONTRACTOR shall be responsible for the delivery, handling, storage and protection of all material and equipment required to complete the Work as specified herein.
- B. Related Sections and Divisions: Specific requirements for the handling and storage of material and equipment are described in other sections of these Specifications.

1.02 PRODUCTS

- A. Components required to be supplied in quantity within a Specification section shall be the same, and shall be interchangeable.
- B. CONTRACTOR shall not use materials and equipment removed from existing construction, except as specifically required, or allowed, by the Contract Documents.
- C. When any construction deviations from the Drawings and/or Specifications necessary to accommodate equipment supplied by CONTRACTOR, result in additional costs to CONTRACTOR or other contractors, such additional costs shall be borne by CONTRACTOR. CONTRACTOR shall also pay any additional costs necessary for revisions of Drawings and/or Specifications by CONSULTANT.
- D. Each major component of equipment shall bear a nameplate giving the name and address of the manufacturer and the catalogue number or designation.

1.03 TRANSPORTATION AND HANDLING

- A. Materials, products and equipment shall be properly containerized, packaged, boxed, and protected to prevent damage during transportation and handling.
- B. CONTRACTOR shall not overload any portion of the structure in the transporting or storage of materials.
- C. CONTRACTOR shall not damage other construction by careless transportation, handling, spillage, staining or impact of materials.
- D. CONTRACTOR shall provide equipment and personnel to handle products, including those provided by OWNER, by methods to prevent soiling and damage.
- E. CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.
- F. CONTRACTOR shall handle product by methods to avoid bending or overstressing. Lift large and heavy components only at designated lift points.

1.04 DELIVERY AND RECEIVING

- A. CONTRACTOR shall arrange deliveries of products in accordance with the Progress Schedule, allowing time for observation prior to installation.
- B. CONTRACTOR shall coordinate deliveries to avoid conflict with the Work and conditions at the Site; work activities of other contractors or OWNER; limitations on storage space; availability of personnel and handling equipment and OWNER's use of premises.
- C. CONTRACTOR shall deliver products in undamaged, dry condition, in original unopened containers or packaging with identifying labels intact and legible.
- D. CONTRACTOR shall clearly mark partial deliveries of component parts of equipment to identify equipment and contents to permit easy accumulation of parts and to facilitate assembly.
- E. Immediately on delivery, CONTRACTOR shall inspect shipment to review that:
 - 1. Product complies with requirements of Contract Documents and reviewed submittals.
 - 2. Quantities are correct.
 - 3. Accessories and installation hardware are correct.
 - 4. Containers and packages are intact and labels legible.
 - 5. Products are protected and undamaged.

1.05 STORAGE AND PROTECTION

- A. General:
 - 1. CONTRACTOR shall store products, immediately on delivery, in accordance with manufacturer's instructions, with all seals and labels intact and legible.
 - 2. Any additional off-site space required shall be arranged by CONTRACTOR.
 - 3. CONTRACTOR shall allocate the available storage areas and coordinate their use by the trades on the job.
 - 4. CONTRACTOR shall arrange storage in a manner to provide access for maintenance of stored items and for observation.
- B. In enclosed storage, CONTRACTOR shall:
 - 1. Provide suitable temporary weather tight storage facilities as may be required for materials that will be damaged by storage in the open.
 - 2. Maintain temperature and humidity within ranges stated in manufacturer's instructions.
 - 3. Provide ventilation for sensitive products as required by manufacturer's instructions.
 - 4. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.
 - 5. Store solid materials such as insulation, tile, mechanical and electrical equipment, fittings, and fixtures under shelter, in original packages, away from dampness and other hazards.
 - 6. Store liquid materials away from fire or intense heat and protect from freezing.
- C. At exterior storage, CONTRACTOR shall:
 - 1. Store unit materials such as concrete block, brick, steel, pipe, conduit, door frames, and lumber off ground, out of reach of dirt, water, mud and splashing.
 - 2. Store tools or equipment that carry dirt outside.
 - 3. Store large equipment so as not to damage the Work or present a fire hazard.
 - 4. Cover products subject to discoloration or deterioration from exposure to the elements, with impervious sheet material and provide ventilation to avoid condensation.

5. Completely cover and protect any equipment or material which is prime coated or finish painted with secured plastic or cloth tarps. Store out of reach of dirt, water, mud and splashing.
6. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet materials, to prevent mixing with foreign matter.
7. Provide surface drainage to prevent erosion and ponding of water.
8. Prevent mixing of refuse or chemically injurious materials or liquids.
9. Cover aggregates such as sand and gravel in cold wet weather.
10. Remove all traces of piled bulk materials at completion of work and return site to original or indicated condition.

1.06 MAINTENANCE OF STORAGE

- A. CONTRACTOR shall periodically inspect stored products on a scheduled basis.
- B. CONTRACTOR shall verify that storage facilities comply with manufacturer's product storage requirements, and verify that manufacturer required environmental conditions are maintained continually.
- C. CONTRACTOR shall verify that surfaces of products exposed to the elements are not adversely affected and that any weathering of finishes is acceptable under requirements of Contract Documents.
- D. CONTRACTOR shall perform scheduled maintenance of equipment in storage as recommended by the manufacturer. A record of the maintenance shall be kept and turned over to CONSULTANT when the equipment is installed.

1.07 INSTALLATION REQUIREMENTS

- A. Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by the respective manufacturers, unless otherwise specified.
- B. After installation, CONTRACTOR shall protect all materials and equipment against weather, dust, moisture, and mechanical damage.
- C. CONTRACTOR shall be responsible for all damages that occur in connection with the care and protection of all materials and equipment until completion and final acceptance of the Work by OWNER. Damaged material and equipment shall be immediately removed from the Site.

1.08 EQUIPMENT WARRANTIES

- A. Warranties shall be nonprorated, include all parts and labor, and be in written form. Warranties shall specifically exclude buyer's indemnification language. Warranty language shall not eliminate manufacturer's responsibility for sizing of the equipment. During warranty period, manufacturer shall be responsible for any travel expenses, outside contractor fees, and rental equipment fees associated with providing warranty service. Manufacturer shall pay expenses incurred for repairs and parts replacement not made by manufacturer if manufacturer's response is not within 72 hours of notification by OWNER. Warranty language shall be provided with the shop drawings.

1.09 CONCRETE EQUIPMENT BASE

- A. Cast-in-place concrete equipment bases shall be provided for all new and relocated equipment including electrical control panels, motor control centers, switchgear, etc. Concrete equipment bases shall be provided by CONTRACTOR except where specifically noted to be provided by others. Bases shall be 3 1/2-inch minimum height and shall be a minimum of 3 inches larger than equipment being supported. Grouting of equipment bases shall be as recommended by equipment manufacturer.
- B. Concrete and grout shall meet applicable sections of the Specifications.
- C. Provide all anchor bolts, metal shapes and templates to be cast in concrete or used to form concrete for support of equipment.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 73 29

CUTTING, PATCHING, AND ALTERATIONS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: CONTRACTOR shall be responsible for all cutting, fitting, patching, and other alterations required to complete the Work as specified herein or to:
 - 1. Make its several parts fit together properly.
 - 2. Uncover portions of the Work to install improperly sequenced Work.
 - 3. Remove and replace defective Work.
 - 4. Remove and replace Work not conforming to requirements of the Contract Documents.
 - 5. Remove samples of installed Work as specified for testing.
 - 6. Provide penetrations of surfaces for installation of piping and electrical conduit.
 - 7. Rehabilitate or renovate existing spaces.

1.02 REFERENCES

- A. ANSI A10 Safety Requirements for Construction and Demolition.

1.03 QUALITY ASSURANCE

- A. CONTRACTOR shall perform all cutting, patching, and alterations in strict accordance with pertinent requirements of these Specifications.
- B. Except as modified by governing codes, CONTRACTOR shall comply with the applicable provision and recommendations of ANSI A10.

1.04 SUBMITTALS

- A. CONTRACTOR shall submit a written request to OWNER well in advance of executing any cutting or alteration which affects the following:
 - 1. Work of OWNER or any separate contractor.
 - 2. Structural value or integrity of any element of the Project.
 - 3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 - 4. Efficiency, operational life, maintenance, or safety of operational elements.
 - 5. Visual qualities of sight-exposed elements.
- B. The request shall include:
 - 1. Description of affected work.
 - 2. The necessity for cutting, patching, or alteration.
 - 3. Effect on work of OWNER, any separate contractor, or on the structural or weather-proof integrity of the Project.
 - 4. Description of proposed work to include:
 - a. Scope of cutting, patching, or alteration.
 - b. Trades who will execute the Work.
 - c. Products proposed to be used.
 - d. Extent of refinishing to be done.
 - 5. Alternatives to cutting and patching.

- 6. Written permission of any separate contractor whose work will be affected.
- C. Submit written notice to OWNER designating the date and the time the Work will be uncovered or executed.

1.05 SCHEDULING AND COORDINATION

- A. All work under this section shall be coordinated with OWNER's work forces and those of other contractors and shall be accomplished at times acceptable to OWNER.
- B. Before starting any work relating to existing utilities (electrical, sewer, water, heat, gas, fire lines, etc.) that will temporarily discontinue or disrupt service, notify CONSULTANT and OWNER 72 hours in advance and obtain OWNER's approval before proceeding with this phase of the Work. Temporary facilities, if required, shall be in place prior to disruption of service.

PART 2—PRODUCTS

2.01 NEW MATERIALS

- A. For replacement of work removed, CONTRACTOR shall use materials which comply with the pertinent sections of these Specifications.
- B. All new materials for patching and extending work shall match existing products and work.
- C. CONTRACTOR shall determine type and quality of existing products by inspection and any necessary testing and workmanship by use of existing as the standard.

2.02 UNSALVAGEABLE MATERIALS

- A. Materials or items demolished and not designated to become the property of OWNER or not designated to be reinstalled shall become the property of CONTRACTOR and shall be removed from the site and legally and properly disposed of by CONTRACTOR.
- B. Materials shall be removed by CONTRACTOR in a manner that will avoid damage to materials or equipment to remain.

PART 3—EXECUTION

3.01 INSPECTION

- A. CONTRACTOR shall inspect existing conditions including elements subject to movement or damage during cutting, patching, and other alterations.
- B. After uncovering the Work, CONTRACTOR shall inspect conditions affecting installation of new products or performance of new work.
- C. CONTRACTOR shall report unsatisfactory or questionable conditions to CONSULTANT in writing.

- D. CONTRACTOR shall not proceed with work until unsatisfactory or questionable conditions are resolved.
- E. Beginning of cutting, patching, and alterations work means acceptance of existing conditions by CONTRACTOR.

3.02 PREPARATION AND PROTECTION

- A. CONTRACTOR shall provide temporary bracing, shoring, needling, and support of the structure during alterations work as necessary to prevent collapse, settling, or deflection and to protect persons and property from injury or damage.
- B. Temporary supports must adequately carry all existing and imposed load.
- C. CONTRACTOR shall provide and maintain temporary protection of surface finishes, equipment, and adjacent work designated to remain where demolition, removal, and new work is being done, connections are being made, materials are being handled, or equipment is being removed.
- D. CONTRACTOR shall provide temporary partitions or barriers to contain all dust, dirt, and debris from entering into finished areas or areas where OWNER is operating, storing, or manufacturing products.
- E. CONTRACTOR shall provide adequate fire protection in accordance with local Fire Department requirements.
- F. CONTRACTOR shall provide waterproofing, weather protection, heat, and other facilities for that portion of the Work which may be exposed by cutting and patching, demolition, or other alterations.
- G. CONTRACTOR shall cut, move, or remove items as necessary for access to alterations and renovations work and replace and restore at completion of the Work.
- H. CONTRACTOR shall prepare surfaces and remove surface finishes to provide for proper installation of new work and new finishes.
- I. CONTRACTOR shall be responsible for any damage to the existing structure or its contents directly or indirectly by its crews or those of its subcontractors.

3.03 PERFORMANCE

- A. CONTRACTOR shall accomplish all work of cutting, removal, demolition, patching, or other alterations using only persons skilled in the appropriate trade.
- B. CONTRACTOR shall execute the Work in a careful and orderly manner.
- C. CONTRACTOR shall execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs.
- D. CONTRACTOR shall execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.

- E. CONTRACTOR shall fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- F. CONTRACTOR shall thoroughly clean and prepare all surfaces to receive new finish or covering to completely remove all dirt, dust, grease, oil, paint, loose materials, and soil.
- G. CONTRACTOR shall refinish entire surface as necessary to provide an even finish to match adjacent finishes:
 - 1. For continuous surfaces, refinish to nearest intersection.
 - 2. For an assembly, refinish entire unit.

3.04 DEMOLITION, CUTTING, AND REMOVAL

- A. Cutting and removal of construction shall be performed by CONTRACTOR so as not to cut or remove more than is necessary and so as not to damage adjacent work.
- B. CONTRACTOR shall cut out embedded anchorages and attachment items as required to properly provide for patching and repair of the respective finishes.
- C. CONTRACTOR shall not cut structural work in a manner resulting in a reduction of load-carrying capacity or load/deflection ratio.
- D. CONTRACTOR shall not cut operational elements and safety components in a manner resulting in decreased performance, shortened useful life, or increased maintenance.
- E. CONTRACTOR shall not cut work exposed to view (exterior or interior) in a manner resulting in noticeable reduction of visual qualities as determined by OWNER.
- F. Construction that is to remain which is loosened, cracked, or otherwise damaged or defaced as a result of careless cutting or demolition and is unsuitable for use intended shall be removed and replaced at no additional cost to OWNER.
- G. CONTRACTOR shall clean demolished areas and remove debris, waste, and rubbish from the building at the conclusion of each day's work.
- H. CONTRACTOR shall not let piled waste material endanger the structure.

3.05 PATCHING, EXTENDING, AND MATCHING

- A. Patching work shall conform to the standards of the Specifications where applicable, and where not specified, work shall conform to the highest standards of the applicable trade.
- B. CONTRACTOR shall patch construction to match adjacent work unless noted otherwise.
- C. Patching or restoration shall be carried to natural breaks (e.g., corners) wherever possible.
- D. CONTRACTOR shall provide adequate support to substrate for patching finishes.

END OF SECTION

SECTION 01 77 00

CONTRACT CLOSEOUT

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Closeout Procedures.
 - 2. Final Cleaning.
 - 3. Adjusting.
 - 4. Project Record Documents.
 - 5. Warranties.
 - 6. Warranty Bond.

1.02 CLOSEOUT PROCEDURES

- A. CONTRACTOR shall provide submittals to CONSULTANT that are required by governing or other authorities.
- B. CONTRACTOR shall comply with General Conditions and Supplementary Conditions and complete the following before requesting CONSULTANT's observation of the Work or designated portion thereof for substantial completion.
 - 1. Submit executed warranties, workmanship bonds, maintenance agreements, inspection certificates, and similar required documentation for specific units of Work, enabling OWNER's unrestricted occupancy and use.
 - 2. Submit record documentation, maintenance manuals, tools, spare parts, keys, and similar operational items.
 - 3. Submit consent of surety (if surety required in Contract).
 - 4. Complete final cleaning, touch-up work of marred surfaces, and remove temporary facilities and tools.

1.03 FINAL CLEANING

- A. It is CONTRACTOR's responsibility to completely clean up the construction site at the completion of the Work.
- B. CONTRACTOR shall clean areas of the building in which painting and finishing work is to be performed just prior to the start of this work and maintain these areas in satisfactory condition for painting and finishing. This cleaning includes:
 - 1. Removal of trash and rubbish from these areas.
 - 2. Broom cleaning of floors.
 - 3. Removal of any plaster, mortar, dust, and other extraneous materials from finish surfaces, including but not limited to exposed structural steel, miscellaneous metal, masonry, concrete, mechanical equipment, piping, and electrical equipment.
- C. In addition to the cleaning specified above and the more specific cleaning that may be required in various technical sections of the Specifications, CONTRACTOR shall prepare the Project for occupancy by a thorough cleaning throughout, which shall include the following:

1. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
2. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
3. Replace filters of operating equipment.
4. Clean debris from roofs, gutters, downspouts, and drainage systems.
5. Clean site; sweep paved areas, rake clean landscaped surfaces.
6. Remove waste and surplus materials, rubbish, and construction facilities from the Site.

1.04 ADJUSTING

- A. CONTRACTOR shall adjust operating products and equipment to provide smooth and unhindered operation.

1.05 PROJECT RECORD DOCUMENTS

- A. CONTRACTOR shall maintain on Site one set of the following record documents to record actual revisions to the Work:
 1. Drawings.
 2. Specifications.
 3. Addenda.
 4. Change orders and other modifications to the Contract.
 5. Reviewed shop drawings, product data, and samples.
 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. CONTRACTOR shall make entries that are complete and accurate, enabling future reference by OWNER.
- C. CONTRACTOR shall store record documents separate from documents used for construction.
- D. CONTRACTOR shall record information concurrent with construction progress.
- E. Specifications: CONTRACTOR shall legibly mark and record at each Product section description of actual products installed, including the following:
 1. Manufacturer's name and product model and number.
 2. Product substitutions or alternates utilized.
 3. Changes made by addenda and modifications.
- F. Record Drawings: CONTRACTOR shall legibly mark each item to record actual construction including:
 1. Measured depths of foundations in relation to finish floor datum.
 2. Measured horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements.
 3. Measured locations of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of the Work.
 4. Field changes of dimension and detail.
 5. Details not on original Contract Drawings.

1.06 WARRANTIES

- A. CONTRACTOR shall provide warranties beyond project one-year warranty as required by technical sections.
- B. Submit warranty information as follows:
 - 1. Provide original copies bearing authorized signatures.
 - 2. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers, and provide Table of Contents and assemble in three-ring binder with durable cover.
 - 3. Submit with request for certificate of Substantial Completion.
 - 4. For items of work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance listing date of acceptance as start of warranty period.

1.07 WARRANTY BOND

- A. CONTRACTOR shall provide warranty bond prior to or with the final Application for Payment in accordance with General Conditions of the Agreement.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 91 00
STARTING OF SYSTEMS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. General.
 - 2. Equipment and System Installation.
 - 3. Starting Equipment and Systems.
 - 4. Demonstration, Instructions, and Operator Training.
 - 5. Start-Up and Testing.
 - 6. Equipment Systems Requiring Certification of Proper Installation.
 - 7. Equipment Systems Requiring Additional Documentation.
- B. CONTRACTOR shall perform the Work described in the following subsections.

1.02 GENERAL

- A. The number of days for manufacturer's services stated in the Specifications shall be considered as the minimum number of days. Should additional time be required for services because of equipment malfunction or other problem, such time shall be at the expense of CONTRACTOR, with no change in Contract Price.
- B. "Days" specified shall consist of 8-hour days on-site, excluding travel time.
- C. CONTRACTOR shall designate and provide one person to be responsible for scheduling, coordinating, and expediting the specified services. Scheduling the services shall be done in cooperation with, and with the prior approval of CONSULTANT and OWNER. Such schedule shall be arranged with the appropriate subcontractors, manufacturers, and suppliers with sufficient time to allow their compliance with the service requirements.
- D. CONTRACTOR shall manage equipment checkout such that checkout has been completed and deficiencies addressed prior to demonstration and training. Scheduling training prior to checkout may result in cancellation when checkout cannot be completed prior to training.

1.03 EQUIPMENT AND SYSTEM INSTALLATION

- A. Competent and experienced technical personnel shall represent the manufacturers of all equipment and systems for as many days as may be necessary to provide proper installation and to resolve assembly or installation problems at the site that are attributable to, or associated with, the equipment furnished. This requirement applies to manufacturers for all equipment furnished, whether or not specifically set forth in the Specifications.
- B. Where a Certificate of Proper Installation is called for in this Specification Section, the manufacturer's representative shall provide the attached Certificate of Proper Installation stating that the equipment or system has been installed in accordance with the manufacturer's instructions and has been inspected by a manufacturer's authorized representative, that it has been serviced with the proper initial lubricants, that applicable

safety equipment has been properly installed, that the proper electrical and mechanical connections have been made, and that any other manufacturer requirements have been met. This certification shall be provided to CONSULTANT and OWNER prior to the start-up. This certificate is in addition to the manufacturer's standard startup reports, checklists, and other pertinent information.

- C. Functional (or run) testing is required for all equipment and systems. The manufacturer's representative shall supervise the functional test, which shall include checking for proper rotation, alignment, speed, excessive vibration, and noisy operation. The Manufacturer's Certificate of Proper Installation shall state that proper adjustments have been made and that the equipment or system is ready for start-up.
- D. Manufacturer shall demonstrate, using laser alignment equipment, if appropriate, that the installed equipment has been aligned properly. Final acceptance of equipment will not be granted until manufacturer has demonstrated to CONSULTANT that acceptable alignment to tolerances have been achieved. For pumps with motors 7.5 hp and larger, the acceptable shaft alignment tolerances shall be as recommended in the pump manufacturer's written instructions and shall include parallel offset and angular gap measurements.

1.04 STARTING EQUIPMENT AND SYSTEMS

- A. Where field testing and start-up services are called for in the Specifications, or when technical assistance is necessary as a result of any malfunction of the equipment or system furnished, the manufacturer's representative shall provide such services.
- B. Manufacturer's representative shall also conduct and/or assist with performance testing, as required by the Specifications. These services shall continue until such times as the applicable equipment or system has been successfully tested for performance and has been accepted by OWNER for full-time operation.
- C. Coordinate schedule for start-up of various equipment and systems. Coordination includes, but is not limited to, communication with subcontractors, suppliers, OWNER, and CONSULTANT. CONTRACTOR shall confirm that all necessary work is complete and that the equipment and systems can be operated in conjunction with all associated processes.
- D. Notify CONSULTANT and OWNER a minimum of 7 days prior to start-up of each item using the attached Equipment Startup and O&M Training Scheduling form. CONTRACTOR shall submit form to CONSULTANT.
- E. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or for other conditions that may cause damage.
- F. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- G. Verify wiring and support components for equipment are complete and tested.
- H. Execute start-up under supervision of applicable manufacturer's representative and CONTRACTOR's personnel in accordance with manufacturers' instructions.
- I. Require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up and to supervise

placing equipment or system in operation. Authorized representative shall provide approval for starting of systems in writing where specified.

- J. Equipment manufacturer shall provide a written report covering checkout, testing, inspections, and start-up and shall identify any deficiencies noted. Report shall be submitted to CONSULTANT. CONTRACTOR shall be responsible for correcting all deficiencies noted in report. In addition, CONTRACTOR shall submit a fully executed Certificate of Proper Installation form if required in Paragraph 3.01 of this section.

1.05 DEMONSTRATION, INSTRUCTIONS, AND OPERATOR TRAINING

- A. For all mechanical equipment and systems and where called for in the Specifications, provide a qualified technical representative to provide detailed instructions to OWNER's personnel for operation and maintenance of equipment and associated instrumentation. Training services shall include pre-start-up classroom instruction and start-up on-site instruction, as stated in the Specifications.
- B. Refer to the Specifications for additional training requirements.
- C. CONTRACTOR shall coordinate the pre-start-up training periods with OWNER's operating personnel and manufacturers' representatives.
 - 1. Schedule training dates and times with OWNER, that are acceptable to the OWNER, using equipment, startup, and O&M training form.
 - 2. Submit outline and presentation to CONSULTANT at least 7 days in advance of training.
 - 3. Provide name, contact information, and brief synopsis of qualifications of the trainer.
 - 4. If materials above are not provided at least 7 days in advance, training may be canceled.
 - 5. Failure of supplier's or manufacturer's representative to appear for scheduled training, failure to notify OWNER 24 hours in advance of need to cancel scheduled training or failure to arrive within 30 minutes of start of scheduled training shall result in reimbursement to OWNER for time lost by OWNER's personnel in waiting for arrival of manufacturer's representative. Except in case of failure to arrive on time, time will not exceed 1 hour for each employee scheduled to receive training. Failure to arrive on time will be reimbursed by actual time late, up to 1 hour, after 1 hour, training will be rescheduled. CONTRACTOR shall reimburse OWNER via a change order.
 - 6. During the training, instructor will dedicate its time solely to training and not start-up services.
 - 7. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with OWNER's personnel in detail to explain all aspects of operation and maintenance.
 - 8. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment.
 - 9. Prepare and insert additional data in operation and maintenance manuals when need for additional data becomes apparent during instruction.
 - 10. OWNER may videorecord the training for future internal use. Provide to OWNER paper and electronic copies of any media used as part of training.
 - 11. Provide training handouts for each of OWNER's personnel present.

- D. CONTRACTOR shall provide attached Certificate of Operator Training cosigned by OWNER and supplier's representative verifying training was accomplished to satisfaction of all parties.
- E. Operation and maintenance manual submitted in accordance with Section 01 33 00–Submittals shall be provided prior to operator training.
- F. For equipment or systems requiring seasonal operation, perform demonstration for dormant season at start of dormant season.
- G. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to OWNER's satisfaction.
- H. Where items of equipment are placed into service at different times or sequence, manufacturer's services for start-up, field testing, and supervision shall be provided for each time or sequence. Training shall be provided prior to or at the time the first similar item of equipment is placed in service.

1.06 START-UP AND TESTING

- A. Prior to acceptance of any portion of the Work, start-up and testing of all equipment and testing of all materials furnished on the Project by CONTRACTOR shall have been conducted in the presence of representatives of CONTRACTOR, OWNER, and CONSULTANT and also manufacturer if requested by OWNER or CONSULTANT.
- B. CONTRACTOR shall provide whatever temporary installations and conditions are necessary in order to perform start-up and testing operations on all equipment and materials furnished under the Contract. Temporary connections and equipment necessary during start-up and testing operations shall include, but not be limited to, temporary piping and electrical power and control equipment and devices, temporary connection from various parts of the systems and any other labor, materials, fuel, devices, or items that may be required for start-up and testing operations. Temporary conditions shall include filling with water, if necessary, to check equipment and materials.
- C. All temporary installations and conditions shall be removed by CONTRACTOR upon completion of start-up and testing.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 EQUIPMENT SYSTEMS REQUIRING CERTIFICATION OF PROPER INSTALLATION

- A. All equipment specified in Divisions 43 and 46.

3.02 EQUIPMENT SYSTEMS REQUIRING ADDITIONAL DOCUMENTATION

- A. Section 26 09 00—Controls and Instrumentation: Documented date(s) of CONTRACTOR written request for On-Site Acceptance Test.

END OF SECTION

TS No. _____

EQUIPMENT START-UP AND O&M TRAINING SCHEDULING FORM
STRAND ASSOCIATES, INC.®

PROJECT _____ CLIENT _____

CONTRACT _____

CONTRACTOR _____ Date: _____

The following equipment is scheduled for start-up on _____

EQUIPMENT NAME: _____ SPECIFICATION SECTION: _____

MANUFACTURER: _____ MINIMUM HOURS OF TRAINING: _____

DATE O&M MANUALS SUBMITTED: _____

Specification Section 01 91 00 requires that start-up and operation and training be conducted by a qualified manufacturer's representative prior to placing equipment in operation. Review Specification Sections 01 33 00 and 01 45 00 and the individual equipment sections for start-up and training requirements. OWNER may find it necessary to propose alternate dates for training based on conflicts with other training and staff availability. The Operation and Maintenance Manuals must be submitted prior to training.

After the equipment or system has been properly installed and is functioning correctly, submit a written report in accordance with Specification Section 01 45 00.

Submit the completed form to CONSULTANT and OWNER at least 7 days prior to start-up and training.

Proposed Training Date: _____ Time of Training: _____

Factory-trained representative giving training:

Name(s): _____

Company: _____

Address: _____

Phone: _____

Fax: _____

E-mail: _____

CERTIFICATE OF PROPER INSTALLATION

Project_____

Equipment_____

Specification Section_____

Contract_____

I hereby certify the equipment supplier/manufacturer has inspected this equipment and that it has been properly installed, adjusted, and calibrated. I further certify this equipment may now be operated for test purposes and/or normal use.

MANUFACTURER'S REPRESENTATIVE

Signature_____Date_____

Name (print)_____

Title_____

Representing_____

CONTRACTOR

Signature_____Date_____

Name (print)_____

Title_____

This form shall be completed and submitted to CONSULTANT prior to OWNER training.

CERTIFICATE OF OPERATOR TRAINING

Project_____

Equipment_____

Specification Section_____

Contract_____

I hereby certify the equipment supplier/manufacturee has instructed OWNER's personnel in the start-up operation and maintenance of this equipment as required in the Specifications.

MANUFACTURER'S REPRESENTATIVE

Signature_____Date_____

Name (print)_____

Title_____

Representing_____

CONTRACTOR

Signature_____Date_____

Name (print)_____

Title_____

OWNER

I hereby state that my operating personnel received instruction for start-up, operation, and maintenance of this equipment.

Signature_____Date_____

Name (print)_____

Title_____

END SECTION

Section 01 91 00-8

1157.001/1-2025

SECTION 02 41 00

DEMOLITION

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: All demolition, removal, and salvage work as shown on the Drawings or specified herein.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. CONTRACTOR shall submit permits and notices, if required, authorizing building demolition.

1.03 QUALITY ASSURANCE

- A. CONTRACTOR shall perform demolition, removal, and salvage in conformity with applicable federal, state, and local safety practices and code requirements.
- B. CONTRACTOR shall contact all public utilities and shall shut off, cut and cap all utility services in accordance with utility requirements, codes, rules, and regulations.
- C. Obtain and pay for all necessary permits, licenses, and certificates required.

1.04 SEQUENCE

- A. No demolition, removal, or salvage work shall commence until approval to proceed has been granted by OWNER. Such work shall be completed in accordance with the construction sequence included in Division 01 of these Specifications and in accordance with the construction phases of this project and work to be done by other contractors.

PART 2–PRODUCTS

2.01 GENERAL

- A. Compacted fill shall meet the requirements of Section 31 23 00–Excavation, Fill, Backfill, and Grading.
- B. Pipe fittings and materials shall meet the requirements of Section 33 00 10–Buried Piping and Appurtenances and Section 40 05 00–Piping and Appurtenances.

PART 3-EXECUTION

3.01 BREAKING DOWN AND REMOVING STRUCTURES

A. General:

1. All existing structures, with all attached parts and connections, shown on the Drawings or specified to be removed or that interfere with the new construction, shall be entirely removed within the limits shown or specified, unless otherwise provided.
2. When a portion of any existing structure is to be retained, CONTRACTOR shall take care during construction operations so as not to impair the value of the retained portion.
 - a. Complete all operations necessary for the removal of any existing structure which might endanger the new construction prior to the construction of the new work.
 - b. Do not use any equipment or devices which might damage structures, facilities, or property which are to be preserved and retained.
3. When existing reinforcing is exposed at the surface of removal areas, CONTRACTOR shall burn back the reinforcing bars 2 inches and patch with nonshrink grout, unless noted otherwise.

B. Pavement, Curb, Gutter, Sidewalk, Driveways, Crosswalk, and Similar Structures:

1. Where portions of the existing structure are to be left in the surface of the finished work, CONTRACTOR shall remove the structure to an existing joint, or saw and chip the structure to a true line.
2. Sufficient removal shall be made to provide for proper grades and connections in the new work.

3.02 ABANDONING AND REMOVING UTILITIES AND UNDERGROUND PROCESS PIPING

- A. CONTRACTOR shall be responsible for the turning off or unhooking and purging of all utilities and process piping before starting the demolition work. Remove all utility lines, including electrical services and process piping that are shown or specified to be removed. Remove utility lines that are to be abandoned as needed to clear new construction.
- B. The ends of utility lines and process piping shown or specified to be abandoned that are exposed by excavation shall be plugged with concrete to prevent soil infiltration into the pipes.

3.03 EQUIPMENT

- A. CONTRACTOR shall remove all equipment specified herein or indicated.
- B. CONTRACTOR shall remove associated exposed conduit, power wiring, controls, switches, instrumentation, control wiring, control boxes, appurtenances, and their supports serving equipment to be removed. Electrical items shall be removed to their junction with motor control center, control panel, or their junction with conduit serving other equipment that is to remain.
- C. CONTRACTOR shall remove all piping and appurtenances and their supports serving equipment indicated to be removed. Piping shall be removed to its junction with the main service header serving other equipment that is to remain or new equipment as indicated. Remaining piping and tubing shall be fitted with an appropriate blind flange or plug and insulated as required.

- D. CONTRACTOR shall remove equipment bases, anchor bolts, and other supports serving equipment to be removed. Concrete bases shall be removed to 1 inch below floor elevation and repaired with nonshrink grout plus surfacing to match existing.
- E. CONTRACTOR shall patch floors, walls, and ceilings as required to match existing or as indicated where equipment, piping, electrical, bases, or supports are removed.
- F. CONTRACTOR shall remove the following major equipment items or systems. The following list is not intended to be all-inclusive. CONTRACTOR shall remove all items indicated or specified to be removed.
 - 1. Final Clarifier Mechanisms and Weirs.
 - 2. RAS and WAS Airlift Pumps.

3.04 SALVAGE

- A. OWNER has first right of refusal to all material, piping, and equipment removed.
- B. All equipment, material, and piping, except as specified hereinafter, within the buildings and structures to be demolished and additional items as noted shall be removed by CONTRACTOR. CONTRACTOR shall inspect each structure and determine the type and amount of equipment, materials, and piping to be removed.
- C. All equipment, material, and piping, except as specified hereinafter, within the limits of the demolition and additional items noted to be removed, will become the property of CONTRACTOR if OWNER does not claim under first right of refusal and shall be removed from the project site. Comply with State and local ordinances and regulations for disposing of materials.

3.05 BACKFILL

- A. CONTRACTOR shall fill all abandoned structures and excavations resulting from removal of structures and utilities with compacted fill. See Section 31 23 00—Excavation, Fill, Backfill, and Grading for required degree of compaction.
- B. Prior to filling, CONTRACTOR shall break one opening in the floor or wall near the base of each compartment to allow groundwater to freely migrate through the structure.

END OF SECTION

SECTION 03 01 30

CONCRETE SURFACE REPAIR

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Miscellaneous concrete surface repairs.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Repair Locations: Aeration Basins, Final Clarifiers.
- D. CONTRACTOR shall INCLUDE in the Bid the following quantities of concrete surface repairs. Wall horizontal and vertical surface repairs: 10 cubic yards.
- E. Payment to CONTRACTOR for repairs will be adjusted, add or deduct, based on the actual repairs performed (more or less than specified quantities) and the unit price(s) bid for these repairs. Unit price(s) shall include all materials, labor, and incidental items associated with completing repairs as noted in these specifications. Unit price for wall surface repairs shall include cost for scaffolding. Before any concrete surface repair work begins, CONTRACTOR and CONSULTANT shall agree on the extent of the work after drainage and cleaning of final clarifiers and aeration basins is complete.

1.02 SUBMITTALS

- A. Comply with Section 01 33 00—Submittals.
- B. Product Data: Submit manufacturer's technical data sheets for each product.
- C. Submit a list of project references as documented in this section under Paragraph 1.03 Quality Assurance. Include the name and phone number of the contact charged with oversight of each project.

1.03 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer Qualifications: Company with minimum 15 years of experience in manufacturing of specified products and systems.
 - 2. Applicator Qualifications:
 - a. Company with a minimum of 5 years of experience in the application of the specified products and systems on projects of similar size and scope, and is acceptable to product manufacturer.
 - b. Successful completion of a minimum of five projects of similar size and complexity to specified Work.

1.04 PROJECT CONDITIONS

A. Environmental Requirements:

1. Application range of repair mortar is from 20°F (min 7°C) to 85°F (29°C). Follow ACI-recommended concreting practices for hot or cold weather.
2. Frost or frozen surfaces shall be thawed and dry.
3. Do not apply material if snow, rain, fog, or mist is anticipated within 12 hours after application. Allow surfaces to attain temperature and conditions specified before proceeding with application.

PART 2-PRODUCTS

2.01 MANUFACTURER

- #### A.
- Repair materials shall be by Master Builders Solutions, or equal.

2.02 MATERIALS

- #### A.
- Top Slab Surface Repairs: Repair mortar shall be one component, early strength gaining, cementitious patching material, MasterEmaco® T415 by Master Builders Solutions, or equal.
- #### B.
- Vertical Wall Surface and Underside of Slab Repairs: Repair mortar shall be one component, rheoplastic, shrinkage-compensated, fiber-reinforced, cementitious repair mortar, MasterEmaco® S 488CI by Master Builders Solutions, or equal.
- #### C.
- Top of Wall Repairs: Top of wall repairs shall be cast-in-place concrete as specified in Section 03 30 00–Cast-In-Place Concrete.
- #### D.
- Reinforcing Primer: Primer for reinforcing shall be a 2-component liquid epoxy bonding agent and anticorrosion coating, MasterEmaco® ADH 326 by Master Builders Solutions, or equal.

PART 3-EXECUTION

3.01 IDENTIFICATION

- #### A.
- When various tanks and other structures are removed from service and are available for observation, CONTRACTOR and CONSULTANT shall observe conditions and identify areas to be repaired. Where practicable, approximate quantities of repair material shall be agreed upon prior to commencement of repairs. Where quantities may be affected by subsurface conditions not visible prior to repairs, quantities shall be determined and agreed upon as soon as practicable after removal of unsound concrete.

3.02 SURFACE PREPARATION

- #### A.
- Protect adjacent Work areas and finish surfaces from damage during repair work.
- #### B.
- Concrete:
1. Remove unsound or delaminated concrete, providing minimum 1/4-inch (6 mm) substrate profile and 3/4-inch (19 mm) clearance behind corroded reinforcing steel.

2. After removal of concrete, but before placement, mechanically abrade concrete surface to remove bond-inhibiting materials and to provide additional mechanical bond. Do not use method of surface preparation that will fracture concrete. Verify absence of microcracking or bruising according to ICRI Guideline No. 310.2.
 3. Sawcut straight edges along repair area perimeters minimum of 1 inch (25 mm) deep to eliminate feather edges. Do not cut reinforcement.
 4. Report cracks that appear in interface area of patch or overlay to CONSULTANT, and repair.
 5. Continue expansion and control joints through repair or as required; review with CONSULTANT.
 6. Dampen base concrete interface to be repaired to saturated surface dry (SSD) conditions by wetting, fogging, or ponding with clean water for 24 hours.
- C. Reinforcing Steel:
1. Expose full circumference of corroded steel in areas to be repaired.
 2. Remove oxidation and scale from exposed reinforcing steel according to ICRI Technical Guideline No. 310.1R *Guide to Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion*.
 3. To prevent future steel corrosion, coat prepared reinforcing steel with reinforcing primer as specified.
 4. Any existing reinforcement displaced by prior demolition operations shall be bent back into place.

3.03 INSTALLATION

- A. Substrate shall be SSD with no standing water during application.
- B. Mix components and apply concrete according to manufacturer's instructions.
- C. Repair areas shall be water-cured for 7 days or use an approved curing compound compatible with coatings if area is to be overcoated.

END OF SECTION

SECTION 03 11 00
CONCRETE FORMWORK

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Forms for cast-in-place concrete.
 - 2. Form accessories.
 - 3. Openings for other work.
 - 4. Form stripping.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ACI 117–Tolerances for Concrete Construction.
- B. ACI 301–Structural Concrete for Buildings.
- C. ACI 318–Building Code Requirements for Reinforced Concrete.
- D. ACI 347–Recommended Practice for Concrete Formwork.
- E. PS1–Construction and Industrial Plywood.
- F. NSF/ANSI 61–Drinking Water System Components.

1.03 DESIGN

- A. All formwork shall comply with ACI 347 and ACI 301.
- B. CONTRACTOR shall assume the responsibility for the complete design and construction of the formwork.

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00–Submittals for form ties, form coatings, form liners (if any), and any other form accessories.
- B. Submit geometry of forms for circular structures.

PART 2–PRODUCTS

2.01 FORMS

- A. Forms shall be of wood, plywood, steel, fiberboard lined, or other approved materials which will produce concrete which meets the specified requirements. The type, size, quality, and shape of all materials of which the forms are made are subject to the review of CONSULTANT.
- B. Caution shall be exercised in the use of wood or composition forms or form liner to be certain that no chemical reaction will take place which causes a damaging effect on the concrete surface.

2.02 FORM TIES–NONREMOVABLE

- A. Internal wall ties shall contain positive stops at the required wall thickness. The exterior clamp portions of the tie shall be adjustable in length. Ties shall have cones on the water side of water-containing structures. Ties shall also have cones on the exterior side of all structures which have PVC water-stopped construction joints. Ties shall provide a positive disconnection on both ends 1 to 1 1/2 inches inside the finished face of the concrete.
- B. All wall ties used in the placement of structures which have PVC or hydrophilic water-stopped construction joints shall contain integral waterstops. All such ties shall be crimped or deformed in such a manner that the bond between concrete and tie cannot be broken in removal of the outer units. This portion of the tie shall not be removed prior to 24 hours after completion of the concrete placement.
- C. The use of wood spacers and wire ties will not be approved.

2.03 FORM TIES–REMOVABLE

- A. Taper ties which are designed to be removed entirely from the wall may be used with forms designed for this tie type and spacing.
- B. Tie holes shall be plugged with either a neoprene plug, Sure-Plug by Dayton Superior, Inc., or an EPDM rubber plug, X-Plug by Sika Greenstreak, or equal.
- C. Cementitious waterproofing material for patching taper tie holes shall be Hey Di K-11, Xypex Patch-N-Plug, or equal. Taper tie holes above the normal operating water surface shall be patched with mortar mix as specified in Section 03 30 00–Cast-In-Place Concrete for patching tie holes.

2.04 FORM COATINGS

- A. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.
- B. Form release agents for potable water containing structures shall be compliant with NSF/ANSI 61.

2.05 CHAMFER STRIPS

- A. Provide 3/4-inch by 3/4-inch wood or plastic chamfer strips at all exposed corners, except as noted.

2.06 KEYWAYS

- A. Keyways shall be formed with wood inserts.

PART 3-EXECUTION

3.01 CONSTRUCTION

- A. Forms shall conform to the shape, line, grade, and dimensions as shown on the Drawings. They shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports and shall support the loads and pressures without deflection from the prescribed lines. They shall be properly braced or tied together so as to maintain position and shape. Spacing of ties shall be recommended by the tie manufacturer.
- B. Formwork and finished concrete construction shall meet the tolerances specified in ACI 117.
- C. All exposed curved surfaces shall be formed to the continuous surface of the radius specified. Where segmented forms are proposed, a form system which deviates more than 3/8 inch from a circle through pan edges will not be allowed.
- D. Architectural surfaces and surfaces to be fitted with equipment shall be formed to match the shape intended. Where indicated on the Drawings, the form shall be lined with minimum 3/8-inch masonite and shimmed as required.
- E. When forms are placed for successive concrete placement, thoroughly clean concrete surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.
- F. At the request of CONSULTANT, temporary openings shall be provided at the base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before depositing concrete.
- G. Provide inserts and provide openings in concrete form work to accommodate work of other trades. Verify size and location of openings, recesses, and chases with the trade requiring such items. Securely support items to be built into forms.
- H. Provide top forms for inclined surfaces where the slope is too steep to place and vibrate concrete.
- I. Bevel wood inserts for forming keyways (except in expansion joints where inserts shall have square edges), reglets, recesses, and the like to allow for ease of removal. Inserts shall be securely held in place prior to concrete placement. Unless otherwise shown, chamfer strips shall be placed in the angles of the forms to provide 3/4-inch bevels at exterior edges and corners of all exposed concrete.

- J. The forms shall be oiled with a field-applied commercial form oil or a factory-applied nonabsorptive liner. Oil shall not stain or impede the wetting of surfaces to be cured with water or curing compounds. The forms shall be coated prior to placing reinforcing steel. Oil on reinforcement will not be permitted.
- K. All form surfaces shall be thoroughly cleaned, patched, and repaired before reusing and are subject to review of CONSULTANT.

3.02 FORM REMOVAL

- A. Supporting forms and shoring shall not be removed until the member has acquired sufficient strength to support its own weight and the construction live loads on it.
- B. All form removal shall be accomplished in such a manner that will prevent injury to the concrete.
- C. Forms shall not be removed before the expiration of the minimum times as stated below or until the concrete has attained its minimum 28-day design strength as confirmed by concrete cylinder tests, unless specifically authorized by CONSULTANT.
 - 1. Wall and Vertical Faces: 24 hours.
 - 2. Columns: 24 hours.
 - 3. Beams and Elevated Slabs: 14 days.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes providing complete, in-place, all steel and fibers required for reinforcement of cast-in-place concrete as shown on the Drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. Applicable standards listed in this section include, but are not necessarily limited to the following:
 - 1. ACI 315—Manual of Standard Practice for Detailing Reinforced Concrete Structures.
 - 2. ACI 318—Building Code Requirements for Reinforced Concrete.
 - 3. ASTM A1064—Standard Specifications for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - 4. ASTM A615—Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 5. ASTM A996—Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcing.
 - 6. ASTM C1116—Standard Specification for Fiber-Reinforced Concrete.
 - 7. CRSI—Manual of Standard Practice.

1.03 SUBMITTALS

- A. Comply with pertinent provisions of Section 01 33 00—Submittals.
- B. Provide complete shop drawings of all material to be furnished and installed under this section:
 - 1. Before fabrication of the reinforcement is begun, CONTRACTOR shall obtain the approval of CONSULTANT on reinforcing bar lists and placing drawings.
 - 2. These drawings and lists shall show in detail the number, size, length, bending, and arrangement of the reinforcing. Reinforcing supports shall also be located on the shop drawings.
 - 3. Shop drawings shall be in accordance with ACI 315.

1.04 PRODUCT HANDLING

- A. Delivery:
 - 1. Deliver reinforcement to the job site bundled, tagged, and marked.
 - 2. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- B. Storage: Store reinforcement at the job site on blocks and in a manner to prevent damage and accumulation of dirt and excessive rust.

PART 2-PRODUCTS

2.01 MATERIALS

- A. Reinforcing bars shall comply with ASTM A615 or A996 Type R, Grade 60. Reinforcing bars required to be welded shall be ASTM A706 low alloy.
- B. Steel wire and welded wire fabric shall comply with ASTM A1064. Fabric shall be provided in flat sheets. Rolled fabric shall not be used.
- C. Reinforcement supports, including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place shall be:
 - 1. Wire bar-type supports complying with CRSI recommendations, unless otherwise indicated.
 - 2. For slabs on grade, supports with sand plates, or horizontal runners where base material will not support chair legs.
 - 3. For exposed-to-view concrete surfaces or where the concrete surface will be exposed to weather or moisture, where legs of supports are in contact with forms, supports with either hot-dipped galvanized or plastic protected legs.
 - 4. When supports bear directly on the ground and it is not practical to use steel bar supports, precast concrete blocks may be used to support only the bottom lift of reinforcement. The precast blocks must be solid, be of an equal or higher strength than the concrete being placed, must provide adequate support to the reinforcement, and be of proper height to provide specified reinforcing cover. The use of face bricks, hollow concrete blocks, rocks, wood blocks, or other unapproved objects will not be permitted.
- D. Fibrous Reinforcing:
 - 1. Fibrous concrete reinforcement shall be Fibermesh 300, manufactured by Propex Concrete Systems, or equal.
 - 2. Reinforcement shall be 100% virgin polypropylene fibrillated, multi-length graded fiber containing no reprocessed olefin materials and specifically manufactured for use as concrete secondary reinforcement.
 - 3. Physical Characteristics:
 - a. Specific Gravity: 0.91.
 - b. Fiber Length: Multidesign gradation.
- E. Mechanical Splices and Threaded Couplers:
 - 1. Mechanical splices shall be Zap Screwlok by Bar Splice Products, Inc., or equal.
 - 2. Threaded couplers and dowel bar replacements shall be Dowel Bar Splicer System by Dayton/Richmond, or equal.
 - 3. Mechanical splices and couplers shall be capable of developing at least 125% of the yield strength of the reinforcing bar.

2.02 FABRICATION

- A. General:
 - 1. Fabricate reinforcing bars to conform to required shapes and dimensions with fabrication tolerances which comply with CRSI Manual.
 - 2. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material.
 - 3. Unless otherwise shown on the Drawings, all end hook dimensions shall conform with "ACI Standard Hooks."

- B. Reinforcement with any of the following defects shall be deemed unacceptable and will not be permitted in the work:
 - 1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
 - 2. Bend or kinks not indicated on Drawings or final shop drawings.
 - 3. Bar with reduced cross section because of excessive rusting or other cause.

PART 3—EXECUTION

3.01 INSPECTION

- A. Examine the substrate, formwork, and the conditions under which concrete reinforcement is to be placed.
- B. Correct conditions detrimental to the proper and timely completion of the work.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General:
 - 1. Comply with the specified standards for details and methods of placing reinforcement and supports.
 - 2. Clean reinforcement to remove loose rust, mill scale, earth, and other materials that reduce or destroy bond with concrete.
- B. Placing Reinforcement:
 - 1. All reinforcing shall be placed in accordance with Contract Drawings and with shop drawings stamped and approved by CONSULTANT.
 - 2. Position, support, and secure reinforcing against displacement by formwork, construction, or concrete placement operations.
 - 3. Support reinforcing by metal chairs, runners, bolsters, spacers, and hangers as needed.
 - 4. Unless otherwise shown on the Drawings, the reinforcement is to be so detailed and placed as to allow the following concrete protection:
 - a. Three inches of cover where the concrete is placed directly against ground.
 - b. Two inches of cover where the concrete is placed in forms but is to be exposed to weather, liquid, or the ground.
 - c. One-inch cover in slabs and walls not exposed to weather, liquid, or the ground.
 - d. One and one-half-inch cover in beams, girders, and columns not exposed to weather, liquid, or the ground. This cover applies to beam stirrups and column ties where applicable.
 - 5. Reinforcement shall be positioned within $\pm 3/8$ inch for members with depth to tension reinforcing from compression face less than or equal to 8 inches. Tolerance shall be $\pm 1/2$ inch for members with depth to tension reinforcing from compression face greater than 8 inches. Tolerance on dimension between adjacent bars in slab and wall reinforcing mats shall be 1 inch. Secure against displacement by anchoring at the supports and bar intersections with wire or clips.
 - 6. Bars shall be securely tied at all intersections, except where spacing is less than 1 foot in each direction when alternate intersections shall be tied. To avoid interference with embedded items, bar spacing may be varied slightly if acceptable to CONSULTANT. Tack welding of reinforcing will not be permitted.

7. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
 8. If reinforcing must be cut because of openings or embedded items in the concrete, additional reinforcing must be provided adjacent to the opening at least equal in cross sectional area to that reinforcing which was cut, and it shall extend a minimum of 36 bars diameters beyond the opening on each side or as shown on the Drawings. At sumps or depressions in slabs, bars shall be bent and/or extended under sumps or depressions.
 9. Wall reinforcing mats shall be secured in a vertical plane by providing clearance from forms with bar supports and by using Z-shaped bars at ± 4 feet on center wired between two mats of steel, spacing and staying both of them. Nails shall not be driven into the forms to support reinforcement and neither shall wire for this purpose come in contact with the forms. Alternate top transverse bars in slab shall be supported by individual bar chairs at approximately 3 foot 0-inch centers. Bottom longitudinal bars shall be supported by continuous bar chairs at approximately 4 foot 0-inch centers.
 10. If carrier bars are to be used, CONTRACTOR shall provide reinforcing bars for this purpose in addition to the reinforcing called for by the Drawings and Specifications.
- C. Reinforcement Supports:
1. Strength and number of supports shall be sufficient to carry reinforcement.
 2. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support.
 3. Do not use supports as bases for runways for concrete-conveying equipment and similar construction loads.
- D. Welded Wire Fabric:
1. Install welded wire fabric in as long of lengths as practicable.
 2. Lap adjoining pieces at least one full mesh.
 3. Fabric shall be supported with bar supports.
- E. Splices:
1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying.
 2. Lap splices in reinforcing shall be provided as shown on the Drawings. Where lap splice lengths are not shown on the Drawings, provide Class B, Category 1 lap splices in accordance with ACI 318.
 3. Adjacent splices of tangential bars in circular slabs and horizontal bars in circular walls shall be staggered a minimum of one full lap splice length or 3 feet, whichever is greater, unless otherwise shown. Stagger dimension shall be measured from center to center of lap splices.
 4. For circular walls, horizontal bar lap splices shall not coincide in vertical arrays more frequently than every third bar.
 5. Mechanical splices and threaded dowel bar inserts may be used where acceptable to CONSULTANT.
- F. Embedded Items:
1. Allow other trades to install embedded items as necessary.
 2. Particularly after bottom layer of reinforcing is placed in slabs, allow electrical contractors to install conduit scheduled for encasement in slabs prior to placing upper layer of reinforcing.
- G. Minimum Reinforcing: Where reinforcing is not shown, provide a minimum of No. 4 at 8-inch centers each way in members 10 inches or less in thickness and No. 5 at 12-inch centers each way in each face in members greater than 10 inches thick.

H. Fibrous Reinforcing:

1. Fibrous concrete reinforcing shall be used in all building interior slab-on-grade concrete and all precast concrete topping, and where shown on the Drawings.
2. Add fibers at a minimum rate of 1.5 pounds per cubic yard.
3. Mix concrete in strict accordance with reinforcement manufacturer's recommendations.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: All cast-in-place concrete as shown except as noted otherwise.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ACI 211.1–Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- B. ACI 301–Specifications for Structural Concrete.
- C. ACI 304R–Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- D. ACI 305R–Guide to Hot Weather Concreting.
- E. ACI 306R–Guide to Cold Weather Concreting.
- F. ACI 308–Specification for Curing Concrete.
- G. ACI 309–Guide for Consolidation of Concrete.
- H. ACI 318–Building Code Requirements for Structural Concrete and Commentary.
- I. ASTM C31–Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- J. ASTM C33–Standard Specification for Concrete Aggregates.
- K. ASTM C39–Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- L. ASTM C40–Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- M. ASTM C88–Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- N. ASTM C94–Standard Specification for Ready-Mixed Concrete.
- O. ASTM C143–Standard Test Method for Slump of Hydraulic-Cement Concrete.
- P. ASTM C150–Standard Specification for Portland Cement.
- Q. ASTM C156–Standard Test Method for Water Loss (from a Mortar Specimen) Through Liquid Membrane-Forming Curing Compounds for Concrete.

- R. ASTM C172–Standard Practice for Sampling Freshly Mixed Concrete.
- S. ASTM C231–Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- T. ASTM C260–Standard Specification for Air-Entraining Admixtures for Concrete.
- U. ASTM C309–Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- V. ASTM C494–Standard Specification for Chemical Admixtures for Concrete.
- W. ASTM C595–Standard Specification for Blended Hydraulic Cements.
- X. ASTM C618–Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- Y. ASTM C652–Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
- Z. ASTM D994–Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- AA. ASTM D1752–Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00–Submittals.
- B. Submit the following information:
 - 1. Gradation of fine and coarse aggregate–ASTM C33.
 - 2. Specific gravity and dry rodded density of each aggregate.
 - 3. Test of deleterious substances in fine and coarse aggregate–ASTM C33.
 - 4. Design mix of each individual concrete mix to be used.
 - 5. Previous test results or trial batch results with 7- and 28-day compressive strengths for each concrete mix proposed.
 - 6. Certified mill test results for cement identifying brand, type, and chemistry of cement to be used.
 - 7. Brand, type, principal ingredient, and amount of each admixture to be used.
- C. It is important that the above data be submitted to CONSULTANT well in advance of anticipated concreting operations to avoid any delay in construction.

PART 2–PRODUCTS

2.01 CEMENT

- A. Cement shall be Portland cement Type I/II conforming to ASTM C150 or Portland limestone cement Type IL conforming to ASTM C595. All cement shall be the product of one reputable manufacturer and mill.
- B. Cement shall be stored in a dry, weathertight, properly ventilated structure with the floor raised not less than 1 foot above the ground.

2.02 FLY ASH

- A. All fly ash used as an admixture in Portland cement or Portland limestone cement concrete shall be Class C or F conforming to the requirements of ASTM C618.

2.03 AGGREGATE

- A. All aggregates shall be washed and shall consist of natural sand, gravel, or crushed rock and shall have clean, hard, durable, uncoated grains of strong minerals. The amounts of deleterious substances present in the fine and coarse aggregate expressed in percentages by weight shall not exceed the following:

Deleterious Substance	Aggregate	
	Fine	Coarse
Clay Lumps and Friable Particles	3.0	3.0
Coal and Lignite	0.5	0.5
Mineral finer than No. 200 sieve	3.0	
Soft Fragments	3.0	3.0
Chert*	---	5.0
Sum of Chert and Clay Lumps		5.0

* Material classified as chert and having a bulk specific gravity of less than 2.45. The percentage of chert shall be determined on the basis of the weight of chert in the sample retained on a 3/8-inch sieve divided by the weight of the total sample.

- B. The combined amount of all deleterious substances in an aggregate shall not exceed 5% of the weight of the aggregate.
- C. If requested by CONSULTANT, sodium sulfate soundness tests (ASTM C88) shall be performed on the aggregate. When the aggregate is subjected to 5 cycles, the weight loss shall not exceed 12%. Samples of proposed aggregates shall be submitted to an independent laboratory for testing in advance of concrete work. All testing shall be performed in accordance with ASTM C33. Certified test results shall be submitted to CONSULTANT confirming that aggregate complies with all stated specifications. Report shall identify source of aggregate and absorbed water.
- D. Fine aggregate shall be well-graded from coarse to fine and shall conform to the following requirements:

Percentage by Weight	
Passing 3/8-inch sieve	100
Passing No. 4 sieve	95-100
Passing No. 8 sieve	80-100
Passing No. 16 sieve	50-85
Passing No. 30 sieve	25-60
Passing No. 50 sieve	5-30
Passing No. 100 sieve	0-10

- E. Gradation of fine aggregate shall be reasonably uniform and not subject to the extreme percentages of gradation specified above. The fineness modulus shall be not less than 2.3 or more than 3.1, nor shall the fineness modulus of any sample vary by more than +0.20 from the fineness modulus of the representative sample used in proportioning the concrete.
- F. If requested by CONSULTANT, fine aggregate shall be subjected to the color-metric test for organic impurities (ASTM C40) and shall not produce a color darker than Figure 1, unless they pass the mortar strength test. Aggregate producing color darker than Figure 2 shall not be used in any event.
- G. Coarse aggregate shall be well-graded from coarse to fine, and when tested by laboratory sieves having square openings, shall conform to the following requirements:

	Percentage by Weight Aggregate
	3/4-Inch Stone
Passing 2-inch sieve	---
Passing 1 1/2-inch sieve	---
Passing 1-inch sieve	100
Passing 3/4-inch sieve	90-100
Passing 3/8-inch sieve	20-55
Passing No. 4 sieve	0-10
Passing No. 8 sieve	0-5

- H. Aggregates must be allowed to drain for at least 12 hours before being used. The ground upon which aggregates are stored must be hard, firm, well-drained, and free from all vegetable matter. Various sizes of aggregates must be stored separately, and if they have become contaminated or merged with each other, they shall not be used.

2.04 WATER

- A. Water used in mixing concrete shall be clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious substances.

2.05 ADMIXTURES

- A. Water Reducing Admixture shall be Master Pozzolith® 200 by Master Builders Solutions, Daracem 19 by Grace, or equal. Water reducing admixture shall conform to ASTM C494, Type A and Type F. Water reducing admixture shall not reduce durability, shall increase strength 10%, and shall not affect bleeding characteristics over reference mix.
- B. Air-Entraining Admixture shall be equal to MasterAir® AE 90 by Master Builders Solutions, Darex by Grace Construction Products, or equal. Air-entraining admixture shall conform to ASTM C260.
- C. No other admixture will be allowed without written approval of CONSULTANT. All admixture shall be compatible with cement, aggregate, and water used.

2.06 PROPORTIONING

- A. The proportions of aggregate to cement shall be such as to produce a workable mixture that can be thoroughly compacted and that will work readily in the forms and around reinforcement without permitting materials to segregate or excess water to collect on the

surfaces. The combined aggregates shall be such that when separated on the No. 4 sieve, the weight passing the sieve shall not be less than 30% nor greater than 50%.

- B. Concrete of various classes shall have the following maximum water/cement or water/(cement + fly ash) ratio minimum compressive strengths at 28 days and minimum cement and fly ash contents:

Class	Maximum Water/ Cement or Water/ (Cement+Fly Ash)	Minimum 28 Day Strength-Pounds per Square Inch	Cement Content-Pounds per Cubic Yard	Fly Ash- Pounds per Cubic Yard	
				Type C	Type F
A-FA	0.45	4,000	480	110	125
B	0.53	3,500	517	---	---

- C. All concrete mixes shall be designed for a strength of 15% above that specified to allow for job variations. All mixes shall be designed in accordance with ACI 211.1 by a qualified concrete engineer or qualified laboratory technician. Required materials test data shall be submitted with design mixes for review and approval by CONSULTANT. Mix computations shall be submitted if requested by CONSULTANT.
- D. The slump for all concrete shall be 3 inches and concrete with a slump within the range of 2 to 3 1/2 inches will be acceptable, unless otherwise stated.
- E. A water-reducing admixture shall be used in all concrete. A qualified representative of the manufacturer shall be available to assist in proportioning the concrete, advise on the proper addition of the admixture to the concrete, and advise on adjustments of concrete proportions to suit job conditions.
- F. An air-entraining admixture shall be used in all concrete except as noted. Air content shall be tested by the pressure method as outlined in ASTM C231 and shall be between 4% to 7% by volume. An air-entraining admixture is not required for concrete patching and for concrete floors, equipment pads, and supports in interior heated buildings where the concrete will be protected from freezing during and after construction.
- G. CONTRACTOR shall submit to CONSULTANT concrete cylinder compressive strength results from previous projects for the same concrete mixes proposed on the current project. If this information is not available, one cubic yard trial batches of each individual mix proposed for use shall be made prior to use in the work. Four test cylinders shall be made for each trial batch, two to be tested at 7 days and two at 28 days. The trial batches shall be made preceding actual placement operations so that the results of the 7-day tests can be obtained. All costs for material, equipment, and labor incurred during design of concrete mixes shall be borne by CONTRACTOR.
- H. All aggregates shall be measured by weight. The concrete mixer is to be equipped with an automatic water-measuring device that can be adjusted to deliver the desired amount of water.

2.07 BONDING AGENT

- A. Bonding agent for bonding new concrete to existing concrete at construction joints and for bonding concrete overlays to existing concrete shall be a liquid latex product meeting

ASTM C1059, Type II. Acceptable products include Euroweld 2.0 by Euclid Chemical, Acrylic Bonding Agent J40 by Dayton Superior, or equal.

2.08 PATCHING ADDITIVE

- A. Acceptable manufacturers include MasterEmaco® A 660 by Master Builders Solutions, Sonocrete by Sonneborn Contech Co., or equal.

2.09 NONSHRINK GROUT

- A. Acceptable manufacturers include Dayton Superior, Master Builders Solutions, or equal. Grout shall be nonshrink, nonmetallic and shall achieve a strength of 7,500 psi in 28 days.

PART 3-EXECUTION

3.01 MIXING

- A. Ready-mixed concrete shall be batched, mixed, and delivered in accordance with ASTM C94 and ACI 304R. In general, concrete shall be mixed 50 revolutions at plant, 20 upon arrival at site, and 20 each time water is added; maximum of 110 revolutions at mixing speed. Concrete shall be delivered and discharged within 1 1/2 hours or before the drum has revolved 300 times after introduction of water to the cement and aggregates or the cement to the aggregates. Truck mixers shall be equipped with drum revolution counters. In no event shall concrete which has taken its initial set be allowed to be used. Retempering of concrete is not permitted.
- B. A representative of CONSULTANT may be at the batching plant periodically to observe the batching and mixing.
- C. No water shall be added on the job unless required by CONTRACTOR and with the knowledge of CONSULTANT; the amount of water, if added, shall be recorded on all copies of the delivery tickets. If water is added, CONTRACTOR shall verify that the required water-cement ratio is not exceeded.
- D. Concrete shall have a temperature not less than 60°F nor more than 80°F as delivered to the jobsite.
- E. With each load of concrete, delivery tickets shall be made available for review by CONSULTANT upon request. Delivery tickets shall provide the following information:
 - 1. Date.
 - 2. Name of ready-mix concrete plant, job location, and CONTRACTOR.
 - 3. Type of cement and admixtures, if any.
 - 4. Specified cement content in sacks per cubic yard of concrete and approved concrete mix number or designation.
 - 5. Amount of concrete in load, in cubic yards.
 - 6. Water-cement ratio.
 - 7. Water added at job, if any.
 - 8. Truck number and time dispatched.
 - 9. Number of mixing drum revolutions.
- F. For job-mixed concrete, all concrete materials shall be mixed in a machine batch mixer for at least 1 1/2 minutes after all ingredients are in the mixer and shall continue until there is a uniform distribution of the materials and the mass is uniform in color and homogeneous. The

mixer shall not be loaded beyond the capacity given by the manufacturer and shall be rotated at the speed recommended by the manufacturer. The mixer is to be provided with positive timing device that will positively prevent discharging the mixture until the specified mixing time has elapsed.

3.02 BONDING TO EXISTING CONCRETE

- A. When placing new concrete adjacent to existing concrete, the existing concrete shall be thoroughly roughened, cleaned, and saturated with water 24 hours before pouring new concrete. Existing concrete is defined as concrete more than six months old. At time of new pour, remove any standing water and apply bonding agent. Bonding agent shall be applied in accordance with manufacturer's recommendations.

3.03 EMBEDDED ITEMS IN CONCRETE

- A. All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.
- B. All contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.
- C. Embedded items shall be positioned accurately and supported against displacement. Reinforcing bars shall clear embedded items a minimum of 2 inches.

3.04 PLACING CONCRETE

- A. Before placing concrete, all equipment, forms, ground, reinforcements, and other surfaces with which the concrete will come in contact are to be thoroughly cleaned of all debris, ice, and water. Ground shall be wetted prior to placement of concrete on it.
- B. After reinforcement is placed and before concrete is placed over it, CONSULTANT shall be allowed sufficient time to observe the reinforcing.
- C. Unless otherwise authorized by CONSULTANT, all concrete shall be placed in the presence of CONSULTANT.
- D. Concrete shall be conveyed from the mixer to the place of final deposit as rapidly as practicable by methods that will prevent the segregation or loss of materials. Chuting for conveying purposes must be accomplished in such a manner as to prevent segregation or loss of materials. Receiving hoppers shall be installed at the chute discharge and at no point in its travel from the mixer to place of final deposit shall the concrete pass through a free vertical drop of more than 3 feet. Elephant trunks or tremies shall be used in all wall pours to prevent coating of forms and reinforcing bars.
- E. Care shall be taken to avoid an excess of water on the concrete surface. Excess water shall be drained or otherwise removed from the surface. Dry cement or a mixture of cement and sand shall not be sprinkled directly on the surface to absorb water.
- F. Concrete in wall and beam pours shall be deposited in approximately horizontal layers not to exceed 18 inches in thickness. Each layer shall be well worked into the preceding layer while both layers are still soft.

- G. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation from rehandling or flowing. The maximum allowable lateral movement of the concrete after being deposited is 3 feet. Once concreting is started, it shall be carried on as a continuous operation until the placing of the section or panel is completed.
- H. All concrete shall be placed with the aid of mechanical vibrating equipment in accordance with ACI 309. In congested areas, vibration shall be supplemented by hand spading adjacent to the forms. Vibration should secure the desired results within 5 to 15 seconds at intervals of 18 inches apart maximum. The vibrator shall penetrate the preceding layer of concrete. Vibrators shall have a frequency of not less than 10,000 impulses per minute when in operation submerged in concrete.
- I. A sufficient number of spare vibrators shall be kept in ready reserve to provide adequate vibration in case of breakdown of those in use.
- J. In placing concrete in beams where it is intended to be continuous and monolithic with the slab above, a delay to provide for settlement of the deep concrete shall be scheduled before placing the upper concrete in the slab. The length of delay shall be as long as possible and still permit the revibration of the deep concrete.
- K. Concrete is not to be placed under water. A suitable means shall be provided for lowering the water level below surfaces upon which concrete is to be placed. This may require excavating approximately 12 inches below the bottom of the concrete surface and refilling with gravel and compacting. The groundwater shall not be allowed to rise to the bottom of the concrete until 24 hours after the concrete pour has been completed. Water shall not be allowed to fall upon or run across the concrete during this period.
- L. No extra payment will be allowed for dewatering, undercutting, and gravel fill.

3.05 MOIST CURING

- A. All concrete shall be maintained in a moist condition for at least 7 days after being deposited except that for high-early strength concrete, a 3-day period will be sufficient. Moist curing shall be accomplished by one of the following methods:
 - 1. Wood forms left in place and kept wet at all times. If wood forms are not going to be kept wet or if metal forms are used, they shall be removed as soon as practicable and other methods of moist curing shall be started without delay.
 - 2. Use of a curing compound conforming to ASTM C309, Type I as approved by CONSULTANT. Curing compound shall be applied at a uniform rate as indicated by the manufacturer sufficient to comply with the requirements of the test water retention of ASTM C156. Curing compound applied to vertical concrete surfaces after forms are removed shall be specially adapted to provide required coverage on the vertical surface. On nonformed surfaces, the curing compound shall be applied immediately after the disappearance of the water sheen after finishing of the concrete. Curing compound shall not be used on concrete surfaces that are to be painted, receive ceramic tile or resilient flooring, or be waterproofed. The curing compound for potable water structures shall be certified per NSF/ANSI-61. Care shall be taken not to get curing compound on construction joints, reinforcing steel, and other surfaces against which new concrete will be poured.
 - 3. Use of plastic film. Plastic film shall have a minimum thickness of 4 mils. It shall be placed over the wet surface of the fresh concrete as soon as possible without marring the surface and shall be weighted so that it remains in contact with all exposed surfaces of the concrete. All joints and edges shall be lapped and weighted. Any tears in the film shall be immediately repaired.

4. Application of wet coverings weighing 9 ounces per square yard such as burlap, cotton mats, or other moisture-retaining fabrics. The covering system shall include two layers and shall be kept continuously moist so that a film of water remains on the concrete surface throughout the curing period.
 5. Use of an approved waterproof curing paper. Edges of adjacent sheets shall be overlapped several inches and tightly sealed.
 6. Ponding of water or continuous sprinkling of water is permitted. Sprinkling at intervals will not be permitted.
 7. Construction joints shall be moist cured by one of the methods listed above except by Method "2."
- B. The use of moist earth, sand, hay, or another method that may discolor hardened concrete will not be permitted.

3.06 HOT WEATHER CONCRETING

- A. When the atmospheric temperature exceeds 80°F during concrete placement, this section and ACI 305 shall apply in addition to all other sections of the specifications.
- B. The temperature of the delivered concrete shall not exceed 85°F.
- C. Care shall be exercised to keep mixing time and elapsed time between mixing and placement at a minimum. Ready-mix trucks shall be dispatched so as to avoid delay in concrete placement, and the work shall be organized to use the concrete promptly after arrival at the jobsite.
- D. The subgrade, forms, and reinforcing shall be sprinkled with cool water just prior to placement of concrete. Prior to placing concrete, there shall be no standing water or puddles on the subgrade.
- E. If approved by CONSULTANT, an admixture for retarding the setting of the concrete may be used.
- F. Exposed concrete surfaces shall be carefully protected from drying. Continuous water curing is preferred. Curing compounds shall be white pigmented.

3.07 COLD WEATHER CONCRETING

- A. Conditions of this section shall apply, in addition to all other sections of the specifications, when placing concrete in cold weather. Cold weather is defined as a period when, for more than three successive days, the average daily temperature drops below 40°F. When temperatures above 50°F occur during more than half of any 24-hour period, the period will no longer be regarded as cold weather. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. Cold weather concreting shall conform to all requirements of ACI 306.1, except as modified by the requirements of these specifications.
- B. Detailed procedures for the production, placement, protection, curing, and temperature monitoring of concrete during cold weather shall be submitted to CONSULTANT. Cold weather concreting shall not begin until these procedures have been reviewed for conformance with ACI 306.1.

- C. All concrete materials, forms, ground, mixing equipment, and other surfaces with which the concrete is to come in contact shall be free from frost, and the temperature of contact surfaces shall be 35°F or above. Ground upon which concrete is to be placed shall not be frozen at any depth.
- D. The mixing water and aggregates shall be heated and when entering the mixer shall have temperatures not exceeding 175°F and 80°F, respectively. Concrete temperature as mixed shall not exceed 80°F and shall typically be between 55°F and 70°F. Concrete, when placed in the forms, shall have a temperature of not less than 50°F.
- E. Freshly placed concrete shall be protected by adequate covering, insulating, or housing and heating. If heating is used, ambient temperature inside the housing shall be maintained at a minimum of 70°F for 3 days or 50°F for 5 days. The maximum ambient temperature during curing shall not exceed 80°F. If insulating methods are used, recommendations contained in ACI 306R shall be followed. Surface temperature shall be maintained at 50°F for 7 days. After the curing period, the temperature of the concrete shall be reduced uniformly at a rate not to exceed 40°F per 24 hours until outside air temperature is reached. Heating of enclosure shall continue if it is anticipated that the outside air temperature will drop more than 20°F in the next 24 hours. The concrete temperature shall be obtained by attaching a thermometer provided by CONTRACTOR to the concrete surface. Concrete shall be kept moist.
- F. If heating is used, the housing shall be constructed weathertight and shall be constructed in a manner that will provide uniform air circulation and air temperatures over the complete concrete area that is being cured. Special attention shall be given to the edges and ends of a concrete pour with the housing extending at least 5 feet beyond any concrete surface being protected. The housing shall be in place and heat applied within 2 hours after concrete placement.
- G. Heating may be by steam or hot air. Heaters shall be vented to outside of the housing. Open burning salamanders will not be permitted. Heating devices shall not be placed so close to the concrete as to cause rapid drying or discoloration from smoke.
- H. If heating is used, CONTRACTOR shall provide sufficient 24-hour inspection of the heaters to provide compliance with the above-specified temperature requirements during the curing period. CONTRACTOR shall provide maximum-minimum thermometers for CONSULTANT's use.
- I. The use of calcium chloride, salts, or other chemical admixtures for the prevention of freezing is prohibited.
- J. Salts or other deleterious materials shall not be used on temporary or permanent structures above concrete surfaces that are being placed, finished, or cured.

3.08 FINISHING

- A. Flat Work:
 - 1. Floated Finish: Place, consolidate, strike off, and level concrete eliminating high spots and low spots. Do not work concrete further until it is ready for floating. Begin floating with a hand float, a bladed power float equipped with float shoes, or a powered disk float when the bleed water sheen has disappeared and the surface has stiffened sufficiently to permit the operation. Immediately refloat the slab to a uniform texture.
 - 2. Light Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks.

3. Hard Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks. Continue hand troweling until a ringing sound is produced as the floor is troweled.
 4. Tolerance for concrete floors shall be 1/4 inch within 10 feet in any direction. Straight edge shall be furnished by CONTRACTOR.
 5. Broom or Belt Finish: Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface.
 6. The above finishes shall be used in the following locations:
 - a. Float Finish: Surface to receive roofing, waterproofing, or sand bed terrazzo.
 - b. Light Troweled Finish: Submerged tank slabs.
 - c. Hard Troweled Finish: Building floors.
 - d. Broom or Belt Finish: Exterior slabs, sidewalks, tops of walls, and tank slabs to receive grout topping.
- B. Formed Surfaces:
1. Within 2 days after removing forms and prior to application of a curing compound, all concrete surfaces shall be observed and any poor joints, voids, stone pockets, or other defective areas shall be patched at once before the concrete is thoroughly dry. Defective areas shall be chipped away to remove all loose and partially bonded aggregate. The area shall be thoroughly wetted and filled with as dry as practical mortar mix placed to slightly overfill the recess. Mortar shall include a bonding agent. After partial set has taken place, the excess mortar shall be removed flush with the surface on the concrete using a wood float. All patching shall be cured, protected, and covered as specified for concrete. All cracks, leaks, or moist spots that appear shall be repaired. No extra compensation will be allowed CONTRACTOR for such work.
 2. The exterior or removal portion of nonremovable ties shall be removed with the use of a special tool designed for this purpose. Cutting or chipping of concrete to permit removal of exterior portion will not be permitted.
 3. For nonremovable ties, tie rod holes left by the removal of the exterior portion of the tie and cone shall be thoroughly wetted and filled by ramming with as dry as practical mortar mix in such a manner such that it completely fills the hole. Mortar shall include a bonding agent. All patching shall be cured, protected, and covered as specified for concrete. The holes are to be filled immediately after removal of the exterior portion of the tie.
 4. Holes left by removable ties shall be filled by installing a neoprene plug near the center of the wall. The balance of the hole shall be filled with mortar as specified above to within 1 inch of the face of the wall. The remainder of the hole shall be filled with a waterproofing compound.
 5. All finished or formed surfaces shall conform accurately to the shape, alignment, grades, and sections as shown or prescribed by CONSULTANT. All surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness. All sharp angles, where required, shall be rounded or beveled. Any formed surface to be painted shall be free of any material that will be detrimental to the paint. The surface of the concrete shall be given one of the following finishes immediately after form stripping:
 - a. Finish A shall be referred to as a sack finish. Surfaces shall be free of contaminants prior to sacking. After wetting the surface, a grout shall be rubbed in using a rubber float or burlap. After the grout hardens sufficiently, it shall be scraped from the surface with the edge of a steel trowel without disturbing the grout in the air holes. After further drying, the surface shall be rubbed with burlap to remove all surface grout. The entire surface shall be finished to secure a continuous, hard, dust-free uniform texture surface free from pinholes and other minor imperfections. Finish A will be required for all unpainted surfaces (See Section 09 91 00–Painting for painted surfaces), interior surfaces of equipment rooms, operation areas, and permanently exposed vertical surfaces. Where steel-faced forms are used to form walls, the

- portion of wall to receive the sack finish shall first be roughened by brush blasting or other acceptable method to achieve a texture similar to 40 to 60 grit sandpaper.
- b. Finish B shall be the same as Finish A, except that the final burlap rubbing may be omitted, providing the steel trowel scraping removes the loose buildup from the surface. Finish B shall be provided for waterproof- and moistureproof-coated surfaces.
 - c. Finish C shall be referred to as a finish that has surface imperfections less than 3/8 inch in any dimension. Surface imperfections greater than 3/8 inch shall be repaired or removed and the affected areas neatly patched. Finish C or smoother shall be provided for interior surfaces of wet wells, tanks, and channels from 1 foot below minimum water surfaces and down and otherwise unfinished interior surfaces.
 - d. Finish D shall be the finish for surfaces that may be left as they come from the forms, except that tie holes shall be plugged and defects greater than 1/2 inch in any dimension shall be repaired. Finish D shall be provided for surfaces to be buried or covered by other construction such as masonry veneer.
- C. All precautions shall be taken to protect the concrete from stains or abrasions, and any such damage shall be removed or repaired under this Contract.

3.09 LOADING OF CONCRETE STRUCTURES

- A. No concrete structure or portion thereof shall be loaded with its design load until the concrete has obtained its specified 28-day compressive strength. This shall include but not be limited to vertical live load, equipment loading, water loading, groundwater loading, and backfill load. Concrete strength at time of loading shall be determined by testing field-cured concrete cylinders.
- B. Extreme care shall be taken so that construction loads do not exceed design loading of the structure.

3.10 NONSHRINK GROUT

- A. Nonshrink, nonmetallic grout shall be used for filling recesses and pockets left for equipment installation and for setting of base plates. The material used shall be approved by CONSULTANT. Store, mix, and place the nonshrinking compound as recommended by the manufacturer. The minimum compressive strength shall be 5,000 psi at age 7 days and 7,500 psi at age 28 days.

3.11 TESTING AND SAMPLING

- A. The following tests of fresh concrete shall be performed by the SPECIAL INSPECTOR. The SPECIAL INSPECTOR shall prepare, protect, transport, and have tested all cylinders at its expense.
 - 1. Sampling of concrete for slump tests, air tests, temperature tests, and for making concrete test cylinders shall be performed in accordance with ASTM C172.
 - 2. Cylinders:
 - a. Three test cylinders shall be made for each pour less than 25 cubic yards, four test cylinders shall be made for each pour between 25 and 100 cubic yards, and eight test cylinders shall be made for each pour in excess of 100 cubic yards. Each concrete mix shall be represented by at least four cylinders for the entire job. Concrete for cylinders shall be collected near the middle of the load and/or as requested by CONSULTANT.
 - b. Cylinders shall be made and tested in accordance with ASTM C31 and ASTM C39, respectively. The cylinders must be kept moist and at temperatures between 60°F

and 80°F and shall remain undisturbed and stored in a location free from vibration. In hot weather, the cylinders shall be covered with wet burlap and stored in a shaded area. It is CONTRACTOR's responsibility to provide a suitable protected location for storing cylinders on the jobsite.

- c. After 24 hours, the cylinders shall be transferred to an independent testing laboratory acceptable to OWNER. The cylinders shall be packed in sawdust or other cushioning material for transit to avoid any bumping or jarring of the cylinders.
 - d. Cylinders shall be broken at 7 and 28 days or as requested by CONSULTANT. Test results shall be transmitted immediately and directly to CONSULTANT and OWNER. Test data shall include date and location of pour and concrete mix used.
3. Slump Test: The SPECIAL INSPECTOR shall make one slump test near the beginning of all pours with two tests being made for all pours in excess of 25 yards or as requested by CONSULTANT. Slump tests shall conform to ASTM C143.
 4. Air Test:
 - a. When air-entrained concrete is used, the air content shall be checked by The SPECIAL INSPECTOR near the beginning of all pours with at least two checks being made for all pours in excess of 25 cubic yards, or as requested by CONSULTANT.
 - b. The air contents shall be checked using the pressure method in accordance with ASTM C231. The pocket-sized alcohol air indicator shall not be used unless it is first used in conjunction with the pressure method test.
- B. All costs of additional testing and sampling of fresh or hardened concrete needed because of suspected or actual violation of the specifications shall be borne by CONTRACTOR.

3.12 RECORDS

- A. A record is to be kept of all concrete work. The record shall include the date, location of pour, concrete mix, slump, air content, test cylinder identification, concrete temperature, and ambient air temperature. In addition, for cold weather concreting the record shall include the daily maximum-minimum thermometer readings of all thermometers during the entire curing period for all concrete pours. The Resident Project Representative will keep this record, and CONTRACTOR shall assist in obtaining needed information.

3.13 SIDEWALKS AND EXTERIOR SLABS

- A. Sidewalks shall be constructed where shown on the Drawings. They shall be a minimum of 5 inches thick and shall slope away from buildings or structures at a rate of 1/4 inch per foot. Concrete shall be as previously specified. Sidewalks shall be constructed on 3 inches of compacted granular fill. They shall have tooled joints of 1 inch minimum depth at approximately 5-foot centers with 1/2 inch preformed expansion joint filler at approximately 25-foot centers with one at all corners and located anywhere sidewalks abut structures and buildings.

3.14 CONCRETE REMOVAL AND PATCHING

- A. All areas disturbed as a result of concrete removal or repair shall be patched as specified in Bonding to Existing Concrete.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Shop-fabricated carbon steel and aluminum items, metal stairs, and weirs, baffles, and troughs.
 - 2. Stair treads and nosings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A36—Carbon Structural Steel.
- B. ASTM A53—Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- C. ASTM A123—Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A143—Practice for Safeguarding Against Embrittlement of Hot-Dipped Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- E. ASTM A153—Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- F. ASTM A240—Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- G. ASTM A276—Stainless Steel Bars and Shapes.
- H. ASTM A307—Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
- I. ASTM A384—Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
- J. ASTM A385—Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
- K. ASTM A500—Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- L. ASTM A780—Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- M. ASTM A992—Structural Steel Shapes.
- N. ASTM A1008—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.

- O. ASTM A1011—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.
- P. ASTM B209—Aluminum and Aluminum-Alloy Sheet and Plate.
- Q. ASTM B211—Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.
- R. ASTM B221—Aluminum and-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
- S. AWS A2.0—Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- T. AWS A5.4—Stainless Steel Electrodes for Shielded Metal Arc Welding.
- U. AWS D1.1—Structural Welding Code—Steel.
- V. AWS D1.2—Structural Welding Code—Aluminum.
- W. AWS D1.6—Structural Welding Code—Stainless Steel.
- X. ASTM F593—Standard Specifications for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- Y. ASTM F594—Standard Specification for Stainless Steel Nuts.

1.03 DESIGN REQUIREMENTS

- A. All fabrications shall meet applicable code requirements including OSHA.

1.04 SUBMITTALS FOR REVIEW

- A. Comply with pertinent provisions of Section 01 33 00—Submittals.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, sections, elevations, and details where applicable.
- C. Mill Test Reports: Submit indicating structural strength and composition.
- D. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.05 QUALITY ASSURANCE

- A. Fabricate steel members in accordance with AISC Code of Standard Practice.
- B. Welders Certificates: Certify welders employed on the work, verifying AWS qualification within the previous 12 months.

1.06 QUALIFICATIONS

- A. Qualify welding processes and welding operators in accordance with AWS *Standard Qualifications Procedures*.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to job site properly marked to identify the structure for which it is intended and at such intervals to allow uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.
- B. Store all members off the ground using pallets, platforms, or other supports.
- C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures.
- D. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to OWNER.

PART 2-PRODUCTS

2.01 MATERIALS-CARBON STEEL

- A. Steel Sections:
 - 1. ASTM A36 (channels, angles, plates).
 - 2. ASTM A992 (wide flange sections).
 - 3. Pipe: ASTM A53, Grade B.
 - 4. Tubes: ASTM A500, Grade B.
 - 5. Silicon content of steel members to be hot-dipped galvanized shall be in the range of 0 to 0.04%. Submit mill test reports confirming compliance.
- B. Sheet Steel: ASTM A1011.
- C. Plain Washers: Round carbon steel complying with FS FF-W-92.
- D. Bolts, Threaded Rods, and Nuts: ASTM A307 Grade A, or galvanized to ASTM A153 for galvanized components for exterior use and where built into exterior walls.
- E. Lock Washers: Helical spring-type carbon steel complying with FS FF-W-84.
- F. Welding Electrodes: Comply with AWS D1.1. E70XX electrodes for carbon steel. For ASTM A992 steel and any other steel with 50 ksi or greater yield strength, use only E7018 or other E70XX electrodes specifically permitted by AWS D1.1.
- G. Select fasteners for the type, grade, and class required.

2.02 MATERIALS-STAINLESS STEEL

- A. Unless otherwise noted, all stainless steel bars and shapes shall meet the requirements of ASTM A276 and shall be Type 316L.
- B. Unless otherwise noted, all stainless steel bolts shall meet the requirements of ASTM F593 and shall be Type 316L.
- C. Unless otherwise noted, all stainless steel nuts shall meet the requirements of ASTM F594 and shall be Type 316L.

- D. If components are not available in Type 316L, other 300 Series type shall be used as approved by CONSULTANT.
- E. Welding Electrodes:
 - 1. Comply with AWS D1.6.
 - 2. Use ER316L electrodes for 316L stainless steel.
 - 3. Use ER308L electrodes for 304L stainless steel.

2.03 MATERIALS—ALUMINUM

- A. Extruded Aluminum: ASTM B221, Alloy 6061, Temper T6.
- B. Sheet Aluminum: ASTM B209, Alloy 3005.
- C. Aluminum-Alloy Bars: ASTM B211, Alloy 6061, Temper T6.
- D. Bolts, Nuts, and Washers: Steel, galvanized to ASTM A153.
- E. Welding Materials: AWS D1.2; type required for materials being welded.

2.04 ACCESSORIES

- A. Stair Treads: Stair treads for galvanized stairs shall be constructed of nonslip grating and shall have an integral nosing. Treads shall be IKG Industries, or equal, serrated, galvanized swage-locked treads with 1 1/4-inch abrasive nosing.

2.05 FABRICATION

- A. Fabrication and Assembly:
 - 1. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the approved shop drawings.
 - 2. Properly mark and match-mark materials for field assembly and for identification as to structure and site for which intended.
 - 3. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
 - 4. Where finishing is required, complete the assembly, including welding of units, before start of finishing operation.
 - 5. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.
- B. Connections:
 - 1. Bolts and washers of all types and sizes shall be provided for completion of all field erection.
 - 2. Comply with AWS Code for procedures, appearance, and quality of welds used in correcting welded work.
 - 3. Assemble and weld built-up sections to produce true alignment of axes without warp.
 - 4. Welding shall be done by the shielded arc process.
 - 5. All welds shall be chipped, ground smooth, and primed immediately after fabrication.

- C. Workmanship:
1. Use materials of size and thickness shown or, if not shown, of size and thickness to produce strength and durability in the finished product.
 2. Work to dimensions shown or accepted on the shop drawings using proven details of fabrication and support.
 3. Form exposed work true to line and level, with accurate angles and surfaces, and with straight sharp edges.
 4. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing works.
 5. Cap all open ends of pipe and structural tubing.
 6. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush; match and blend with adjoining surfaces.
 7. Provide for anchorage of the type shown. Coordinate with supporting structures. Fabricate and space the anchoring devices to provide adequate support for intended use.
 8. Cut, reinforce, drill, and tap miscellaneous metal work as indicated to receive hardware and similar items.

2.06 MISCELLANEOUS METAL FABRICATION

- A. Metal Stairs:
1. Fit and shop-assemble components in largest practical sections for delivery to site.
 2. Fabricate components with joints tightly fitted and secured.
 3. Supply components for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
 4. Treads and risers for metal pan stairs shall be fabricated with 14 gauge sheet steel, closed risers, treads ready to receive concrete.
 5. Galvanized grating stair treads shall be bolted to stringers with galvanized bolts.
 6. Galvanized safety treads shall be screwed to galvanized carrier angles.
- B. Weirs and Baffles: Weirs and baffles shall be hot-dipped galvanized steel.

2.07 FINISHES

- A. Do not prime surfaces where galvanizing or field welding is required.
- B. Structural Steel Members: Galvanize after fabrication to the requirements in this section and ASTM A123.
- C. Surfaces that will be inaccessible after assembly or erection shall be finish painted prior to assembly or erection.
- D. Galvanizing:
1. All items, except piping designated to be galvanized, shall be hot-dipped galvanized in accordance with ASTM Specification A123 and A153. Piping shall be hot-dipped galvanized in accordance with ASTM A53. Furnish a Certificate of Compliance stating that the galvanizing complies with ASTM Specifications and Standards and all other applicable requirements specified herein.
 2. Fabrication of items to be galvanized shall be in accordance with ASTM A143, A384, and A385. Structural steel shall be fabricated generally in accordance with Class 1

guidelines as shown in *Recommended Details for Galvanized Structures* as published by the American Hot Dip Galvanizer's Association, Inc.

3. Galvanized items shall be handled, transported, and stored to prevent damage or staining to the coating. Maintain adequate ventilation and continuous drainage.
 4. Silicon content for steel to be hot-dipped galvanized shall be in the range of 0 to 0.04%.
 5. Steel work shall be precleaned utilizing a caustic bath, acid pickle and flux, or shall be blast cleaned and fluxed. In either case, all surface contaminants and coatings shall be removed.
 6. All welding shall be performed in accordance with the American Welding Society publication D19.0-72, *Welding Zinc Coated Steel*. All uncoated weld areas shall be touched up.
- E. Aluminum shall have a mill finish unless otherwise specified. Any aluminum in contact with concrete or dissimilar metal shall be coated with multiple coats of bituminous paint, minimum 10 mils dry.

PART 3-EXECUTION

3.01 EXAMINATION

- A. Correct conditions detrimental to the proper and timely completion of the work.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors which are to be embedded in concrete construction.
- B. Coordinate delivery of such items to project.
- C. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

- A. Setting Precast Anchorages:
 1. Clean bearing surfaces free from bond-reducing materials, and roughen to improve bond to surfaces. Clean the bottom surface of bearing plates.
 2. After the bearing members have been positioned and plumbed, tighten and anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
 3. Pack grout solidly between bearing surfaces and plates so that no voids remain.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction including threaded fasteners for concrete inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.
- C. Cutting, Fitting, and Placement:
 1. Perform cutting, drilling, and fitting for installation of miscellaneous metal fabrications.

2. Set work accurately in location, alignment, and elevation and make plumb, level, true, and free from rack measured from established lines and levels.
3. Fit exposed connections accurately together to form tight hairline joints.
4. Weld connections that are not to be left as exposed joints, grind joints smooth, and touchup shop paint coat or galvanizing repair.

D. Weirs and Baffles:

1. Provide watertight splice plates at joints between sections of weirs and baffles.
2. Weirs and baffles shall be installed level with a tolerance of $\pm 1/8$ inch.

3.04 FIELD WELDING

- A. Comply with AWS Code for procedures of manual shielded metal arc welding (steel, stainless steel) and gas metal arc welding (aluminum), appearance and quality of weld made, and methods in correcting welding work.

3.05 TOUCH-UP PAINTING

- A. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting in accordance with Section 09 91 00–Painting.

3.06 GALVANIZING REPAIR

- A. Areas damaged by welding, flame-cutting, or during handling, transport, or erection shall be repaired by one of the following methods whenever damage exceeds 3/16 inch in width.
1. Cold Galvanizing Compound:
 - a. Surfaces to be reconditioned with zinc-rich paint shall be clean, dry, and free of oil, grease, and corrosion products.
 - b. Areas to be repaired shall be power disc-sanded to bright metal. So that a smooth reconditioned coating can be effected, surface preparation shall extend into the undamaged galvanized coating.
 - c. Touch-up paint shall be an organic cold-galvanized compound having a minimum of 94% zinc dust in the dry film.
 - d. The paint shall be spray- or brush-applied in multiple coats until a dry film thickness of 8 mils minimum has been achieved. A finish coat of aluminum paint shall be applied to provide a color blend with the surrounding galvanizing.
 - e. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.
 2. Zinc-Based Solder:
 - a. Surfaces to be reconditioned with zinc-based solder shall be clean, dry, and free of oil, grease, and corrosion products.
 - b. Areas to be repaired shall be wire-brushed.
 - c. Heat shall be applied slowly and broadly close to but not directly onto the area to be repaired. The zinc-based solder rod shall be rubbed onto the heated metal until the rod begins to melt. A flexible blade or wire brush shall be used to spread the melt over the area to be covered. The zinc-based solder shall be applied in a minimum thickness of 2 mils.
 - d. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.

END OF SECTION

SECTION 05 52 00

HANDRAILS AND RAILINGS

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes aluminum handrails, railings, and fittings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A53–Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- B. ASTM B241–Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.

1.03 DESIGN REQUIREMENTS

- A. Railings and handrails shall be designed in accordance with and meet the applicable requirements of the Occupational Safety and Health Act and the applicable International Building Code 2015.
- B. Submit engineering calculations for all rails, posts, and connections demonstrating compliance with the design requirements. Calculations shall be stamped by a Texas Professional Engineer.

PART 2–PRODUCTS

2.01 ALUMINUM RAILING SYSTEM

- A. Provide a mechanically joined pipe railing system, Tabco 2500 Railing System as manufactured by Tuttle Aluminum and Bronze Co. or equal.
- B. Rails shall be ASTM B241, Aluminum Alloy 6063-T6, 6005-T5, or 6105-T5, Schedule 40, 1 1/2-inch-diameter pipe extrusion.
- C. Posts shall be ASTM B241, Aluminum Alloy 6063-T6, 6005-T5, or 6105-T5. Schedule 40, 1 1/2-inch-diameter pipe.
- D. Furnish and install 4-inch by 1/4-inch toeboards where shown or noted on the Drawings, or where required by OSHA 1910.29(k).
- E. Provide expansion joints in railing and toeboards at expansion joints in structures and as necessary to prevent buckling or buildup of stresses. Expansion joints shall occur within 1 foot of posts.

- F. Finished joints shall be smooth.
- G. All rails, posts, toeboards, and connectors shall have a M10C22A41 clear anodized finish.
- H. Posts shall be anchored to the top of walls and decks with a flange base plate. Base plate shall reinforce the bottom end of the post as required to meet OSHA design criteria.
- I. Stainless steel adhesive or expansion bolt anchoring system, in accordance with manufacturer's recommendations, shall be used.
- J. All accessories and connections for aluminum rails and posts shall be aluminum or stainless steel.
- K. Any aluminum in contact with concrete or dissimilar metal shall be coated with multiple coats of bituminous paint, minimum 10 mils dry.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install all railing in accordance with approved shop drawings and manufacturer's instructions providing a complete installation.
- B. Install components plumb and level, accurately fitted, and free from distortion or defects.
- C. Clean all components as recommended by railing manufacturer.

END OF SECTION

SECTION 05 53 00

GRATING

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes floor and stair tread grating.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A123–Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. NAAMM Metal Bar Grating Manual ANSI NAAMM MBG531 and MBG532.
- C. ASTM B221-Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.03 PERFORMANCE REQUIREMENTS

- A. Floor grating and plank shall be designed for a maximum deflection of 1/4 inch when supporting a 100 psf uniform load.

1.04 FIELD MEASUREMENTS

- A. Take all field measurements prior to preparation of shop drawings. Verify that field measurements are as indicated on shop drawings.

PART 2–PRODUCTS

2.01 FLOOR GRATING

- A. All grating, unless otherwise specified, shall be rectangular bar style, swage-locked aluminum floor grating with serrated surface.
- B. Acceptable manufacturers include the following or equal: Harsco Industrial, IKG Type S-19-4-BS.
- C. All edges of the grating and all openings in the grating for pipe and miscellaneous equipment shall be banded by welding on minimum 1/8-inch-thick bars. The band shall have less depth than the bearing bars to permit drainage.
- D. Individual sections shall be of a size to permit ease in handling with a maximum length not in excess of 8 feet. Weight of individual sections shall not exceed 75 pounds.

- E. Where possible, provide a 12-inch-wide section of grating over each stop gate and over each valve operating nut.
- F. All aluminum grating support angles shall be aluminum. Support angles shall be provided at the bearing ends of all grating. This includes locations such as wall openings and corners. Support angles shall also be provided at the nonbearing ends of grating where shown on the Drawings.
- G. For aluminum grating stair treads, refer to Section 05 50 00–Metal Fabrications.
- H. Provide 4-inch by 1/4-inch toeboards anchored to edge of grating at all slide gates in grated areas.

2.02 FINISHES

- A. Protection of Aluminum from Dissimilar Materials:
 - 1. Where aluminum surfaces come into contact with dissimilar metals, surfaces shall be kept from direct contact by painting the dissimilar metal with multiple coats of bituminous paint, minimum 10 mils dry, or other approved insulating material.
 - 2. Where aluminum surfaces come into contact with dissimilar materials such as concrete, masonry, or lime mortar, exposed aluminum surfaces shall be painted with multiple coats of bituminous paint, minimum 10 mils dry, or other approved insulating material.

PART 3–EXECUTION

3.01 EXAMINATION

- A. Verify that opening sizes and dimensional tolerances are acceptable.
- B. Prior to installation, CONTRACTOR shall inspect supports for correct size, layout, and alignment. Any inconsistencies between Contract Drawings and supporting structure deemed detrimental to placement shall be reported in writing to CONSULTANT prior to placement.

3.02 INSTALLATION

- A. Place embedded frames and supports in correct position, plumb and level. Provide blocking as required to maintain alignment of sections.
- B. Seal small gaps between embedded angles at face of wall with backer rod to prevent concrete entry.
- C. All floor grating shall be secured to supporting members with saddle clips supplied by the grating manufacturers. Stud bolts and other hardware shall be supplied by CONTRACTOR.
- D. Install in accordance with shop drawings and standard installation clearances as recommended by the NAAMM Metal Bar Grating Manual.
- E. Cutting, Filling, and Placement:
 - 1. Perform all cutting and fitting required for installation.

2. Cutouts for circular obstructions are to be at least 2 inches larger in diameter than the obstruction. Cutouts for all piping 4 inches or less shall be made in the field.
3. All rectangular cutouts are to be made to the next bearing bar beyond the penetration with a clearance not to exceed bearing bar spacing.
4. Utilize standard panel widths wherever possible.

END OF SECTION

SECTION 05 56 00

ANCHOR BOLTS AND POST-INSTALLED ANCHORS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Anchor bolts, expansion bolts, adhesive anchors, and screw anchors.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
- B. ASTM F1554—Anchor Bolts, Steel, 36, 55, and 105-ksi yield strength.
- C. ICC-ES International Code Council—Evaluation Service.
- D. AC 193—Acceptance Criteria for Mechanical Anchors in Concrete Elements.
- E. AC 308—Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete.
- F. ACI 355.2—Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary.
- G. ACI 355.4—Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary.

PART 2—PRODUCTS

2.01 GENERAL

- A. Unless indicated otherwise on the Drawings or specified, use the following bolt material for the various installation situations:
 - 1. Stainless Steel: For all submerged locations, below final grade, and in contact with aluminum appurtenances and other items not to be painted. Also for anchoring equipment, unless otherwise specified.
 - 2. Steel: In other locations in contact with items to be painted or encased in concrete.

2.02 ANCHOR BOLTS

- A. Anchor bolts complete with washers and nuts shall be fabricated as shown or as specified by the equipment manufacturer and unless otherwise indicated shall be hot-dip galvanized carbon steel or 316 stainless steel. Anchor bolts shall, as a minimum, conform to the requirements of ASTM F1554-Grade 36.
- B. Stainless steel anchor bolts shall be used in all submerged locations, below final grade, and in contact with aluminum and other items not to be painted. Galvanized anchor bolts shall be used elsewhere.

2.03 EXPANSION BOLTS

- A. Expansion bolts shall be KWIK Bolt TZ by Hilti, Inc., Power-Stud+ SD2, SD4, or SD6 by DeWalt, Strong-Bolt or Strong-Bolt 2 by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All expansion bolts shall comply with the International Building Code 2015, AC 193, and ACI 355.2. They shall be ICC-ES approved for use in cracked and uncracked concrete.
- C. Expansion bolts will not be permitted as substitutes for embedded anchor bolts except with the prior written acceptance of CONSULTANT or where otherwise specifically called for.

2.04 ADHESIVE ANCHORS

- A. Adhesive anchors shall be HIT HY 200 by Hilti, Inc., Red Head C6+ or Red Head A7+ by ITW, Pure 110+ or AC200+ by DeWalt, Set-XP by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All adhesive anchors shall comply with the International Building Code 2015, AC 308, and ACI 355.4. They shall be ICC-ES approved for use in cracked and uncracked concrete.

2.05 SCREW ANCHORS

- A. Screw anchors shall be KWIK HUS-EZ by Hilti, Inc., Screw-Bolt by DeWalt, Titen-HD by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All screw anchors shall comply with the International Building Code 2015. They shall be ICC-ES approved for use in cracked and uncracked concrete.

PART 3-EXECUTION

3.01 ANCHOR BOLTS

- A. Anchor bolts for structural members shall be located as shown and specified.
- B. Anchor bolts for mechanical equipment shall have embedment length, edge distances, and spacing as required by the equipment manufacturer.
- C. All dirt or foreign materials shall be removed prior to embedding into concrete. After anchor bolts have been embedded, their threads shall be protected by grease and by installing the nuts or by other means until the time of installation of the equipment or metal work.

3.02 EXPANSION BOLTS

- A. Unless otherwise noted on the Drawings, expansion bolt edge distance and spacing shall be in accordance with manufacturer's printed installation instructions.
- B. Bolt embedment shall at least equal 6-bolt diameters.

- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.
- D. Where location of bolts is adjustable, reinforcing steel shall be located prior to drilling holes and bolts shall be located to clear reinforcing steel.

3.03 ADHESIVE ANCHORS

- A. At locations shown on the Drawings, reinforcing bars or threaded rod shall be provided in existing concrete by drilling holes, injecting epoxy adhesive, and inserting the reinforcing bar.
- B. All existing surfaces to receive adhesive anchors, including the entire area in contact with the new concrete, shall be cleaned and roughened to amplitude of 1/4 inch.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.
- D. Adhesive anchors shall be installed in concrete having a minimum age of 21 days at the time of installation.
- E. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and anchors shall be located to clear reinforcing steel.
- F. CONTRACTOR shall arrange an anchor manufacturer's representative to provide on-site installation training for installation of their adhesive anchor system products. Submit documentation that all CONTRACTOR's personnel or subcontractors who install adhesive anchors have been trained prior to the announcement of anchor installation.

3.04 SCREW ANCHORS

- A. Unless otherwise noted on the Drawings, screw anchor edge distance and spacing shall be in accordance with manufacturer's recommendations.
- B. Anchor embedment shall at least equal 6-bolt diameters.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.
- D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and anchors shall be located to clear reinforcing steel.

END OF SECTION

SECTION 09 91 00

PAINTING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Surface preparation and application of paints and coatings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
 - 1. Payment Procedures: All associated work shall be included in the Lump Sum Bid.

1.02 REFERENCES

- A. AMPP—Association for Materials Protection and Performance.
- B. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
- C. ASTM D2247—Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
- D. ASTM D3363—Standard Test Method for Film Hardness by Pencil Test.
- E. ASTM D4060—Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- F. ASTM D4541—Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- G. ASTM D4585—Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.
- H. Federal Register—Code of Federal Regulations (CFR).
- I. Federal Register—Resource Conservation and Recovery Act (RCRA).
- J. Federal Register—Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).
- K. ICRI—International Concrete Repair Institute.
- L. NACE—National Association of Corrosion Engineers.
- M. SSPC—The Society for Protective Coatings—Steel Structures Painting Manual.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00—Submittals.

- B. Shop primer proposed for use shall be submitted with all material and equipment submittals. All shop primers shall be of the same generic type and quality as those specified herein.
- C. Submit manufacturer's Safety Data Sheets (SDS) for each type of paint with each shop drawing submittal. SDS sheets shall be posted at the construction site at all times painting is in progress.
- D. Substitution submittals shall include performance test data, as certified by a qualified testing laboratory, for the ASTM tests specified in Paragraph 2.01.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: All paints, surface preparation, and application methods shall conform to federal requirements for allowable exposure to lead and other hazardous substances.
- B. Prepainting Meeting:
 - 1. A prepainting meeting shall be held immediately following the project preconstruction conference. The prepainting meeting is to be held prior to any material and equipment that requires painting is delivered to the site.
 - 2. CONTRACTOR, the paint subcontractor, and the paint manufacturer's representative shall be present to review the specifications and project scope.
 - 3. The paint manufacturer's representative shall review progress at the site as requested by CONSULTANT. These are generally expected to be prior to monthly progress meetings.

1.05 FIELD QUALITY CONTROL

- A. Furnish testing apparatus as applicable for observing surface preparation, testing atmospheric conditions and testing coatings, prior to beginning surface preparation. Provide the following apparatus:
 - 1. One set of U.S. Department of Commerce thickness calibration plates, certified by the National Bureau of Standards, to test dry film thickness.
 - 2. One wet-film thickness gauge.
 - 3. One dry-film thickness gauge, Mikrotest III, 0 to 40 mils with calibration standard approved by the Bureau of Standards.
 - 4. One Bacharach Sling Psychrometer, Model 12-7011.
 - 5. Tinker and Razor Model M-1 Holiday Detector and recommended wetting agent.
 - 6. One set of SSPC-VIS 1-89 Visual Standards for Abrasive Blast Cleaned Steel.
- B. Provide access via scaffolding or staging for inspection.
- C. Entire surface of coated submerged concrete shall be tested with holiday detector. Mark and repair all pinholes, then retest until no pinholes are found.
- D. CONTRACTOR shall provide documentation to CONSULTANT of conditions before and during painting operations for each area and each day's work. Documented conditions shall include the following at a minimum: date, area of work, system used, preparation methods, environmental conditions, quantity and thickness of coating placed, noted conditions, and nonconforming items. CONSULTANT can provide sample report form if CONTRACTOR does not have their own.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the site in original containers with labels intact and seals unbroken.
- B. Drop cloths shall be used in all areas where painting is done to fully protect other surfaces.
- C. Oily rags and waste must be removed from the building each night or kept in an appropriate metal container.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. CONTRACTOR shall dry-heat, dehumidify, and ventilate to obtain painting conditions recommended by the paint manufacturer during surface preparation, application, and cure.
- B. Relative humidity conditions as specified by the paint manufacturer's data sheet shall be adhered to. This includes times in which supplemental heat is used. Supplemental heat shall be indirect-fired hot air furnaces or electric heat. Open-flame heaters shall not be used.
- C. No unprotected, unheated exterior painting shall be undertaken when damp weather appears probable, nor when the temperature of the substrate is below 55°F, unless approval in writing is received from the paint manufacturer.

1.08 COLOR SELECTIONS

- A. Provide color charts for all coatings being used on the project. After initial selection of colors by OWNER, provide draw down samples of selected colors for OWNER's final approval. For stained wood, provide specified wood species sample with selected color for final approval.
- B. CONTRACTOR shall provide a summary sheet at the completion of the project listing the finish paint products used and the manufacturer's color identification for each item painted. This summary sheet should be submitted to CONSULTANT and OWNER for review.

PART 2—PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. All materials required for painting shall be types and quality as manufactured by Tnemec Company, Inc., Sherwin-Williams Company, Carboline, PPG Protective and Marine Coatings, or equal, unless noted otherwise in the schedule.
- B. Where thinning is necessary, only the products of the manufacturer furnishing the paint will be allowed. All such thinning shall be done strictly in accordance with the manufacturer's instructions.
- C. Paint and paint products of Tnemec Company and Sherwin-Williams, listed in the following specifications, are set up as standard of quality. Carboline and PPG Protective and Marine Coatings have preapproved equivalent products that shall be used. Other manufacturer's products will be considered as a substitution if CONTRACTOR and paint manufacturer certify that the products offered are recommended for the service intended, are compatible with the shop primers used, are equal in solids content and composition, and are of the same

type. Submittal shall include the following performance data as certified by a qualified testing laboratory. ASTM Specifications shall be the latest revision:

1. Abrasion–ASTM D4060, CS-17 Wheel, 1,000 grams load.
2. Adhesion–ASTM D4541.
3. Hardness–ASTM D3363.
4. Humidity–ASTM D2247 and D4585.
5. Salt (Fog) Spray–ASTM B117.

PART 3–EXECUTION

3.01 SURFACE PREPARATION

A. General:

1. All surfaces to be painted shall be prepared as specified herein and by the manufacturer's published data sheet and label directions. The objective shall be to obtain a uniform, clean, and dry surface.
2. No field painting shall be done before the prepared surfaces are observed by CONSULTANT. Surfaces painted without such observation shall be abrasive-blast-cleaned and repainted.
3. Prior to field-blasting, a sample of the blast abrasive shall be provided to CONSULTANT for pH testing. Additional samples of subsequent deliveries or batches of blast abrasive shall be provided to CONSULTANT for pH testing.
4. For on-site abrasive-blasting, low-dust, low-silica content material shall be used. Coal slag abrasive shall be used on pipe and ferrous materials. Staurolite abrasive shall be used on concrete and concrete block.
5. Quality of surface preparations listed below are considered a minimum. If paint manufacturer requires a better preparation for a particular application, it shall be considered a requirement of this specification.
6. All concrete surfaces shall be tested for moisture in accordance with ASTM D4263 and, if necessary, F1869. Surfaces shall also be verified that the pH of the cleaned concrete surface to be coated is within the range of 8 to 11.

B. Ferrous Metal:

1. All ferrous metal to be primed in the shop shall have all rust, dust, and mill scale, as well as all other foreign substances, removed by abrasive blasting. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting.
2. All ferrous metals not primed in the shop shall be abrasive-blasted in the field prior to application of the primer, pretreatment, or paint.
3. Abrasive blasting of metals in the shop shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for immersion service shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for nonimmersion service shall be in accordance with SSPC-SP6 Commercial Blast Cleaning.
4. Solvent cleaning in accordance with SSPC-SP1 shall precede all abrasive-blasting operations.
5. Ductile iron pipe shall be prepared by abrasive blasting per National Association of Pipe Fabricators NAPF 500-03-04 Abrasive Blast Cleaning.
6. Prior to finish coating, all primed areas that are damaged shall be cleaned and spot-primed.

- C. Galvanized: Where galvanized items are not submerged or buried, they shall be cleaned with nonhydrocarbon solvent cleaner (such as Clean N Etch, or equal) in accordance with SSPC-SP1 and shall be abrasive-blasted in accordance with SSPC-SP16 Brush-Off Blast Cleaning.
- D. Copper: Where copper piping is not submerged or buried, it shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.
- E. PVC and CPVC: All PVC and CPVC to be painted shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.
- F. Aluminum: Where listed in the Schedule to be painted, it shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.

3.02 APPLICATION

- A. All materials shall be used as specified by the manufacturer's published data sheets and label directions.
- B. No paint shall be applied on a wet or damp surface and in no case until the preceding coat is dry and hard. Each coat shall be allowed to dry in accordance with manufacturer's data sheets before the next coat is applied.
- C. Drying time shall be construed to mean "under normal conditions." Where conditions are other than normal because of the weather or because painting must be done in confined spaces, other drying times will be necessary.
- D. Additional coats of paint shall not be applied, nor shall units be returned to service until paints are thoroughly dry and cured.
- E. Steel that will be inaccessible in the completed work shall receive the final coat before enclosure.
- F. Paint shall be applied to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable. Tops and bottoms of walls and areas that are "cut-in" by brush prior to rolling shall have a uniform appearance in comparison with adjoining surfaces.
- G. Concrete block walls shall be back-rolled to achieve a pinhole-free surface coat.
- H. Walls and ceiling surfaces shall receive a minimum of one coat of paint before surface-mounted items such as conduits, boxes, piping, etc., are installed on these surfaces.
- I. Crevices and other hard-to-apply areas shall be back-rolled/back-brushed in conjunction with application of the first field coat of primer or intermediate coat. This includes, but is not limited to, between pipe flanges, pipe flange/pipe barrel joints, equipment fittings, and other narrow openings.
- J. For PVC and CPVC piping, unions and valves shall not be painted.

- K. No field coating of paint shall be applied to ductile iron piping until the piping has been tested, the pipe gaps or joints have been caulked, and the caulk has fully cured, as specified in Section 40 05 00–Piping and Appurtenances.

3.03 FIELD QUALITY CONTROL

- A. Examination of work on the site by the manufacturer's representative shall be performed when requested by CONSULTANT.

3.04 CLEANING

- A. All stains and marks shall be removed from other surfaces upon completion of the work.

3.05 SCHEDULE

A. General:

1. At the completion of the project, all painted surfaces which have been damaged shall be repainted or touched-up.
2. See Finish Schedule on the Drawings for an additional reference for areas to be painted.
3. The painter shall use some discretion in what should and should not be painted. Do not paint over labels and other information, bronze, machined surfaces, moving parts where painting may impair movement, hot surfaces which may peel, etc. If in doubt whether a part should be painted, ask CONSULTANT.
4. Products listed first are Tnemec and second are Sherwin-Williams.

B. New Work:

1. All new work done by all trades shall be painted by CONTRACTOR in accordance with the following schedule and in accordance with paint manufacturer's recommendation. It is the intent of these specifications that all non-galvanized ferrous metal items scheduled for painting be shop-primed. If items are not shop-coated, surfaces shall be prepared and painted in the field as specified. If any items of new construction are not listed, CONTRACTOR shall request paint system from CONSULTANT, and the items shall be painted as part of this Contract without additional cost.
2. Cast or ductile iron, tar coated; buried: Not painted.
3. Cast or ductile iron, submerged:
 - a. One shop coat Series 1 Omnithane (N69-1255 Epoxoline), Dura-Plate 235 Beige as primer.
 - b. Touch-up prime coat prior to finish coating and one stripe coat on all edges of N69 Epoxoline, Dura-Plate 235.
 - c. Two coats of Series N69-Hi-Build Epoxoline II, (one coat) Sher-Glass FF.
4. Steel, machinery, and equipment; not submerged (including pipes to be insulated):
 - a. One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Fast Cure Beige as primer.
 - b. Touch-up primer prior to finish coat, and either:
 - (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 Fast Cure for interior surfaces; or
 - (2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646 Fast Cure; and one coat of 1094 Endura-Shield, Acrolon 218HS for exterior surfaces.
5. Motors, gear drives, and doors delivered with nonepoxy primers:
 - a. Degrease per SSPC-SP1.
 - b. Lightly hand-sand per SSPC-SP2.
 - c. Apply one coat 135-1255 Chembuild Beige, Macropoxy 646 Fast Cure Beige.

- d. Apply two finish coats as follows:
 - (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 Fast Cure for interior surfaces, or
 - (2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646 Fast Cure, and one coat of 1094 Endura-Shield, Acrolon 218HS for exterior surfaces.
 6. Steel, machinery, and equipment, submerged:
 - a. One shop coat Series 1 Omnithane (N69-1255 Epoxoline), Dura-Plate 235 Beige as primer.
 - b. Touch-up prime coat prior to finish coating, and one stripe coat on all edges of N69 Hi-Build Epoxoline, Dura-Plate 235.
 - c. Two coats of N69 Hi-Build Epoxoline, (one coat) Sher-Glass FF.
 7. Galvanized (except for walkway grating and frame), copper, brass, CPVC, and PVC; not submerged or buried:
 - a. Two coats of N69 Hi-Build Epoxoline, Macropoxy 646 Fast Cure for interior surfaces, or
 - b. One coat of N69 Hi-Build Epoxoline, Macropoxy 646 Fast Cure, and one coat of 1094 Endura-Shield, Acrolon 218HS for exterior surfaces.
 - c. For galvanized items that are embedded in construction, provide one coat before installing.
 8. Insulation of equipment, pipes, and ductwork:
 - a. Two coats of Series 1029 Endurotone, DTM Acrylic.
 - b. Colored PVC jacketing shall not be painted.
 9. Galvanized, copper, CPVC, and PVC; submerged or buried: Not painted.
 10. Aluminum items:
 - a. Exposed areas of structural items such as railings and grating shall not be painted.
 - b. For structural items in contact with concrete, see Division 05.
 11. Stainless steel: Not painted.
 12. Steel and Ductile Iron Insulated Coating Systems:
 - a. Tnemec Products:
 - (1) Primer coat shall be Tnemec Series 94-H20 Hydro Zinc.
 - (2) Two intermediate coats shall be Tnemec Series 971 Aerolon.
 - (3) Finish coat shall be Tnemec Series 1028T Enduratone HDP.
 - b. Sherwin Williams Products:
 - (1) Primer coat shall be Corothane I Galvapac 1K.
 - (2) Five Intermediate Coats shall be Heat-Flex[®] Hi-Temp 3500.
 - (3) Two finish coats shall be Shercryl HPA.
 - c. All finish colors selected by OWNER.
 - d. If equipment to be coated does not have a zinc-rich shop primer coating option, CONTRACTOR shall either surface prepare area as necessary or provide manufacturer recommended tie-coat.
- C. Existing Areas: Existing areas damaged by removal of existing work and/or installation of new work shall be repainted to match existing and in accordance with the schedule for new work. Existing equipment and structures shall be painted in accordance with the following schedule and as listed in the Finish Schedule, or as noted on the Drawings.
1. PVC and plastic piping:
 - a. Hand sand.
 - b. Solvent clean.
 - c. Coat in accordance with item 12 of new work.
 2. Ductile iron piping:
 - a. Remove existing coating and prepare as specified.
 - b. Coat in accordance with items 6 or 8 of new work with shop primer replaced by field primer.

3. Cast-in-Place Concrete Walls which remain exposed and are currently painted.
 - a. Prepare as specified.
 - b. Coat in accordance with items 4 or 5 of new work.
 4. Final Clarifiers No. 1, 2, all existing steel and ductile iron (see Section 46 43 22–Final Clarifier Collectors):
 - a. Remove aluminum handrails and grating prior to preparation. Protect all equipment prior to preparation.
 - b. Abrasive blast to remove all existing coating as specified.
 - c. Field paint as required for new items.
- D. Coverage:
1. Dry mil thickness shall conform to those specified. Mil test measurement shall conform to SSPC Steel Structures Painting Manual. Dry Film Thickness (DFT) shall be verified in accordance with SSPC-PA2.
 2. The coatings listed will provide the mil thickness given when applied at the coverages listed. Upon the request of CONSULTANT, such surfaces shall be checked by the painter with a calibrated mil thickness gauge and any deficiencies found in the film shall be remedied by additional coat(s) at the expense of CONTRACTOR.
 3. On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative pinhole-free finish either by decreasing the coverage rate or by applying additional coats of paint.
 4. Coverages reflect manufacturer's recommendations using spray application techniques. Where brushing or rolling is specified or performed at the discretion of the painter, one additional coat, minimum, will be required to achieve total DFT as specified and recommended by the manufacturer.

	Min. Sq. Ft.** Coverage	Min. Dry Mil** Thickness Per Coat
Products		
1029 Endurotone, DTM Acrylic	200	
N69 Hi-Build Epoxoline II, Macropoxy 646 Fast Cure		
Steel or Impervious Substrate Primer Coat	---	4.0
Steel or Impervious Substrate Intermediate Coat(s)	---	5.0
Steel or Impervious Substrate Finish coat	---	5.0
135-1255 Chembuild, Macropoxy 646 Fast Cure	335	4.0
Steel Doors	---	3.0
20HS Pota-Pox, Macropoxy 646 Fast Cure		
Steel or Impervious Substrate Primer	---	4.0
Steel or Impervious Substrate Intermediate Coat(s)	---	5.0
Steel or Impervious Substrate Finish Coat	---	5.0
1094 Endura-Shield II, Acrolon 218HS	---	2.5
201 Epoxoprime, ArmorSeal 1000 HS Epoxy	250	
280 Tneme-Glaze, ArmorSeal 1000 HS Epoxy	250	
Epoxoblock WB 1254, Kem Cati-Coat HS	80	
N69 Hi-Build Epoxoline, Macropoxy 646 Fast Cure (Masonry and Concrete)	250	
Series 1 Omnithane, DuraPlate 235 (Primer)		3.0, 5.0
N69 Hi-Build Epoxoline II (Submerged)		6.0
Sher-Glass FF (Submerged)		12.0
Macropoxy 5500 LT (potable water system)		
Stripe Coat	---	5.0

	Min. Sq. Ft.** Coverage	Min. Dry Mil** Thickness Per Coat
Tnemec Series 94-H20, Sherwin Williams Corothane I Galvapac 1k		
Potable Water System Primer	---	3.0
Insulating Coating System Primer	---	3.0
Tnemec Series 21,		
Potable Water Stripe and Finish Coat	---	12.0
Sherwin Williams SherPlate 600		
Potable Water Intermediate and Finish Coats	---	6.0
Tnemec Series 1224 Epoxoline		
Insulating Coating Tie-Coat	---	6.0
Tnemec Series 971 Aerolon		
Insulating Coating	---	50.0
Tnemec Series 1028 Enduratone		
Insulating Coating Topcoat	---	3.0
Sherwin Williams Heat-Flex® Hi-Temp 3500		
Insulating Coating	---	20.0
Sherwin Williams Shercryl HPA		
Insulating Coating Topcoat	---	3.0
Sherwin-Williams Products		
ProMar 200 Primer (sprayed)	200	
ProMar200 Primer (rolled/brushed)	260	
ProMar 200 Enamel (sprayed)	280	
ProMar 200 Enamel (rolled/brushed)	360	

** Roller or brush application requires two or more coats to obtain recommended film thickness. No allowance is made here for overspray, waste in handling, mixing, or application. Final, minimum total DFT shall be equal to that specified. Paint submittals shall note where roller or brush application is proposed and the paint manufacturer's recommendations of number of coats to achieve the required thickness shall be noted.

Primer, intermediate and/or final surface colors shall be of contrasting colors to promote coverage.

- E. Pipe Colors: Colors are to be selected by OWNER, with the following piping colors used where applicable. Pipe color shall be in accordance with the requirements of the Texas Administrative Code.

Pipe Type	WASTEWATER PIPING COLORS
	TX 30 TAC Chapter 217.329
Raw sludge line	-
Sludge recirculation suction line	-
Sludge drawoff line	-
Sludge recirculation discharge line	-
Liquid Alum	Yellow with orange bands
Alum	Yellow with green bands

Pipe Type	WASTEWATER PIPING COLORS
	TX 30 TAC Chapter 217.329
Sludge	Brown
Biogas	-
Natural gas	Red
Potable water	Light Blue
Chlorine	Yellow
Sulfur dioxide	Lime Green with yellow bands
Sewage (wastewater)	Gray
Compressed air	Light Green
Instrument air	Light Green with dark green bands
Heating hot water (buildings or digesters)	Blue with 6-inch red bands spaced 30 inches apart
Fuel oil	-
Plumbing drains and vents	-
Polymer	White with green bands
Ozone	Stainless steel with white bands
Nonpotable water	Purple and stenciled "Non-Potable Water"
Raw Water	Tan
Effluent after clarification	Dark Green
Ferric Chloride	Brown with red bands
Ferric Sulfate	Brown with yellow bands
Electrical Conduit	In compliance with the National Electrical Code

Pipe Type	WATER PIPING COLORS
	TX 30 TAC Chapter 290.42
Water Lines	
Raw	Tan
Settled or Clarified	Green
Finished or Potable	Light blue
Chemical Lines	
Alum	Yellow with green bands
Ammonia	Yellow with brown bands
Carbon slurry	-
Caustic soda	White with orange bands
Chlorine (gas)	Yellow
Chlorine (solution)	Yellow with red bands
Chlorine dioxide	Yellow with blue bands
Ferric chloride	Brown with red bands
Ferric sulfate	Brown with yellow bands
Fluoride	White with yellow bands
Lime slurry	-
Liquid alum	Yellow with orange bands
Liquid caustic	White with red bands
Ozone	Stainless steel with white bands
Phosphate compounds	-
Polymers or coagulant aids	White with green bands
Potassium permanganate	-
Sods ash	-

Pipe Type	WATER PIPING COLORS
	TX 30 TAC Chapter 290.42
Sulfuric acid	-
Sulfur dioxide	-
Waste Lines	
Backwash supply	Light Blue
Backwash waste	Dark Gray
Drain	Dark Gray
Filter effluent	Light Blue
Sludge	-
Sewer (sanitary or other)	-
Other Lines	
Compressed air	Light green
Gas	-
Other lines	-
Instrument air	Light green with dark green bands

Section 653.120 Piping Identification:

- 1) Piping in a water treatment facility shall be identified clearly by legends and color coding as described in the Standards or American National Standards Institute (ANSI) Standard A-13.1. A consistent standard shall be used throughout the system.
 - 2) Potable water lines shall be clearly and permanently identified where dual water lines or pressure sewer systems exist.
- F. Shop Finish Painting: The following items shall have factory-applied finishes and will not require field painting. CONTRACTOR shall field touch-up any damaged areas with factory-provided touch-up coating. Clarifiers (center pier bolt template, bottom seal ring, manifold and center pier).

END OF SECTION

SECTION 22 13 29
SUBMERSIBLE PUMPS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Scum pumps.
- B. Related Sections and Divisions: Applicable provisions of Division 01 govern work under this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New start-up shall be for the purpose of determining alignment, lubrication, voltage, and amperage readings. Proper electrical connections, pump rotation, discharge, and gauge readings shall be noted on start-up report. A copy of the start-up report shall be made and sent to both the CONTRACTOR and to the CONSULTANT.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.
- C. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- D. Submit manufacturer's installation instructions.
- E. Include project specific wiring diagrams for motor panel. Submittals must be specific to this project. Generic submittals will not be accepted.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.
- B. Include replacement and spare parts lists.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization or Substantial Completion of the project.

PART 2-PRODUCTS

2.01 PLUMBING EQUIPMENT

- A. Sewage Ejector and Dewatering Pumps:
 - 1. Manufacturers: Submersible sump pumps shall be manufactured by Hydromatic (H), Myers (M), PACO (P), Zoeller (Z), or equal. Furnish and install complete sump pump systems as shown on the drawings and specified herein. The complete system shall include pumps, electric controls, level controls, and all accessories.
 - 2. Drawings were prepared based on Hydromatic. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes, including CONSULTANT's changes, to accommodate the other Base Bid equipment including, but not limited to, structural, mechanical, and electrical work.
 - 3. Schedule:

Pump No.	Model No.	Capacity (gpm)	TDH (ft)	Discharge Diameter	RPM	Voltage	Phase	HP
SCMP-40-01	SPD50H	50	30	2"	3450	480	3	1/2
SCMP-40-02	SPD50H	50	30	2"	3450	480	3	1/2

4. Type: Submersible pumps shall be constructed of epoxy-coated cast iron shell, cast iron volute, two-vane enclosed semiopen or recessed vortex nonclog cast iron pump. Impeller shall be cast iron with a stainless steel shaft and stainless steel fasteners and have upper and lower ball bearings. Pump shall be oil-lubricated or factory-sealed grease lubricated with a ceramic mechanical seal. Pump shall be capable of passing 1 1/2-inch solids.
5. Motors: The motor shall be submersible-type, ball-bearing design, and oil-filled with built-in thermal overload protection sized for nonoverloading over the entire pump curve. Motor housing shall be filled with dielectric pure, clean insulating oil. Motor shall have precision mechanical seal to prevent leakage into the housing. Seal faces shall be carbon and ceramic, super lapped for long leakproof life. Power cord and float switch cords shall be provided in lengths adequate to reach the control panel as provided by pump manufacturer. Pump motor shall be nonoverloading over the entire curve. Stainless steel kelling grips shall be provided for support of pump and float cables.
6. Controls:
 - a. Electrical components specified within this section shall be provided in accordance with Division 26—Electrical Specifications. All electrical equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 26.
 - b. Control Panel (MCP-40): A wall-mounted NEMA 4X control panel with controls as indicated below shall be furnished. The control panel shall include combination starters for each pump, circuit breakers for each pump, H-O-A switches, green “Run,” and red “Fail” LED push-to-test indicating lights for each pump, elapsed time meters for each pump, red “HWL” LED push-to-test indicating light, and a duplex alternator. The alternator shall have a three-position selector switch to select either pump as the lead pump or auto alternation of the two pumps. Provide red beacon and horn for indication of high water level.
 - c. Auxiliary Contact(s): There shall be an auxiliary contact from the HWL alarm signal for remote indication at the future SCADA System.
 - d. Float(s): Level sensing shall be by mercury-free float switches, one each for pump ON, one for common pumps OFF, and one for HWL alarm at each station provided.
7. Accessories:
 - a. Rails: Dual stainless steel liftout guide rails with stainless steel wall, pump and sump brackets. Provide bronze and neoprene quick-disconnect fitting and corrosion-proof pull chain or cable.
 - b. Piping: Provide dual check valves, full port ball valves, union or flange for each pump discharge, and flexible connectors.
 - c. Explosion proof Class I, Division 1, Groups C and D motor.
 - d. Provide intrinsic safety barriers for float switches to be wired intrinsically safe.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Plumbing system shall be installed in accordance with local plumbing requirements and applicable portions of the 2006 International Plumbing Code. Where requirements conflict, the stricter standard shall apply.
- B. Install all piping, conduit, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the general contractor, making sure that access is available for all equipment and specialties. Where

access is required in plaster walls or ceilings, furnish the access doors to the general contractor.

- C. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, ductwork, conduit, and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.
- D. Startup and test equipment adjusting operating and safety controls for proper operation.
- E. Install pumps in accordance with manufacturer's instructions. Set level and plumb.
- F. Test fixtures to demonstrate proper operation. Replace malfunctioning units or components.
- G. Provide isolation valves at plumbing equipment.

3.02 TESTING AND CLEANING

- A. General:
 - 1. The water used for tests shall be obtained from a potable source of supply.
 - 2. Prepare testing reports. If testing is performed in segments, submit separate report for each segment, complete with diagram or clear description of applicable portion of piping. After testing has been accepted for portions thereof, certify in writing the time, date, name, and title of the persons reviewing the test. This shall also include the description of what portion of the system has been accepted. A complete record shall be maintained of all testing that has been accepted and shall be made available at the jobsite. Upon completion of the work, all records and certifications regarding testing shall be submitted to CONSULTANT before final payment is made.
 - 3. Gauges used for testing shall have increments as follows:
 - a. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
 - b. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
 - c. Tests requiring a pressure of greater than 100 psi shall use a testing gauge having increments of 2 psi or less.
 - 4. Defective work or material shall be reworked and replaced and test repeated. Repairs shall be made with new materials. Pipe dope, caulking, tape, dresser couplings, etc., shall not be used to correct deficiencies.
 - 5. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

END OF SECTION

SECTION 26 05 00

GENERAL ELECTRICAL REQUIREMENTS

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes general requirements for all electrical work.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this section.

1.02 REFERENCES

- A. ANSI/NFPA 70—National Electrical Code (NEC).
- B. ANSI/IEEE C2—National Electrical Safety Code.

1.03 CONTRACT DOCUMENTS

- A. Any equipment roughed in improperly and/or not positioned on implied centerlines or as dictated by good practice shall be repositioned at no cost to OWNER.
- B. The Drawings are generally diagrammatic, and CONTRACTOR shall coordinate the Work so that interferences are avoided. Provide all offsets in conduit, fittings, etc., necessary to properly install the work. All offsets, fittings, etc., shall be provided without additional expense to OWNER.
- C. Hazardous or classified locations, where referenced in the Specifications or on the Drawings, shall be as defined in the NEC.

1.04 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 70.
- B. Conform to ANSI/IEEE C2.
- C. The rules and regulations of the federal, state, local, and civil authorities and utility companies in force at the time of execution of the Contract shall become a part of this specification.
- D. Obtain electrical permits and inspections from authority having jurisdiction. Costs for permits and inspections shall be paid by CONTRACTOR.

1.05 CODES AND ORDINANCES

- A. CONTRACTOR is expected to know or to ascertain, in general and in detail, the requirements of all codes and ordinances applicable to the construction and operation of systems covered by this Contract. CONTRACTOR shall know or ascertain the rulings and

interpretations of code requirements being made by all authorities having jurisdiction over the work to be performed by them.

- B. In preparing a Bid, CONTRACTOR shall include the cost of all items and procedures necessary to satisfy the requirements of all applicable codes, ordinances, and authorities, whether or not these are specifically covered by the Drawings and Specifications. All cases of apparent conflicts between the Drawings, Specifications, and codes shall be brought to CONSULTANT's attention, as herein before specified. CONTRACTOR shall carry out work and complete construction as required by applicable codes and ordinances and in such a manner as to obtain approval of all authorities whose approval is required.
- C. When requested by CONSULTANT, CONTRACTOR shall provide written calculations to show compliance with applicable codes or the Contract Documents. This shall include, but not be limited to, conduit and wire sizing, junction and pull box fill and sizing, conductor derating, and voltage drop. CONTRACTOR shall indicate calculation method used as well as compliance with applicable code, drawing, or specification.

1.06 EQUIPMENT PROVIDED UNDER OTHER DIVISIONS

- A. Included in this Contract are electrical connections to equipment provided under other divisions. CONTRACTOR shall refer to final shop drawings for equipment being furnished under other divisions, for exact location of electrical equipment, and the various connections required.

1.07 ELECTRICAL DISTRIBUTION SYSTEM

- A. Provide a complete electrical distribution system consisting of components indicated on the Drawings or specified herein including, but not limited to:
 - 1. Feeders, branch wiring, and electrical distribution equipment.
 - 2. All control wiring.
 - 3. Access panels and access doors for access to equipment installed by Division 26.
 - 4. Wiring between system components if equipment is not prewired.
 - 5. Lighting fixtures, lighting controls, and associated wiring.
 - 6. Support system design and supports for electrical raceways.
 - 7. Code-required disconnects.
- B. CONTRACTOR shall connect all equipment furnished by other Divisions consisting of components indicated on the Drawings or specified herein.
- C. Provide balancing and adjusting of electrical loads.
- D. CONTRACTOR shall instruct OWNER's representative in the operation and maintenance of all equipment. The instruction shall include a complete operating cycle on all apparatus.
- E. Provide miscellaneous items for a complete and functioning system as indicated on the Drawings and specified herein.
- F. A partial list of work not included in Division 26 is as follows: Painting (except as otherwise specified herein).

1.08 NOISE

- A. Eliminate any abnormal noises that are not considered by CONSULTANT to be an inherent part of the systems as designed. Abnormal buzzing in equipment components will not be acceptable.

1.09 DRAWINGS

- A. The Drawings indicate approximate locations of the various items of the electrical systems. These items are shown approximately to scale and attempt to show how these items should be integrated with building construction. Locate all the various items by on-the-job measurements in conformance with Contract Documents and cooperation with other trades.
- B. Prior to locating equipment, confer with CONSULTANT as to desired location in the various areas. In no case should equipment locations be determined by scaling drawings. Relocate equipment and bear cost of redoing work or other trades' work necessitated by failure to comply with this requirement.
- C. In certain instances, receptacles, switches, light fixtures, or other electrical devices and equipment, etc., may be relocated. Where relocation is within 10 feet of location shown on the Drawings, and when CONTRACTOR is informed of necessary relocation before work is begun on this portion of the job, the relocation shall be at CONTRACTOR's expense.
- D. The Drawings are schematic in nature and are not intended to show exact locations of conduit, but rather to indicate distribution, circuitry, and control.

1.10 EXISTING UNDERGROUND UTILITIES

- A. The Drawings show approximate location of existing underground utilities based on OWNER-provided record drawings. CONTRACTOR shall excavate and verify the location of all underground utilities prior to installing new electrical equipment and prior to making modifications to existing electrical. This shall include, but not be limited to, feeders to structures and equipment, branch circuit wiring, phone and communication cabling, instrument wiring, and control wiring. CONTRACTOR shall temporarily relocate existing underground utilities to keep the existing facility in operation and for any new construction, and all costs for relocating existing electrical shall be included in the Bid.

1.11 SUBMITTALS

- A. CONTRACTOR shall submit to CONSULTANT for approval prior to beginning work, shop drawings on the equipment and materials proposed to be furnished and installed. See Section 01 33 00–Submittals for requirements.
- B. CONTRACTOR shall, in addition, submit drawings and/or diagrams for review and for job coordination in all cases where deviation from the Contract Drawings are contemplated because of job conditions, interference or substitution of equipment, or when requested by CONSULTANT for purposes of clarification of CONTRACTOR's intent. CONTRACTOR shall also submit detailed drawings, rough-in sheets, etc., for all special or custom-built items or equipment. Drawings and details under this section shall include, but not be limited to, the following, where applicable to this project:
 - 1. Electrical interconnection wiring diagrams; see Section 26 09 00–Controls and Instrumentation and Section 26 24 19–Motor Control.

2. Equipment room layouts showing exact locations and arrangements of equipment, conduit, wiring, etc., and clearances.
- C. These drawings and diagrams shall show applicable electrical switch and breaker sizes as well as the manufacturer's name and catalog number for each piece of equipment used.
- D. Equipment and material submittals must show sufficient data to indicate complete compliance with Contract Documents as follows:
 1. Proper sizes and capacities.
 2. That the item will fit in the available space in the manner that will allow proper service.
 3. Construction materials and finishes.
- E. When the manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. The shop drawings shall be clearly marked and noted accordingly.
- F. When equipment and items specified include accessories, parts, and additional items under one designation, shop drawings shall be complete and include all components.
- G. See additional requirements of shop drawings under Division 01–General Requirements.

PART 2–PRODUCTS

2.01 STANDARD PRODUCTS

- A. All equipment and products shall be of new manufacture per applicable specifications.
- B. All equipment shall be UL and NEMA approved.
- C. Unless specified otherwise, major distribution equipment such as panelboards, motor control centers, motor starters, VFDs, SPD, transformers, etc., shall each be by the same manufacturer.
- D. All equipment and wiring shall be selected and installed for conditions in which it will perform (e.g., general purpose, weatherproof, raintight, explosionproof, dustproof, or any other special type).

2.02 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. While it is not the intention of OWNER to discriminate against any manufacturer of equipment which may be equivalent to specified equipment, a strict interpretation of such equivalency will be exercised in considering any equipment offered as a substitute for specified equipment. CONTRACTOR shall submit with each request for approval of substitute material or equipment sufficient data to show conclusively that it is equivalent to that specified in the following respects:
 1. Performance:
 - a. Capacity at conditions and operating speeds scheduled shall be equal to or greater than that of the specified equipment.
 - b. Energy consumption at the point of rating shall not exceed that of the specified equipment.

- c. Vibration and noise production at the point of rating shall not exceed that of the specified equipment.
 - 2. Materials of construction.
 - 3. Gauges, weights, and sizes of all portions and component parts.
 - 4. Design arrangements, methods of construction, and workmanship.
 - 5. Coatings, finishes, and durability of wearing parts.
 - 6. National reputation of the manufacturer as a producer of first quality equipment of the type under consideration.
 - 7. Availability of prompt, reliable, and efficient service facilities franchised by or affiliated with the equipment manufacturer. This shall include the maintenance of local stocks of critical replacement parts equal to those maintained for the specified equipment.
- B. Requests for substitution shall include CONTRACTOR's reason for the request.
- C. If CONSULTANT does not consider the items equivalent to those specified, CONTRACTOR shall provide those specified.
- D. See General Conditions for additional requirements.

2.03 LOW-VOLTAGE WIRING (LESS THAN 100 VOLTS)

- A. Low-voltage wiring specified in this section shall be applicable to all systems installed that utilize low-voltage wiring where such wiring is not specified in other technical sections.
- B. All wiring shall have copper conductors with 300-volt insulation rating and meet the requirements of NEC Article 725.
- C. All conductors must be suitable for the application intended. Conductors 16 AWG and larger shall be stranded. Conductors 18 AWG and smaller may be solid or stranded.
- D. Control Cable for Class 1 Remote Control and Signal Circuits: Individual conductors twisted together, shielded, and covered with an overall PVC jacket. Cable shall be UL listed, temperature rated, and plenum or nonplenum rated for the application as required in the National Electrical Code.
- E. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits shall be constructed, UL listed, temperature rated, and plenum or nonplenum rated for the application as required in the NEC Article 725.

PART 3-EXECUTION

3.01 CONTINUITY OF SERVICE

- A. CONTRACTOR shall provide and maintain continuous services (power, controls, alarms, etc.) during the entire construction period.
- B. No service shall be interrupted or changed without permission from OWNER. Written permission shall be obtained before any work is started.

- C. When interruption of service is required, all persons concerned shall be notified and a prearranged time agreed upon. Notice shall be a minimum of 72 hours prior to the interruption.

3.02 CLEANUP AND REMOVAL OF RUBBISH

- A. All lighting and appliance panelboards, MCCs, VFD enclosures, motor starter and disconnect switch enclosures, junction boxes, and pullboxes shall be cleaned of debris and wires neatly arranged with surplus length cut off before installation of covers.
- B. Where louvers are provided in motor control panel enclosures, louvers shall be vacuumed free of all dust and dirt. Where air filters are provided in equipment such as control panels, motor control panels, CONTRACTOR shall replace all filters with new at the time of final completion.
- C. All lighting fixture lenses shall be cleaned at the time of installation, and all lens exteriors shall be cleaned just prior to final inspection.
- D. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt, and dust. All temporary labels not used for instruction or operation shall be removed.

3.03 CONCRETE WORK

- A. All cast-in-place concrete for new electrical equipment bases shown on the Drawings shall be provided by CONTRACTOR, except where specifically noted to be provided by others. All new equipment shall be set on 3 1/2-inch minimum leveling slabs including free-standing enclosures, etc. Pads shall be 3 inches larger than equipment being supported.
- B. Concrete shall comply with Section 03 30 00—Cast-In-Place Concrete.
- C. Provide all anchor bolts, metal shapes, and templates to be cast in concrete or used to form concrete for support of electrical equipment.

3.04 PAINTING

- A. All painting of electrical equipment shall be done by CONTRACTOR unless equipment is specified to be furnished with factory-applied finish coats.
- B. All electrical equipment shall be provided with factory-applied prime finish, unless otherwise specified.
- C. If the factory finish on any equipment furnished by CONTRACTOR is damaged in shipment or during construction, the equipment shall be refinished by CONTRACTOR.
- D. One can of touch-up paint shall be provided for each different color factory finish which is to be the final finished surface of the product.

3.05 CAULKING

- A. Caulk with a caulking sealant where indicated on the electrical drawings or hereinafter specified.

- B. Caulking sealant shall be silicone construction sealant as manufactured by General Electric or two-part polysulfide conforming to the requirements and bearing the seal of the Thiokol Chemical Corporation.
- C. Caulking sealant shall contain no acid or ingredients that will stain stone, corrode metal, or have injurious effect on painting. It shall be colored to match adjacent surroundings.

3.06 BUILDING ACCESS

- A. CONTRACTOR shall arrange for the necessary openings in the building to allow for admittance of all apparatus.
- B. When the installation requires openings and access through existing construction and the openings are not provided, CONTRACTOR shall provide the necessary openings.

3.07 COORDINATION

- A. Provide wiring for all motors and all electrically powered or electrically controlled equipment.
- B. All starters, VFDs, disconnects, relays, wire, conduit, push buttons, pilot lights, and other devices for the power and control of motors or electrical equipment shall be provided by CONTRACTOR except as specifically noted elsewhere in these specifications or on the Drawings.
- C. Where starters, VFDs, or other devices are provided by others, they shall be connected and wired by CONTRACTOR.
- D. CONTRACTOR's drawings and specifications shall show number and horsepower rating of all motors furnished, together with their actuating devices. Should any change in size, horsepower rating, or means of control be made to any motor or other electrical equipment after the Contract is awarded, any additional costs because of these changes shall be the responsibility of CONTRACTOR.
- E. All motors shall be provided for starting in accordance with local utility requirements and shall be compatible with starters or VFDs as specified herein or under the various trades' sections of these specifications.
- F. CONTRACTOR shall provide all line voltage power and control wiring (100 volts and above), including temperature control wiring for operation, control, and supervision of all motorized equipment, including wiring between motor starters, VFDs, and control devices as specified herein and as shown on the Drawings. Low-voltage control wiring (below 100 volts) shall be provided by CONTRACTOR supplying the equipment that has low-voltage wiring, unless otherwise noted. CONTRACTOR shall provide raceways for all low-voltage wiring.
- G. CONTRACTOR shall connect and wire all apparatus according to approved wiring diagrams furnished by the various trades.
- H. Motors 1/2 hp and larger shall be NEMA rated 460 volts, three-phase, 60 Hz, unless otherwise shown. Motors 1/3 hp and below shall be 115 volts, single-phase, 60 Hz, unless otherwise shown.

3.08 EXCAVATION AND BACKFILL

- A. Backfill of exterior trenches shall be compacted granular fill, unless otherwise noted. Compaction shall meet the requirements of Section 31 23 00–Excavation, Fill, Backfill, and Grading. Refer to Section 26 05 33–Conduit for additional requirements associated with PVC conduit installed in earth.
- B. Lines passing under foundation walls shall have a minimum of 1 1/2-inch clearance.
- C. Care shall be taken so that there is no disturbance of bearing soil under foundations.
- D. CONTRACTOR shall follow underground pipe runs where possible to avoid additional rock excavation. See Division 31 for rock excavation requirements.

3.09 EQUIPMENT ACCESS AND LOCATION

- A. CONTRACTOR shall coordinate work of this division with that of other divisions so that all systems, equipment, and other components of the building will be installed at the proper time, will fit the available space, and will allow proper service access to those items requiring maintenance. This means adequate access to all equipment not just that installed under this division. Any components for the electrical systems that are installed without regard to the above shall be removed and relocated as required to provide adequate access at CONTRACTOR's expense.
- B. Where various items of equipment and materials are specified and scheduled, the purpose is to define the general type and quality level, not to set forth the exact trim to fit the various types of ceiling, wall, or floor finishes. Provide materials that will fit properly the types of finishes actually installed.
- C. All equipment, junction and pull boxes, and accessories shall be installed to permit access to equipment for maintenance. Any relocation of conduits, equipment, or accessories to provide maintenance access shall be accomplished by CONTRACTOR at no additional cost.
- D. Electrical equipment, devices, instruments, hardware, etc., shall be installed with ample space allowed for removal, repair, calibration or changes to the equipment. Ready accessibility to equipment and wiring shall be provided without moving other equipment that is to be installed or that is already in place.
- E. Locate electrical outlets and equipment to fit the details, panels, decorating, or finish of the space. CONSULTANT shall reserve the right to make minor position changes of the outlets before the work has been installed. Verify door swings before installing room lighting switch boxes, and install boxes on the latch side of door unless noted otherwise.

3.10 WORKMANSHIP

- A. All work shall be performed in compliance with the NEC.
- B. Install work using procedures defined in NECA Standard of Installation.
- C. Location of process equipment as shown on the Drawings is approximate.

- D. Utilization equipment and control devices required under these specifications shall be mounted in a code-approved manner.
- E. Locations of utilization equipment and control devices as shown on the Drawings are within 10 feet of actual positions. Any mounting of this equipment within this 10-foot distance shall be performed at no additional cost to OWNER.
- F. Unless otherwise noted, conduit shall be fastened to building structure or equipment framework and not placed on the floor.
- G. Where materials, equipment apparatus, or other products are specified by manufacturer, brand name, and type or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the Bid.
- H. Materials and equipment of the types for which there are National Board of Fire Underwriters Laboratories (UL) listings shall be so labeled and shall be used by CONTRACTOR.

3.11 AREA CLASSIFICATION

- A. As noted on the Drawings.
- B. Where referenced herein, damp and wet locations shall include, but not be limited to, areas below grade, and exterior locations.

3.12 MODIFICATIONS TO EXISTING CONSTRUCTION

- A. Alterations:
 - 1. Alter, extend, and reconnect conduits as necessary.
 - 2. Reconnect existing conduits that were reused, cut, or exposed because of construction as quickly as possible.
 - 3. Where wiring is involved, new wires shall be "pulled in" between the nearest available accessible reused outlets to the extent allowed by the governing code.
 - 4. Provide new conduits for wires if they cannot be "pulled in" to existing conduits.
 - 5. All new conduits, wiring, and electrical items shall be connected to the existing systems so as to function as a complete unit.
 - 6. Where existing electrical equipment, devices, fixtures, electrically operated items, etc., interfere with any remodeling work, they shall be removed and reinstalled in another location to avoid such interferences. All existing and relocated equipment shall be left in good operating condition.
- B. CONTRACTOR shall remove all electrical equipment, conduit, and wiring associated with the structures, equipment, and control systems specified herein and/or shown on the Drawings to be removed.
- C. Include in Bid removal of existing electrical material and equipment as specified hereinafter, as noted on the Drawings, or as needed by field conditions.
- D. Seal or cap all existing conduit penetrations not being reused.

END OF SECTION

SECTION 26 05 19

WIRE

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Wire.
 - 2. Wiring connections and terminations.
 - 3. Terminal blocks and accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Manufacturers of Wire: Firms regularly engaged in the manufacture of electrical wire products of the types and ratings needed whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical material, which has been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.03 SUBMITTALS

- A. Submit shop drawings and product data under the provisions of Section 01 33 00—Submittals.
- B. Submit shop drawings for wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.
- C. Submit manufacturer's instructions.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-wrapped, waterproof, flexible-barrier material for covering wire on wood reels, where applicable, and weather-resistant fiberboard containers for factory-packaging of wire, connectors, outlets, boxes, lamps, fuses, etc., to protect against physical damage in transit. Do not install damaged wire or other material; remove from project site.

- B. Store wire and other material in factory-installed coverings in a clean, dry, indoor space which provides protection against the weather.

PART 2–PRODUCTS

2.01 WIRE

- A. All wire for permanent installation shall be new stranded copper delivered to project in unopened cartons or reels, except where specifically noted and be UL listed for the use intended. No wire smaller than 12 AWG shall be used unless specifically noted. The use of multiconductor cable is not allowed.
- B. Motor circuit branch wiring and associated control wiring:
 - 1. Minimum size for motor control wiring shall be 14 AWG.
 - 2. Control wiring for supervisory equipment shall be shielded, sized per equipment manufacturer's recommendations, or as shown on Drawings.
- C. All power wiring to motors utilizing Variable Frequency Drives (VFDs) shall be type XHHW-2, unless otherwise noted.
- D. All wiring within motor control panels and motor control centers that does not extend outside of the enclosure or the motor control center bucket shall be insulation-type MTW, minimum size 16 AWG.
- E. All wiring shall be XHHW-2.
- F. Refer to Section 26 05 53–Electrical Identification for required wire insulation color coding and conductor labeling requirements. Initial phase color shall be used throughout the run, even for switch legs. Colors must meet code requirements for each class voltage. Do not duplicate colors, including neutral, on different voltages.
- G. Branch circuit wiring for exterior lights in excess of 75 feet shall be minimum 10 AWG. Circuits 150 feet or over shall be sized for a maximum 2% voltage drop.

2.02 WIRING CONNECTIONS AND TERMINATIONS

- A. Provide crimp type UL or ETL listed terminations for 6 AWG and smaller stranded conductor connections to electrical devices and equipment such as receptacles, switches, and terminal strips. Crimp devices shall be Sta-kon, or equal.
- B. Provide insulated, silicone-filled spring wire connectors with plastic caps for 8 AWG conductors and smaller. Connectors shall be King Silicone-Filled Safety Connectors, or equal. Spring wire connectors shall only be allowed in junction, outlet, or switch boxes. Spring wire connectors are not allowed for terminating motor conductors.
- C. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits. Motor connection kits shall consist of split-bolt connector and motor-lead pigtail splice kit. Individual components shall be as follows:
 - 1. Split-bolt connectors shall be for use with copper conductors only.

2. Pigtail splice kit shall consist of one-hole lug cover, silicone grease, and mastic sealing strip. Kit shall be manufactured by 3M, or equal, 5300 series, and be selected based on motor feeder and split-bolt sizes installed.
- D. No splices will be allowed unless reviewed by CONSULTANT. Where allowed, provide in-line splices for all conductor connections, 6 AWG and larger. Splice compression connectors for installation above grade shall be UL listed in-line copper barrel-type as manufactured by Burndy Type YS-TC, or equal, with heat shrink tubing to match the conductor size. Splice compression connectors for installation below grade shall be UL listed in-line copper barrel-type as manufactured by Burndy Type YS, or equal, with heat shrink tubing to match the conductor size. Splice compression shall be made with a manufacturer-recommended crimp tool.
- E. Above-ground reducing adapters shall be UL listed in-line copper barrel reducers as manufactured by Burndy Type YSR-TC, or equal, with heat shrink tubing to match the conductor size.
- F. Heat shrink tubing for splices and reducing adapters shall be UL listed, heavy wall type as manufactured by Burndy Type HS-H-PF, or equal, to match the conductor size.

2.03 TERMINAL BLOCKS AND ACCESSORIES

- A. Terminal Blocks: ANSI/NEMA ICS 4: UL listed or UL recognized under UL 467, UL 486E, UL1059, and UL 1953 (power terminals only).
- B. Power Terminal Blocks: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts as manufactured by Allen-Bradley 1492-PDL, or equal.
- C. 600-Volt Fuse Holders: Fuse holders for circuits rated up to 30 amps and 600 volts AC shall be finger safe, UL Listed, DIN-rail mountable, and shall include blown-fuse indicating lights. Fuse holders shall be as manufactured by Allen-Bradley Bulletin 1492-FB, or equal.
- D. Signal and Control Terminal Blocks:
 1. General-Purpose Terminal Blocks:
 - a. Terminal blocks shall be rated up to 600 volts AC/DC.
 - b. Terminal blocks shall accept center-mounted jumper bars without increasing the installed space.
 - c. Terminal blocks shall be Allen-Bradley Bulletin 1492-J, or equal.
 - d. Terminal block color shall be gray.
 2. Grounding Terminal Blocks:
 - a. Terminal blocks shall be Allen-Bradley Bulletin 1492-JG, or equal.
 - b. Terminal block color shall be green/yellow.
 3. Disconnect-type Terminal Blocks (300-Volt Class):
 - a. Terminal blocks shall be feed-through type with a knife-blade disconnect.
 - b. Terminal blocks shall be Allen-Bradley Bulletin 1492-JKD, or equal, depending on the application.
 - c. Terminal block color shall be gray.
 4. Fuse-type Terminal Blocks with Indicator (300-Volt Class):
 - a. Terminal blocks for applications from 100 to 300 volts AC shall be Allen-Bradley Bulletin 1492-H4, or equal, with neon blown-fuse indicator.
 - b. Terminal blocks for applications from 10 to 50 volts AC/DC shall be Allen-Bradley Bulletin 1492-H5, or equal, with LED blown-fuse indicator.

- c. Terminal block color shall be black.
 - 5. Terminal blocks shall have self-locking screw compression clamps rated for the size of conductors being terminated and upstream overcurrent protection for each application.
 - 6. The same manufacturer and style of terminal block shall be used throughout the entire project for all applications.
 - 7. Terminal blocks shall have tin-plated copper current bars and tin-plated steel screws. Terminal housings shall be completely finger safe from all live circuits and be constructed of self-extinguishing material with minimum UL 94-V0 flammability rating.
 - 8. Terminal blocks shall accept pre-printed, snap-in labeling cards on both sides without increasing the installed space. Provide terminal block manufacturer's end barriers and screw-type retainers for all terminal block groupings.
 - 9. Terminal blocks shall mount on standard DIN rail and shall be able to be removed without removing adjacent terminal blocks.
 - 10. Multi-level terminal blocks and stacked, single-level terminal block installations are not acceptable.
- E. Refer to Section 26 05 53—Electrical Identification for terminal block labeling requirements.

PART 3—EXECUTION

3.01 GENERAL WIRING METHODS

- A. Install electrical wire and connectors in accordance with the manufacturer's written instructions, applicable requirements of the NEC, the National Electrical Contractors Association's "Standard of Installation," and in accordance with recognized industry practices so that products serve the intended functions. Use appropriate wiring methods and materials for the equipment or environment.
- B. Stranded conductors shall be terminated using crimp-type devices specified herein. Conductors may not be wrapped around a terminal screw.
- C. Place an equal number of conductors for each phase of a circuit in the same raceway.
- D. Torque conductor connections and terminations with calibrated torque wrench to manufacturer's recommended values.
- E. Splice only in junction or outlet boxes. Splicing is not allowed in disconnects, manholes, motor control centers, panelboards, control panels, equipment, etc. Avoid splices between terminals of interconnecting power and control wiring.
- F. Spring wire connectors shall only be used in junction, outlet, or switch boxes. Equipment wireways (e.g., motor control centers, panelboards, disconnects, switchgear, etc.), and control panels shall not have any spring-wire connectors installed; all terminations shall be on terminal strips.
- G. Neatly train, lace, and tie wrap all wiring inside boxes, equipment, control panels, MCCs, and panelboards.
- H. Make conductor lengths for parallel circuits equal.
- I. The same color shall be used for each numbered wire throughout its entire length.

- J. Terminate all wiring on terminal blocks in control panels, VFD enclosures, starter cubicles, and similar equipment. This shall include all spare or unused wires.
- K. Provide a dedicated neutral for each branch circuit or feeder requiring a neutral. Ampacity of neutral conductor shall match that of the branch circuit or feeder.
- L. Do not use a pulling means that can damage the raceway.
- M. Signal wiring (below 100 volts) and intrinsically safe wiring must be in a conduit separate from power and/or control wiring (over 100 volts). Signal wire shall include, but not be limited to, loop-powered devices, voice and data communications, and communication wiring (i.e., Ethernet, serial, etc.). Analog wiring shall be in a conduit separate from all other wiring. Intrinsically safe wiring shall be separated and identified in accordance with Article 504 of the NEC.
- N. Control wiring (e.g., internal thermal overloads, lockout stops, etc.) to motors utilizing VFDs shall be in a conduit separate from motor power wiring.
- O. Provide junction or pull boxes to facilitate the “pulling in” of wires or to make necessary connections. All raceways and apparatus shall be thoroughly blown out and cleaned of foreign matter prior to pulling in wires.
- P. Thoroughly clean wires before installing lugs and connectors.
- Q. Make splices, taps, and terminations to carry full capacity of conductors without perceptible temperature rise.
- R. Terminate spare conductors within equipment, MCCs, control panels, etc., on terminal strips and label as “SPARE.” Spare wiring in pull or junction boxes may be terminated with electrical tape and labeled as “SPARE.” All spare conductor labels shall indicate where the conductors terminate. Refer to Section 26 05 53—Electrical Identification, for additional requirements.
- S. Feeder connections to motors shall be installed within the motor junction box utilizing factory engineered kits as specified herein. Spring wire connectors are not allowed for connections to motors.

3.02 GENERAL LOW-VOLTAGE WIRING METHODS (LESS THAN 100 VOLTS)

- A. Low-voltage wiring installation requirements specified herein shall be applicable to all systems installed that utilize low-voltage wiring where such wiring installation is not specified in other technical sections.
- B. Low-voltage wiring shall be installed in conduit.
- C. Do not use wire smaller than 14 AWG for control wiring greater than 60 volts, or 18 AWG for voltages less than 60 volts. All sizes subject to NEC 725 requirements.
- D. Low-voltage cable splices shall only be allowed in junction boxes.

3.03 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Wax-based pulling lubricant is not allowed unless it includes a Teflon additive.
- B. Install wire in raceway after interior of building is enclosed, watertight, and dry, and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Conductors No. 6 AWG and larger shall be pulled into conduits by hand or by utilizing a tugger with built-in tension meter. Other motorized machines of any type are not allowed for any wire pulling. CONTRACTOR shall provide a report to CONSULTANT for each pull indicating maximum tension reached during the pull along with manufacturer's maximum pulling tension.
- E. Conductors shall be installed in conduit system in such a manner that insulation is not damaged, conductors are not overstressed in pulling, and walls are not damaged. No splices are permitted except in junction boxes or outlet boxes.
- F. CONTRACTOR shall observe code limitation on the number and size of wires in an outlet box. CONTRACTOR shall either lay out work so that the wires do not exceed the particular box limitation or provide larger boxes approved for additional capacity.
- G. Panel riser feeder conductors shall be identified with colored tape at panel lugs. The same phase relation shall be maintained throughout.
- H. Circuiting is indicated diagrammatically on the Drawings.

3.04 TERMINAL BLOCK INSTALLATION

- A. A maximum of one conductor shall be installed on the field-wired side of each terminal block. If rated to accept more than one conductor, a maximum of two conductors shall be installed on the enclosure-wired side of each terminal block. Provide additional terminal blocks and shorting jumpers as required.
- B. Provide a separate ground-type terminal block for each shielded-cable drain conductor.
- C. Provide ten percent spare terminal blocks for each type of connected terminal block, minimum five spare terminal blocks total. For each grouping of terminal blocks, provide 25% spare DIN rail space.
- D. Maintain a minimum of 1 1/2 inches between terminal blocks and adjacent devices and enclosure wireways.

3.05 FIELD QUALITY CONTROL

- A. Inspect wire for physical damage and proper connection.
- B. Prior to energizing, check conduit, raceways, outlet boxes, and wire for continuity of circuitry and for short circuits. Correct malfunction when detected.

- C. Subsequent to wire hookups, energize circuitry and demonstrate functionality in accordance with these specifications.
- D. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.
- E. Perform field inspection and testing according to provisions of this section.

3.06 ACCEPTANCE TESTS

- A. CONTRACTOR shall furnish all materials, labor, and equipment necessary for the acceptance tests specified herein. Acceptance tests shall be performed in the presence of OWNER or OWNER's representative and must be passed before final acceptance of the work.
- B. CONTRACTOR shall be responsible for powered tests of each field-installed device unless specifically noted otherwise. CONTRACTOR shall be responsible for device operation as powered from its power source and signals as received at the I/O modules.
- C. Operation Test: By operational testing, OWNER will give final acceptance of the wiring system when all of the wiring is considered a complete system. All equipment shall function and operate in the proper manner as indicated in the details of the specifications and on the Drawings. All motors shall be properly connected to protective devices, and motor rotation shall be in the correct direction.
- D. A written record of performance tests on electrical and control and instrumentation systems and equipment shall be supplied to OWNER. Such tests shall show compliance with governing codes.

3.07 WIRE INSTALLATION SCHEDULE

- A. Install all wiring in raceways except as otherwise noted. This includes all low-voltage wiring such as instruments, network, etc.

END OF SECTION

SECTION 26 05 23

INSTRUMENT AND COMMUNICATION WIRE AND CABLE

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: This specification contains the requirements for instrument wire and cable as opposed to electrical power wire and cable.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Standards: Comply with standards specified in this section as listed in Division 01.
- B. Qualifications of Installers: Workers who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work.

1.03 PRODUCT HANDLING

- A. Instrument cable shall be furnished in lengths as necessary.
- B. Reels, coils, or package rolls of instrument cable shall be identified with the project name and other tagging identification as called for.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.

1.05 QUALIFICATIONS

- A. CONTRACTOR shall have at least 10 years of experience in the installation of similar systems. CONTRACTOR shall provide documentation upon request to certify that all assigned staff have attended training courses corresponding to the type of cabling and equipment specified herein.
- B. CONTRACTOR shall currently be licensed to install low voltage electronic cabling systems in the state of the project.
- C. CONTRACTOR shall currently meet all manufacturer's requirements for the provision and installation of all equipment specified herein.

PART 2-PRODUCTS

2.01 SHIELDED PAIR CABLING FOR ELECTRONIC INSTRUMENTS

- A. Shielded cabling shall have stranded, tinned-copper conductors, No. 16 AWG, twisted with 2-inch lay.
- B. Insulation of conductors shall be 15 mil, 90°C minimum PVC, rated for 300 volts. Materials shall equal or exceed UL 13 requirements for physical properties.
- C. Color coding shall be manufacturer's standard or as stated.
- D. The outer jacket shall be flame-retardant and weather- and ultraviolet-resistant PVC, 35 mils thick for shielded pair cables, with an 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the requirements of UL 1277. Cable shall be UL labeled as power-limited circuit cable.
- E. A 100% coverage shield shall be applied over the insulated conductors. The shield shall consist of a 0.85 mil minimum thickness aluminum mylar tape. A stranded, tinned-copper drain wire shall be furnished in continuous electrical contact with the shield.
- F. Single-pair shielded cables installed in above-grade conduits shall be Belden 9316, or equal.
- G. Single-pair shielded cables installed in below-grade conduits shall be Belden 9342, or equal.

2.02 HEAT SHRINK TUBING FOR SHIELDED INSTRUMENT CABLES

- A. Heat shrink tubing for sealing the ends of all shielded instrument cables shall be heavy-wall, low-voltage tubing as manufactured by Raychem Type WCSM, or equal.

2.03 INDUSTRIAL ETHERNET CABLE

- A. 600-Volt Rated Shielded Cable:
 - 1. For communication with plant SCADA Systems and equipment in control panels, etc., over 300 volts, and other areas or raceways with power wiring over 300 volts, provide 600-volt-rated, 4-pair, shielded (F/UTP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 6 performance criteria as defined by the ANSI/TIA-568.2-D standard.
 - 2. Cable conductors shall be minimum 23 AWG with PVC jacket and aluminum foil shield with 100% coverage. The cable outer jacket shall be industrial-grade PVC with a maximum overall cable diameter of 0.34 inch. Cable shall be CMR rated, UL listed, 600 V UL AWM rated, and be Belden 7953A or equal.
 - 3. Cable jacket color shall be red.
 - 4. Provide a shielded RJ45 connector on one end of each cable and an unshielded RJ45 connector on the other end of each cable.
- B. Patch cables shall be provided premanufactured by the cable manufacturer or connector manufacturer in sufficient length to connect the associated equipment to any port on the equipment, patch panel, or switch. Field-attached plugs shall be insulation displacement type and shall be by the same manufacturer as the cable.

PART 3-EXECUTION

3.01 INSTALLATION REQUIREMENTS AND SPECIAL CONSIDERATIONS

- A. Shielded pair and industrial Ethernet cabling specified in this section shall be installed in conduit, and may not be run free-air or in nonmetallic tubing such as innerduct.

3.02 GROUNDING

- A. The shielded connection for shielded network cabling shall be connected at the network switch or patch panel and not at the field device connection. Ground network switches accepting shielded network cables.
- B. Shielded cabling shall be installed in accordance with manufacturer's instructions and to minimize electrical noise and interference to associated instruments. Refer to instrument manufacturer's instructions for additional requirements.
- C. Ends of signal wires shall be sealed to prevent the migration of moisture into the cable and to prevent unintentional grounding of the shield at the open end. Seal signal wires using a minimum 1-inch piece of heat-shrink tubing installed over PVC jacket and individual wires, and heat-shrink to a watertight fit.
- D. All shields must be grounded.
- E. Shields shall be grounded at one point only. Shielded cabling shall be isolated and left open at the instrument.

END OF SECTION

SECTION 26 05 26

SECONDARY GROUNDING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Electrical equipment and raceway grounding and bonding.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Indicate location of system grounding electrode connections and routing of grounding electrode conductor.
- B. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 INSTALLATION

- A. Provide a separate insulated equipment grounding conductor for each feeder and branch circuit. Terminate each end on a grounding lug, bus, or bushing.
- B. Bond together system neutrals, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables.
- C. Ground system and equipment as required by code and local ordinances.
- D. Include ground for grounded receptacles, light fixtures, motors and equipment items shown on the Drawings.
- E. Flexible connections do not qualify for ground. All flexible connections must have separate green ground wire from motor base or equipment frame to conduit system.
- F. Provide a separate grounding conductor system for the grounding of all lighting fixtures and devices installed in the same conduit as the branch circuit conductors. Ground conductors shall be individually connected at each device.
- G. Refer to Section 26 05 23–Instrument and Communication Wire and Cable for additional grounding requirements.

3.02 TESTING

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

END OF SECTION

SECTION 26 05 29
SUPPORTING DEVICES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Conduit and equipment support members.
 - 2. Fastening hardware.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.01 MATERIAL

- A. Support Members:
 - 1. 316 stainless steel in exterior locations, Class I locations, and damp and wet locations.
 - 2. Hot-dipped galvanized steel in all other areas.
- B. Hardware:
 - 1. 316 stainless steel in exterior locations, Class I locations, and damp and wet locations.
 - 2. PVC-coated steel clamps and stainless steel hardware with 316 stainless steel members where used to support PVC-coated rigid steel conduits.
 - 3. Hot-dipped galvanized steel in all other areas.
- C. Manufacturers: Unistrut P-1000, B-line, Superstrut, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. All supporting devices and support structures shall be constructed such that the structure adequately supports the load of the equipment installed on it including any wind and/or snow loads. Provide additional support members to those shown on the Drawings to adequately support load.

- B. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors or support members. Do not use spring steel clips and clamps. Provide standoffs as specified in other technical sections.
- C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- D. The ends of all support members shall be ground smooth.
- E. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- F. Do not use powder-actuated anchors.
- G. Do not drill structural steel members.
- H. Fabricate supports with welded end caps and all welds and surfaces ground smooth for neat appearance. Use hexagon head bolts with steel spring-lock washers under all nuts.
- I. In wet locations, install free-standing electrical equipment on concrete pads. Anchor all equipment to adjacent walls with standoffs and caulk.
- J. Install surface-mounted cabinets with a minimum of four anchors.
- K. Do not use chain, wire rope, or perforated strap hangers.
- L. All welds shall be continuous and ground smooth.

END OF SECTION

SECTION 26 05 33

CONDUIT

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Rigid metal conduit and fittings.
 - 2. Rigid aluminum conduit and fittings.
 - 3. Polyvinyl chloride (PVC) externally and internally coated galvanized rigid metal conduit and fittings.
 - 4. PVC conduit and fittings.
 - 5. Liquidtight flexible conduit and fittings.
 - 6. Conduit seals and special fittings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI C80.1—Electrical Rigid Steel Conduit (ERSC).
- B. ANSI C80.5—Electrical Rigid Aluminum Conduit (ERAC).
- C. ANSI/NEMA FB 1—Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
- D. NEMA RN 1—Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal.

1.03 QUALITY ASSURANCE

- A. Manufacturers of Raceways: Firms regularly engaged in the manufacture of electrical raceways of the types and capacities required whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that for the project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical materials, which have been listed and labeled by Underwriters Laboratories.
- E. Prior to shipment to the site, all conduit provided shall be new, unused material, and shall not have been stored outdoors or exposed to weather.

- F. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Provide color-coded thread protectors on the exposed threads of threaded rigid metal conduit.
- B. Handle conduit carefully to prevent end damage and to avoid scoring the finish.
- C. Store conduit inside and protect from weather. When necessary to store outdoors, elevate well above grade and enclose with durable, waterproof wrapping.

PART 2–PRODUCTS

2.01 RIGID METAL CONDUIT AND FITTINGS

- A. Rigid Steel Conduit: ANSI C80.1 and UL6. Heavy wall seamless tubing with hot-dipped galvanized coating.
- B. Conduit bodies for rigid steel conduit shall be as manufactured by Appleton, Form 35, or equal, and be constructed of stamped steel for sizes 2 inches and under, and cast malleable iron for sizes over 2 inches. Conduit bodies shall have domed gasketed covers and stainless steel screws. Conduit bodies sizes 1 1/4-inch and larger shall have built-in pulling rollers. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size according to application.
- C. Rigid Aluminum Conduit: ANSI C80.5 and UL6A. Heavy wall.
- D. Conduit bodies for rigid aluminum conduit shall be as manufactured by Appleton, Form 85, or equal, and be constructed of pressure-cast, copper-free aluminum for sizes 2 inches and under, and sand-cast, copper-free aluminum for sizes over 2 inches. Conduit bodies shall have domed gasketed covers, and stainless steel screws. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size per application.
- E. PVC-coated conduit and fittings shall be internally and externally hot dipped galvanized rigid metal conduit with hot dipped galvanized threads and PVC coating. PVC coating shall be UL listed with rigid metal conduit as the primary means of corrosion protection for the conduit, and PVC coating shall have an external 40 mil thickness with an internal 2 mil urethane coating. Acceptable manufacturers shall be Plasti-bond RedH₂OT by Robroy Industries, Ocal-Blue by ABB (Thomas & Betts), Calbond, or equal. All installers shall be field-certified from the factory for installation and shall provide proof of certification. PVC-coated conduit and fittings shall meet the following listings and manufacturing standards, without exception:

1. ANSI C80.1.
 2. UL6.
 3. NEMA RN1.
- F. Conduit bodies for PVC-coated rigid conduit shall be as manufactured by Plasti-bond RedH₂OT by Robroy Industries, Ocal-Blue by ABB (Thomas & Betts), Calbond, or equal, and have a 40 mil PVC exterior coating and 2 mil red urethane interior coating. Conduit bodies shall be Form 8 style or pulling elbow and include domed, gasketed covers and stainless steel screws. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size according to application.
- G. Fittings and Conduit Bodies: ANSI/NEMA FB 1 and UL 514B; threaded-type material to match conduit. For hazardous locations, fittings and conduit bodies shall meet the requirements of UL 886. Split couplings are not allowed.
- H. Supports: One-hole straps with conduit clamps and backspacers shall be used for surface-mounted conduit. Where standoffs are required, provide conduit clamps and supporting devices as specified in Section 26 05 29—Supporting Devices. One-hole straps with conduit clamps and backspacers for PVC-coated rigid steel conduit shall be PVC-coated rigid steel material.

2.02 PVC CONDUIT AND FITTINGS

- A. Conduit: Heavy wall rigid, Schedule 40, Schedule 80 where noted, UL listed for underground, encased, and aboveground applications. PVC conduit installed in exterior locations shall be UV resistant.
- B. Conduit bodies for PVC conduit shall be as manufactured by Carlon, or equal, and be suitable for use with Schedule 40 or Schedule 80 PVC conduit. Conduit bodies shall have smooth hubs, textured lids, and foam-in-place gaskets. CONTRACTOR shall select body style and size per application.
- C. Supports: Two-hole nonmetallic clamps shall be used for surface-mounted conduit. Where standoffs are required, provide pipe straps and supporting devices as specified in Section 26 05 29—Supporting Devices. Support material shall match that of the conduit type being provided.

2.03 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS

- A. Liquidtight Flexible Metal Conduit:
1. Conduit: Spiral-wound, electrogalvanized, single-strip steel with integral grounding conductor continuously enclosed within the entire length of the convolutions. The flexible PVC jacket shall be sunlight-resistant, flame-retardant, and resistant to damage from mild acids. Conduit shall be UL Listed and be rated for installation in Class I, Division 2, Groups C and D locations. Conduit shall be Liqueflex Type LA, or equal.
 2. Fittings: UL listed with thermoplastic elastomer sealing gasket.
 - a. Provide stainless-steel fittings in exterior and damp and wet locations, unless noted otherwise.
 - b. Provide electro-zinc plated steel fittings in all other areas, unless noted otherwise.

2.04 CONDUIT SEALS AND SPECIAL FITTINGS

- A. Conduit seal-offs for Class I Locations: Robroy Industries Plasti-Bond Red H₂OT Series EYS seal fittings and Crouse Hinds "Chico A" sealing compound, Arrow-Hart, or equal.
- B. Conduit Seals: Duct sealing compound, OZ Gedney Type DUX, or equal.
- C. Expansion Fittings: Crouse Hinds or Robroy Type XJG (non-hazardous location) or Type UNY/UNF (hazardous location), or equal, for rigid, or PVC-coated rigid conduit. Carlon E945 Series, or equal for PVC conduit.
- D. Ground Bushings: Crouse Hinds Model GLL, or equal.
- E. Watertight Hubs: Diecast, insulated and gasketed, rated for wet or dry locations indoors or outdoors. Watertight hubs shall be Appleton HUBXXXDN, Crouse-Hinds Myers Hubs, or equal.
- F. Conduit Plugs: Kwik N Sure pipe plug as manufactured by Cherne Industries, or equal. Plug shall include natural rubber O-ring with galvanized wing nut and hex nut.
- G. Conduit Threads Joint Compound: Kopr-shield conductive, anti-corrosion joint compound as manufactured by Thomas & Betts, or equal.
- H. Mechanical Seals: 316 stainless steel, Link Seal, or equal. Link seals shall be provided with 316 stainless steel bolts, nuts, and fasteners.

PART 3—EXECUTION

3.01 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. Size conduits for branch circuit conductors, control wires, and instrumentation cables so as to have not less than 25% spare capacity after installation; 3/4 inch minimum size. Minimum size for liquidtight flexible metal conduit is 1/2 inch.
- B. Maintain at least 1 inch of separation between conduit sizes to 1 1/2 inches and 2 inches between conduits 1 1/2 inches or larger. Maintain 1 foot of separation between signal conduits (below 100 volts) and power conduits (100 volts and above).
- C. All conduit shall be supported in accordance with the NEC and as specified herein. This shall apply to all conduit types, including flexible conduit.
- D. Provide for the proper application, installation, and location of inserts, supports, and anchor bolts for a satisfactory raceway system. Where any component of the raceway system is damaged, replace or provide new raceway system.
- E. Run conduits concealed to avoid adverse conditions such as heat and moisture, to permit drainage, and to avoid all materials and equipment of other trades. Maintain a minimum clearance of 6 inches from all hot water pipes, flues, or any high-temperature piping or ductwork.

- F. Conduits shall be attached to building surfaces and not suspended unless installed in a Unistrut-type conduit rack as specified herein. Individual conduits shall not be suspended. Clevis hangers are not allowed.
- G. Conduits shall not be run in slabs-on-grade or structural topping slabs.
- H. Independently support or attach the raceway system to structural parts of construction in accordance with good industry practice.
- I. Conduit attached to building surfaces that may be damp or wet shall be spaced out to avoid rust and/or corrosion using fittings approved for the use. Use back straps on all conduit in damp and wet locations, or mount conduit with Unistrut straps, or equal. Watertight hubs shall be used in all damp and wet locations.
- J. Conduits shall be securely fastened to building structure at intervals not exceeding 8 feet or closer, if necessary. Where hangers are necessary, 3/8-inch rod/eyelets/rings/or trapeze type in Unistrut channel and pipe clamps shall be used. Wire or perforated strap iron is not acceptable. PVC conduit shall be securely fastened to building structure at intervals not exceeding 3 feet.

3.02 GENERAL CONDUIT INSTALLATION REQUIREMENTS

- A. Exterior conduit shall be buried below grade and concealed in structure walls. Exposed conduit runs shall be avoided. Conduit may be run exposed only where it is impossible to conceal.
- B. Run exposed conduit grouped and parallel or perpendicular to construction. Do not route exposed conduits over high-temperature machinery nor in contact with such equipment. All conduit shall be run exposed in structures below grade.
- C. All conduit installed below grade shall be buried a minimum of 2 feet 0 inch.
- D. PVC-coated rigid steel conduit and PVC conduit installed in earth shall be bedded in compacted sand with a minimum of 6-inch cover on all sides.
- E. In all PVC conduit runs below grade 200 feet and longer, PVC coated rigid steel conduit shall be used for all 90 degree bends.
- F. Ream conduit smooth at ends, cap upon installation, rigidly attach to structural parts of the building, and securely fasten to all outlet boxes, junction boxes, pull boxes, splicing chambers, disconnect switches, and all other components of the raceway system.
- G. Provide all empty raceways 2 1/2 inches and over with No. 10 galvanized fishwire, and nylon cord for conduits smaller than 2 1/2 inches. Empty raceways and fishwire/nylon cord shall be identified with permanent label, and label shall include conduit termination point. All empty conduits shall be threaded, capped and flush with finished floor or wall. Exposed conduits shall be threaded and capped.
- H. Provide conduit raceway for exposed cables that are not UV resistant. This shall include, but not be limited to, instrument wiring, pump cables, float cables, etc.

- I. Conduit seals shall be provided for intrinsically safe circuits, where conduits pass from the interior to exterior of the building, where conduits enter a room which at any time is a low or high temperature room, where conduits enter a room which at any time is subject to internal air pressures above or below normal and any conduit entering a wet location.
- J. Liquidtight flexible conduit shall be installed in such a manner that liquids tend to run off the surfaces and not drain toward the fittings.
- K. All runs of flexible conduit and flexible conduit couplings to equipment and devices shall be as short as practicable, of the same size as the conduit it extends, and with enough slack to reduce the effects of vibration to a minimum. A minimum of 18 inches of flexible conduit shall be installed for each motor.
- L. Conduits shall be pitched so that drainage is away from all structures.
- M. Conduit bends for PVC conduit shall be made using a hot box, heat blanket, or glycol bender. Open flame or point heat sources of any type are not allowed.
- N. The PVC-coated rigid conduit manufacturer's touch-up compound shall be used on all conduit interior and exterior bare steel exposed because of nicks, cuts, abrasions, thread cutting, and reaming; minimum six coats.
- O. Where below-grade PVC conduit is connected to rigid metal conduit, the length of PVC conduit shall be a minimum of 10 feet. For short, below-grade conduit runs where required lengths of rigid metal conduit limit the length of PVC conduit to less than 10 feet, rigid metal conduit shall be used for the entire run.
- P. Routing of conduits on exterior of buildings shall be avoided to the extent possible and shall not cover or interfere with lighting, signage, windows, louvers, or other openings. All conduit routing on exterior walls shall be reviewed with CONSULTANT for approval prior to installation.
- Q. Conduits installed in damp and wet locations shall have all threads coated with conduit threads joint compound.

3.03 CONDUIT PENETRATIONS AND TERMINATIONS

- A. Where fittings are brought into an enclosure with a knockout, a gasket assembly consisting of an O-ring and retainer shall be installed on the outside. Fittings shall be insulated throat type.
- B. Conduit penetrations for control panels or enclosures containing electronic equipment shall utilize watertight hubs and, if entering the top of the enclosure, shall be located at the front of the enclosure and not over any electronic equipment (e.g., PLC, power supplies, etc.).
- C. Conduit penetrations for all exterior enclosures (e.g., disconnects, junction boxes, control panels) shall utilize watertight hubs and enter the sides or bottom of the enclosure. Conduits shall not penetrate the top of the enclosure.
- D. Provide conduit expansion fittings as specified herein in all conduit runs that cross a structural expansion joint and for conduits protruding from earth.

- E. All conduits that protrude from poured concrete shall be PVC-coated rigid conduit. Conduit shall extend continuously (i.e., no joints) a minimum of 4 feet beyond the poured concrete (both sides).
- F. Conduits passing through masonry, concrete, or similar construction shall be cast in place using PVC-coated rigid conduit extending completely through the construction.
- G. Where above-grade conduits pass through cores in existing structures or through masonry walls, grout openings between conduit and walls or floors with sand cement mortar.
- H. Where wall penetrations through existing walls are below grade, cored openings shall be sealed with waterproof mechanical seals. Cores shall be pitched slightly such that conduit slopes away from building. Sleeve diameter shall be provided and mechanical seals installed as recommended by the manufacturer. Conduit shall extend continuously (i.e., no joints) a minimum of 4 feet beyond the wall (exterior).
- I. All spare conduits that terminate in a building or structure below grade shall be plugged with conduit plugs as specified herein.

3.04 CONDUIT INSTALLATION SCHEDULE

- A. The following schedule lists specific conduit types allowed in designated areas. Those areas not listed under a specific conduit type shall not have that type of conduit installed:
 - 1. Rigid steel:
 - a. Interior locations requiring mechanical protection.
 - b. All exposed interior locations.
 - c. All concealed interior locations.
 - d. Class I, Division 2 interior locations.
 - 2. Rigid aluminum:
 - a. All exposed interior locations.
 - b. Interior locations requiring mechanical protection.
 - c. Exterior locations (except in earth) and locations exposed to weather.
 - d. Class I, Division 2 locations.
 - e. All locations where attached to aluminum railings or aluminum structural members.
 - 3. PVC-coated rigid steel:
 - a. Class I, Division 1 locations.
 - b. Conduits protruding from concrete.
 - c. Interior and exterior locations requiring mechanical protection.
 - d. Earth.
 - e. Exterior locations and locations exposed to weather.
 - f. Within 4 feet of building or structure footing and wall.
 - 4. PVC:
 - a. Earth, except conduits serving Class I locations and within 4 feet of a building or structure footing, or wall. PVC conduit under pavement or roadways shall be Schedule 80.
 - b. Buried below slabs on grade.
 - 5. Liquidtight flexible metal conduit not over 3 feet in length for final connections to:
 - a. Equipment with sliding bases or flexible positioning.
 - b. Equipment with vibration isolation mounting.
 - c. Equipment housing ferromagnetic cores or with integral moving components capable of generating noise or vibrations, including transformers and motors.

- d. All pumps and associated equipment.

END OF SECTION

SECTION 26 05 35

BOXES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Switch, outlet, and small junction boxes.
 - 2. Pull and junction boxes.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this section.

1.02 REFERENCES

- A. ANSI/NEMA OS 2–Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
- B. NEMA 250–Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 QUALITY ASSURANCE

- A. Manufacturers of switches, outlets, boxes, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation Work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical cable, boxes, raceways, wire, connectors, outlets, switches, etc. that have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.01 SWITCH, OUTLET, AND SMALL JUNCTION BOXES

- A. Cast Boxes: Aluminum or cast ferrous, deep-type, gasketed cover, threaded hubs, Eaton FD Series, or equal.

- B. Covers for junction boxes shall have covers that match box type.

2.02 PULL AND JUNCTION BOXES

- A. NEMA 4X Boxes: Boxes shall be 316 stainless steel with hinged cover, recessed quarter-turn padlocking latches, and gasket, Saginaw Control and Engineering Enviroline Series, or equal, where specified herein.
- B. NEMA 12 Boxes: Painted steel with hinged cover, recessed quarter-turn padlocking latches, gasket, and locking system. Boxes shall be Hoffman CSD, or equal.
- C. Where terminal blocks or other devices are mounted in a pull or junction box, provide a 14-gauge steel back panel with a white enamel finish for mounting.
- D. All enclosures with double doors or that are free-standing shall have a three-point latch.
- E. Boxes specified in this section are not allowed to have knockouts and are not allowed to be used as enclosures for control panels.

PART 3-EXECUTION

3.01 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on the Drawings and as necessary for splices, taps, wire pulling, cable bending radii, equipment connections, and code compliance.
- B. Electrical box locations shown on the Drawings are approximate. Verify location and size of outlet boxes in all work areas prior to rough-in.
- C. Where dedicated raceways are provided for different voltage systems or wiring, (e.g., motor power wiring and motor space heaters), separate boxes shall also be provided unless acceptable to CONSULTANT. Where acceptable to CONSULTANT, combined boxes shall be physically divided to separate the wiring.
- D. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of access doors.
- E. Locate and install to maintain headroom and to present a neat appearance.
- F. All boxes attached to building surfaces that may be damp or wet shall be spaced to avoid rust and/or corrosion. All boxes in damp and wet locations shall be on 1/2-inch standoffs.

3.02 SWITCH, OUTLET, AND SMALL JUNCTION BOX INSTALLATION

- A. Provide knockout closures for unused openings.
- B. Support boxes independently of conduit.
- C. Use multiple gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- D. Install boxes in walls without damaging wall insulation.

- E. Switch and outlet boxes provided for branch circuits and feeders shall not contain control wiring. Control wiring and intrinsically safe wiring shall each have dedicated pull and junction boxes provided. Wiring for different voltage systems (e.g., 24 V, 120 V, 480 V) shall have dedicated pull and junction boxes for each voltage.
- F. Align wall-mounted outlet boxes for switches and similar devices.
- G. For weatherproof switches and devices, use cast boxes with proper cover and gasket.
- H. All interior exposed wall and ceiling outlet boxes shall be cast boxes, unless otherwise noted.
- I. Knockout punches or saws shall be used for holes; boxes with prepunched holes are not acceptable.
- J. Boxes shall be of a depth to accommodate wires and splices and shall be equipped with both fixture hanging studs and tapped fixture ears. Boxes shall be installed so that they will support the weight of the fixture. Conduit will not be considered as adequate supports.
- K. Cast boxes with 3/4-inch hubs and aluminum fittings and enclosures may be used with all conduit types.

3.03 PULL AND JUNCTION BOX INSTALLATION

- A. Locate boxes above accessible ceilings or in unfinished areas.
- B. Support pull and junction boxes independent of conduit.
- C. Knockout punches or saws shall be used for holes; boxes with prepunched holes are not acceptable.
- D. Refer to Section 26 05 53—Electrical Identification for junction box labeling requirements.
- E. All interior exposed boxes and all interior boxes with a dimension equal to or greater than 12 inches shall be NEMA 12, unless noted otherwise.
- F. All exterior boxes shall be NEMA 4X stainless steel.

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Nameplates.
 - 2. Labeling tags.
 - 3. Wire and cable markers.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Provide schedule for nameplates and labeling tags with shop drawings. Reference Drawings for type used.

PART 2–PRODUCTS

2.01 NAMEPLATES

- A. Nameplate material shall be multi-color, two-layer, nonconductive engraving plastic suitable for permanent installations in indoor and outdoor locations. The material shall be UV-resistant and suitable for installation in direct sunlight.
- B. Type “A”:
 - 1. Use:
 - a. Motor starters.
 - b. Each separately mounted circuit breaker or disconnect switch.
 - c. Each device in motor control centers.
 - d. Each device in motor control panels.
 - e. Enclosures, pull, and junction boxes.
 - f. Field devices (flowmeter transmitters, level transmitters, etc.).
 - 2. Size: 2 inches by 4 inches.
 - 3. Background Color: Black.
 - 4. Character Color: White.
 - 5. Character Size: 1/2-inch.
 - 6. Engraving: See MCC schedule, one-line, and I/O list for labels, or as requested by CONSULTANT. Label shall include equipment number and description (i.e., SCAL-60-01, Fluoride Scale).
 - 7. Mounting Location: Front exterior.

- C. Type "B":
 - 1. Use: Motor Control Panels.
 - 2. Size: 4 inches by 4 inches.
 - 3. Background Color: Black.
 - 4. Character Color: White.
 - 5. Character Size: 2 1/4 inches.
 - 6. Engraving: Equipment label, Emergency shall be red with white letters. Label shall include equipment number and description (i.e., LP-10-01, First Floor Power Panel).
 - 7. Mounting Location: Equipment: Top wire way.
- D. Type "C":
 - 1. Use: Conduit fittings, etc.
 - 2. Size: 1/2-inch by 4 inches.
 - 3. Background Color: Black.
 - 4. Character Color: White.
 - 5. Character Size: 1/4-inch.
 - 6. Engraving: Control station number and equipment description (e.g., T-15-01, Chlorine Room).
 - 7. Mounting Location: Device front at top

2.02 LABELING TAGS

- A. Labeling tag material shall be multi-color, 2-layer, nonconductive engraving plastic suitable for permanent installations in indoor and outdoor locations. The material shall be UV-resistant and suitable for installation in direct sunlight.
- B. Use: Field-mounted devices without surfaces suitable for mounting fixed nameplates (Valves, Limit Switches, Level Transmitters, Flow Transmitters, etc.).
 - 1. Size: 3/8-inch by 2 inches.
 - 2. Character Size: 1/4-inch.
 - 3. Engraving: As requested by CONSULTANT.

2.03 WIRE AND CABLE MARKERS

- A. Wire and cable markers shall be permanently-attached, heat-shrink type labels.
 - 1. Sleeve: Permanent, PVC, white, with legible machine-printed black markings.
 - 2. Acceptable Manufacturers: Raychem Model D-SCE or ZH-SCE, Brady Model 3PS, or equal.
 - 3. Grounding Conductor: Provide green wire marker; minimum 2 inches wide.
- B. Wire or cable numbering preprinted on the conductor or cable insulation, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable. All wire markers shall be the same throughout the project.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.

- C. Affix nameplates with weatherproof, UV-resistant adhesive in outdoor locations and sticky back adhesive in indoor locations.
- D. Affix labeling tags with stainless steel leaders; vinyl locking wire ties are not acceptable. Provide 3/8-inch hole to accommodate wire tie.
- E. Prepare and install neatly-typed circuit directories and schedules in all panels, including, but not limited to, existing panels and existing panelboards where Work is done under this Contract.
- F. Labeling tags shall only be used for equipment enclosures without surfaces suitable for mounting fixed nameplates.

3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor, including neutral and spare conductors, in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Neutral conductor labels shall include the associated branch circuit number. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams for control wiring. Spare conductors shall have control wire number or shall indicate termination point of wire.
- B. Conductors in pull boxes, motor control centers, control panels, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system. All wiring labels shall be able to be read without removing wire management (i.e., wiring trough covers, spiral windings, etc.) or twisting the wire/cable.
- C. Where terminal blocks are factory provided with non-project-specific labels by equipment manufacturers in MCC buckets, VFDs, motor control panels, control panels, and similar equipment and are wired to terminal blocks in control panels with project-specific labels, the interconnecting wiring shall be labeled at both ends to match the project-specific terminal blocks in the control panel. Provide an additional label on the end of each wire that is connected to a terminal block with a non-project-specific label to indicate the associated terminal block.
- D. Power Conductor Insulation Color Code:
 - 1. 6 AWG and Larger: Provide general-purpose, flame-retardant, permanent tape at each termination and at accessible locations such as junction and pull boxes, panelboards, motor control centers, etc. Apply tape with at least six full, overlapping wraps; minimum 2 inches wide.
 - 2. 8 AWG and Smaller: Provide conductors with color-coded insulation.
 - 3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
120/208 Volts Three-Phase, Four-Wire	Grounded Neutral	White*
	Phase A	Black
	Phase B	Red
	Phase C	Blue

System	Conductor	Color
480 Volts Three-Phase, Three-Wire	Phase A Phase B Phase C	Brown Orange Yellow
Note: Phase A, B, C implies direction of positive phase rotation.		
* When installed as part of a 120-volt branch circuit, provide a color-coded stripe on the white neutral conductor insulation matching the branch circuit insulation.		

E. Control Panel and Field-Installed Control Conductor Insulation Color Code:

1. All conductors shall have color-coded insulation.
2. Colors:

System	Conductor	Color
Supply Voltage	Ungrounded Circuit Conductors Neutral	Black White
Discrete 120-volt AC Input/Output	Control Circuit Conductor Neutral	Red White
Discrete 12/24-volt DC Input/Output	Control Circuit Conductor Common	Blue White with Blue Stripe
Conductors energized when the main disconnect is in the "off" position (e.g., foreign supply voltages)	Control Circuit Conductor AC Neutral DC Common Ground	Orange White White with Blue Stripe Green
Intrinsically Safe	Control Circuit Conductor DC Common	Light Blue White with Two Light Blue Stripes

F. Circuit Identification:

1. Identify power, instrumentation, and control conductors at each termination and at accessible locations such as junction and pull boxes, panelboards, motor control centers, etc.
2. Conductors for panelboard circuits shall identify circuit matching the circuit directory designations, including the neutral conductor.
3. Control conductor identification shall match the associated terminal block label.
4. Circuits Not Listed in Circuit Directories:
 - a. Assign circuit name based on unique device or equipment at load end of circuit.
 - b. Where unique device or equipment names are not available or apparent, add a unique number or letter modifier to each otherwise identical circuit name.

3.03 DATA CABLE AND COMMUNICATION EQUIPMENT IDENTIFICATION

- A. Individual labels shall be placed on both ends of all cables.
- B. Refer to Section 26 05 23—Instrument and Communication Wire and Cable for cable insulation and jack color requirements.

3.04 JUNCTION BOX IDENTIFICATION

- A. All junction boxes shall be labeled with permanent nameplates. Nameplates shall indicate circuit or load served, as well as the power source and highest voltage present on any conductor.

3.05 CONDUIT FITTINGS IDENTIFICATION

- A. All conduit fittings that contain splices of any kind shall be labeled with permanent nameplates indicating "splice within." Nameplates shall be clearly visible at location installed. Nameplates shall be fastened to each conduit fitting with heavy duty, UV-resistant, cold weather cable ties.

3.06 TERMINAL BLOCK IDENTIFICATION

- A. Terminal blocks shall be labeled on both sides of each terminal block. Terminal block numbering shall match the numbers shown on the project-specific wiring diagrams.
- B. Fused terminal blocks labels shall be located on top of the terminal blocks and include the fuse voltage and ampere rating.

3.07 COMPONENT IDENTIFICATION

- A. All components (e.g., relays, timers, power supplies, transformers, etc.) within enclosures shall be identified with sticky-back adhesive, self-laminating, machine-printed marking labels. Labels shall be installed on the enclosure back panel and not on the device itself, wireway covers, or any other removable devices. Labels shall be included on the as-built drawings.

3.08 LABELING FONT REQUIREMENTS

- A. The font for all conductor, cable, and device labels shall be Arial with black characters on white background, and minimum font size 12.
- B. The text for all conductor, cable, and device labels shall be machine printed. Handwritten labels are not acceptable.

END OF SECTION

SECTION 26 09 00

CONTROLS AND INSTRUMENTATION

PART 1–GENERAL

1.01 SUMMARY

A. Related Sections and Divisions:

1. Applicable provisions of Division 01 shall govern work in this section.
2. Section 26 09 10–Controls and Instrumentation Drawings.
3. All other sections of Division 26.

PART 1–GENERAL	1
1.01 SUMMARY.....	1
1.02 SYSTEM DESCRIPTION	1
1.03 QUALITY ASSURANCE.....	2
1.04 SUBMITTALS.....	2
1.05 OPERATION AND MAINTENANCE DATA	3
1.06 DELIVERY, STORAGE, AND HANDLING	4
1.07 SYSTEM ENGINEERING	4
1.08 DESCRIPTION OF THE RAS/WAS PUMPING UPGRADES	5
1.09 CONTRACTOR AND SYSTEM SUPPLIER GENERAL REQUIREMENTS	5
1.10 ACCEPTANCE TESTING, SYSTEM STARTUP, AND SUPPORT SERVICES	6
1.11 COMMON REQUIREMENTS ALL EQUIPMENT	8
1.12 GENERAL CONTROL ALGORITHMS.....	10
1.13 WARRANTY	12
PART 2–PRODUCTS.....	12
2.01 EQUIPMENT ENCLOSURES	12
2.02 COMPACTLOGIX PROGRAMMABLE LOGIC CONTROLLERS.....	14
2.03 UNINTERRUPTIBLE POWER SUPPLIES	16
2.04 INDUSTRIAL CONTROL RELAYS AND CONTACTORS	16
2.05 MAGNETIC FLOW METERS	17
2.06 OPERATOR INTERFACE PANEL	19
2.07 SURGE PROTECTIVE DEVICES FOR CONTROL PANELS, INSTRUMENTATION, AND NETWORK EQUIPMENT	19
2.08 INTRINSIC SAFETY BARRIERS	19
2.09 INDUSTRIAL ETHERNET SWITCHES.....	19
2.10 THREE-PHASE VOLTAGE MONITORS.....	20
2.11 NOTIFICATION DEVICES	20
PART 3–EXECUTION	21
3.01 MCC-A MODIFICATIONS.....	21
3.02 CONTROL PANEL–GENERAL.....	21
3.03 GENERAL OPERATOR INTERFACE PANEL (OIP) REQUIREMENTS	22
3.04 MCP-43	23
3.05 INTRINSICALLY SAFETY BARRIERS JUNCTION BOXES	26

1.02 SYSTEM DESCRIPTION

- A. The work includes furnishing, delivering, installing all items furnished, and placing in operation new motor control panel and controls for new final clarifiers, and new VFDs and controls associated with new RAS/WAS pumps.

- B. System Supplier shall be defined as the fabricator, assembler, and supplier of all system components. This shall include, but not be limited to, all instrumentation as specified, all motor control panels (MCP) and required interface hardware and internal wiring, hardware, system drawings, and MCC modification drawings as necessary.
- C. System supplier shall be responsible for all OIP graphics programming.
- D. CONTRACTOR shall inspect all work. The Bid shall include everything necessary to obtain a complete installation operating in accordance with these specifications and the Bidder's proposal, whether necessary items and equipment are contained in, or are remote from the enclosures furnished under this Contract. All responsibility for this system ultimately lies with CONTRACTOR.
- E. CONTRACTOR shall be responsible for the placing of circuits and making of electrical connections in accordance with System Supplier-furnished drawings, instructions, and field supervision to provide proper connection. CONTRACTOR shall include the services of a System Supplier factory engineer to supervise the making of connections to power supplies, motor leads, communication circuits, existing control equipment, and any other connections external to the new control equipment; adjust the equipment; initiate and check operation; instruct OWNER's electrician on operation and maintenance of the equipment; and place the equipment in operation in an acceptable manner. This shall include on-site review of software/hardware controls from the central control point.
- F. Any auxiliary interface relays and controls needed for completion of this project, if not specifically called for, shall be by System Supplier.

1.03 QUALITY ASSURANCE

- A. System Suppliers: Firms regularly engaged in the design and manufacture of control systems of the size and complexity specified herein, and whose systems have been in satisfactory use in similar service for not less than 10 years.
- B. Installer: A firm with at least 10 years of successful installation experience on projects with control system design and installation work similar to that required for the project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide control panels, power supplies, controllers, relays, wire, and connectors that have been listed and labeled by Underwriters Laboratories.
- E. NECA Standards: Comply with applicable portions of National Electrical Contractor's Association's Standard of Installation.

1.04 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's data, specifications, and installation recommendations for each item specified herein.
- B. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.

- C. Provide product data on all equipment and devices specified herein as well as wiring schematics for all systems.
- D. Shop drawing submittals shall be assembled in phases.
 - 1. The first submittal shall include the following:
 - a. Detailed catalog information, descriptive literature, and specifications of hardware. All items being provided must be specifically noted on this literature, including all field devices and instruments.
 - b. Project implementation plan, including information on project organization, project management, engineering, programming, configuration, training, startup, and maintenance services. Plan shall include key personnel on project, point of contact, and communication protocol.
 - c. Overall network schematic showing all controllers, network switches, and hardware addresses applicable to the system.
 - d. Wiring diagrams for all control panels and MCCs, including modification drawings for existing equipment. Modification drawings shall be completed using electronic CAD software. Handwritten or PDF markups of any kind will not be allowed.
 - 2. Subsequent submittals shall include control narratives.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provision of Section 01 33 00–Submittals.
- B. Include spare parts data listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.
- C. Submit Operation and Maintenance Manuals in accordance with Division 01. The following additional information shall apply:
 - 1. Manuals shall contain, but not be limited to, the following:
 - a. System Hardware.
 - b. System Software.
 - 2. Hardware section shall include:
 - a. Safety precautions, physical description, functional description, operating procedures, theory of operation, maintenance instructions, checkout procedures, troubleshooting procedures, servicing, and removal and replacement procedures.
 - b. Wiring schematic and logic diagrams, parts list, and point-to-point wiring.
 - c. Listing of all hardware timers installed in MCCs and control panels, as well as the ranges set on each timer. Listing shall also include actual timer setting after completion of startup.
 - 3. Software section shall include:
 - a. Software manual shall describe system techniques, general philosophies, list, and description of all standard software. System techniques description shall include a detailed screen-by-screen description explaining where the various signals originate, how to change equipment setpoints and control modes, how alarms are acknowledged, and how to go from screen to screen. All menu selections and their functions shall also be described in detail.
 - b. Program documentation (i.e., PLCs, OIPs) shall include programs, documentation files, database and configuration as installed. Provide two USB flash drives with this information. Usernames and passwords for all programmable devices (i.e., PLCs, OIPs) shall be turned over to OWNER at the time of final completion.

- c. Organize IP address listing in Microsoft Excel format for the SCADA Ethernet Network(s) indicating device hostnames, VLAN ID, descriptions, IP addresses, as well as the subnet mask and default gateway IP addresses.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect equipment from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle equipment carefully to avoid damage to control panel components, enclosure, and finish.

1.07 SYSTEM ENGINEERING

- A. System Supplier shall provide all engineering necessary to accomplish and document the requirements of this specification and be in accordance with the system configuration. The engineering to be performed by System Supplier on this project shall include, but not be limited to, the following categories:
 - 1. PLC system layouts.
 - 2. Panel layouts.
 - 3. I/O configuration and wiring diagrams.
 - 4. PLC programming.
 - 5. Network configuration. Coordinate system IP addresses with OWNER and CONSULTANT.
 - 6. OIP programming.
- B. Installation: CONTRACTOR shall install all system equipment, including PLCs and interconnecting cabling, as required. This work shall include all interconnection wiring from new and existing equipment as required for the completion of the system.
- C. It shall be the responsibility of System Supplier to ascertain that all field devices are compatible and consistent with the new system design. This includes reviewing drawings and data to ascertain the compatibility and consistency of the system with the field devices on such considerations as:
 - 1. Equipment size and available space.
 - 2. Power levels.
 - 3. Power sources.
 - 4. Logic schemes.
 - 5. Signal types and levels.
 - 6. Interface devices where required.
 - 7. All other aspects of field devices impacting the design of the system.
- D. The system shall be programmed to implement the control sequences and to provide monitoring according to this specification. It shall be the responsibility of System Supplier to include all inputs and outputs required to meet all aspects of this specification, regardless of whether they are specifically included in the I/O listing in this specification.
- E. System Supplier shall provide a complete list of spare parts required and where they may be obtained for operating the system for 3 years from startup.

1.08 DESCRIPTION OF THE RAS/WAS PUMPING UPGRADES

- A. System Supplier shall be responsible for the development of all required process control functions based on the algorithms described in this specification. A listing of major process areas and control panels that will need software development for operation is as follows. RAS/WAS Pumps (MCP-43).

1.09 CONTRACTOR AND SYSTEM SUPPLIER GENERAL REQUIREMENTS

- A. This specification, along with the Contract Drawings, defines the requirements of a PLC-based process monitoring and control system. System Supplier shall construct a process monitoring and control system specifically for the demanding requirements of a real-time municipal wastewater treatment system.
- B. It is the intent of this specification to define a fully integrated open-type process monitoring and control system, factory tested, delivered to the site, and ready to function upon connection of a power source and field instrument wiring. Components, peripherals, interconnections, cabling, power supplies, software, and services necessary to form a complete system shall be identified and provided by CONTRACTOR. CONTRACTOR shall be responsible for reviewing the wiring diagrams and control sequences for equipment provided under other divisions of these specifications and coordinating all interface requirements. CONTRACTOR shall submit to CONSULTANT, in writing, any deficiencies noted during this review. Any changes required by CONTRACTOR because of a failure to complete this review shall be the responsibility of CONTRACTOR, at no increase in cost to OWNER.
- C. CONTRACTOR shall be responsible for complete coordination in providing all equipment, sensors, and meters supplied with input and output signals, and contacts that are compatible with the systems as specified herein and existing systems. CONTRACTOR shall also be responsible for complete coordination with manufacturers of other systems specified in other divisions of these specifications with which an interface is required. The Contract Drawings and I/O Listing are symbolic representatives of the required work. It is not intended that the Drawings show all appurtenances. CONTRACTOR shall provide a complete and working system according to the true intent and meaning of the Drawings, Specifications, and standard industry practices.
- D. To provide a complete and totally integrated system, a single manufacturer who has experience in furnishing similar PLC-based monitoring and control systems of the same complexity and size for municipal wastewater treatment systems shall provide the specified equipment and services. The system proposed to meet this specification shall be of field-proven design incorporating manufacturer's standard equipment and software. Service of all peripheral devices shall be provided by the manufacturer of the process monitoring and control system.
- E. Design and specification of devices and the completed system shall conform to the applicable portions of the latest edition of the National Electrical Code (NEC).
- F. Control panels shall bear a serialized UL label indicating that it is UL approved as an assembled unit. Panels that have individual components that are UL labeled, but do not have UL approval as an assembled unit are not acceptable.

- G. Training Program:
1. Submit a training plan including course syllabus, personnel who will be conducting the training, and schedule.
 2. Provide materials, instructors, and workbooks to complete the training.
 3. Training courses shall include:
 - a. Operator Training: The course shall consist of one 4-hour session at the WWTP. Training shall utilize equipment specified herein following installation and field testing.
 - b. Maintenance Training: The course shall consist of one 4-hour session at the WWTP.
 4. Manufacturer's training shall be directed to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than the process itself.
 5. Refer to Section 01 91 00–Starting of Systems for additional training requirements.
- H. System Supplier shall meet the following minimum requirements:
1. System Supplier shall have a full-time staff of qualified programmers who are knowledgeable in the configuration of networked computer systems and the PLCs being provided.
 2. System Supplier shall have a minimum of one Microsoft-certified engineer.
 3. System Supplier shall have training capabilities and shall have conducted training courses in programming and maintenance.
 4. System Supplier shall have an adequate inventory of spare parts.
 5. System Supplier shall have a full-time staff of qualified service technicians.
 6. System Supplier shall be responsible for the programming and documentation of the system.
 7. System Supplier shall be responsible for all details that may be necessary to properly install, wire, adjust, and place in operation a complete and working system.
 8. System Supplier shall be responsible for all coordination between the system and the field devices, instrumentation equipment, motor control centers, and equipment furnished with other divisions of this specification. This shall include interface with existing equipment.
 9. System Supplier shall have a UL panel shop located inside the System Supplier's own facilities.
- I. All components shall be standard make acceptable to OWNER, with one manufacturer to provide all similar components. The Base Bid System Supplier shall be ESCO Automation (319) 377-6655, Integrated Process Solutions, (608) 849-4375, or Wunderlich-Malec (952) 933-3222. See General Conditions regarding substitutions to the Base Bid system suppliers.

1.10 ACCEPTANCE TESTING, SYSTEM STARTUP, AND SUPPORT SERVICES

- A. On-Site Functional Acceptance Testing:
1. After all equipment has been installed and is placed in full-time operation, CONTRACTOR and System Supplier shall demonstrate that all equipment and controls operate in compliance with the Contract Documents. For each piece of equipment being tested, all systems associated with the operation of the equipment (e.g., controls, supply/discharge piping, etc.) shall be installed and be in full operating condition so that all equipment functions are able to be completely tested without delay using real-time process I/O.
 2. All control wiring, hardwired interlocks, OIP screens, control programming, etc., shall be checked out and functionally tested by System Supplier prior to CONSULTANT's on-site

- functional acceptance testing. All functional errors shall be corrected prior to CONSULTANT's on-site functional acceptance testing.
3. CONTRACTOR shall submit updated versions of all OIP screens developed by this System Supplier to CONSULTANT for review at least one month prior to the functional acceptance testing of equipment controlled through the associated OIP screens.
 4. Coordination Videoconferences:
 - a. CONTRACTOR shall schedule and conduct an initial functional acceptance testing coordination videoconference at least two months prior to the anticipated functional acceptance testing. The videoconference shall include CONTRACTOR, System Supplier, Division 26 contractor, OWNER, and CONSULTANT, and all other parties responsible for the equipment and controls scheduled for functional acceptance testing.
 - b. CONTRACTOR shall schedule and conduct additional functional acceptance testing coordination videoconferences one month prior to the date for functional acceptance testing to confirm status of equipment installation and System Supplier checkouts, and updates to the functional acceptance testing schedule, after which CONSULTANT will finalize reservations for travel and accommodations. If the functional acceptance testing is rescheduled within one month of the agreed upon date, there will be deducted from payments due to CONTRACTOR the amount of penalties paid by CONSULTANT for travel and accommodation cancellations. OWNER will deduct the amount of these charges from payments made to CONTRACTOR.
 - c. CONTRACTOR shall provide the following information in written form at each videoconference. All information shall be updated prior to each videoconference.
 - (1) Equipment installation and manufacturer's startup schedule.
 - (2) Status of all power and control system wiring for the equipment scheduled for functional acceptance testing.
 - (3) Schedule and status of System Supplier's on-site checkout and functional testing.
 - (4) Anticipated delays and the cause of each delay.
 - (5) Conflicts with OWNER's operation of the facility.
 - (6) Proposed dates for acceptance testing of all equipment and controls.
 - (7) Proposed dates for future acceptance testing coordination videoconferences.
 5. After being notified by CONTRACTOR that the equipment has been installed and is in full operating condition and ready for CONSULTANT's functional acceptance testing, CONSULTANT will make one 2-day trip to check operation. CONTRACTOR and System Supplier shall be on-site during testing to adjust equipment, correct erroneous wiring, and make modifications to control system and OIP, as necessary. If the equipment and controls do not operate according to the Contract Documents, or if CONTRACTOR and System Supplier are not present during the scheduled testing, there will be deducted from payments due to CONTRACTOR the amount of \$1,500 a day for CONSULTANT's time plus travel and expenses, and for all additional field and office time spent by CONSULTANT checking equipment. OWNER will deduct the amount of these charges from payments made to CONTRACTOR.
 6. System Supplier shall provide functional acceptance testing support through one or more on-site field service engineers and the project control system programmer. Time for the on-site field service engineers and programmer scheduled for functional acceptance testing shall be dedicated to the functional acceptance testing process and shall not be interrupted for other construction-related activities.
- B. Final acceptance and payment will not be made until the system has operated satisfactorily for a minimum of 30 consecutive days. CONTRACTOR shall include in the Bid field follow-up

to provide proper adjustments and operation during the first year following project final completion. Prior to beginning the 30-day test, the following criteria shall be met:

1. Satisfactory operation of I/O control loops.
2. Satisfactory operation of software.
3. Satisfactory operation of control program.
4. Satisfactory operation of peripheral equipment.
5. The necessary debugging programs have been performed.
6. Data output is reliable.
7. Control loops are operational.
8. Checking and calibrating of systems have been completed.

C. CONTRACTOR, through System Supplier, shall provide the following support services:

1. Field Service Engineer: Field service engineer shall be responsible for programming of system PLCs and OIPs in the factory and at the site. Field service engineer shall be present at the factory acceptance test and be present for startup of all systems and available throughout the entire construction process until final completion. Service technicians sent for system startup will not be acceptable. Support shall include on-site time. Services shall include, but not be limited to:
 - a. Commissioning, installation, startup, and testing of equipment.
 - b. Revising or rewriting manuals to incorporate an installed and accepted system.
 - c. On-site training.
 - d. Software modifications.
2. In-factory support shall include consultation following the acceptance testing and shipment. Services shall include, but not be limited to:
 - a. Researching and answering questions related to the system operation, documentation, and system use and functions.
 - b. Program modifications.
 - c. Revising or rewriting manuals.
3. Post-startup support shall include follow-up services during the one-year period following final acceptance. Service shall include follow-up recalibration and replacement of defective equipment, as well as additional training, software modifications, and control configurations as requested by OWNER. This shall include 8 hours for work on-site other than warranty repair or replacement of defective equipment. This time shall be used for software enhancements and modifications to improve the operation of the system. In addition to the 8 hours, include one trip to the site.

D. CONTRACTOR shall not install any hardware or software to enable remote access or control without written permission from OWNER and CONSULTANT.

1.11 COMMON REQUIREMENTS ALL EQUIPMENT

- A. All indicating and recording devices shall be electric or electronic.
- B. All indicating and control devices mounted on motor control panel and MCC enclosure doors (e.g., meters, gauges, electronic indicators, pilot lights, selector switches, VFD HIMs, OIPs, etc.) shall be located at eye level, minimum 48 inches, maximum 60 inches, from floor to bottom of device. Indicating devices on MCC enclosure doors located in the bottom half of an MCC section shall be mounted as high as possible.
- C. All motor control power shall be 120 volts with suitable circuit protection (fuses or breakers). Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.

- D. Devices powered at 120 volts from motor control panels shall be fused. This shall include, but not be limited to, motor-operated valves, flowmeters, and transmitters.
- E. Provide lightning protection, isolation transformers, and fused disconnects at each end of each power circuit, supervisory circuit, and local supervisory circuit with transformers and relays, if necessary, to obtain supervisory power. 120-volt power shall be available at all control points. Lightning protection shall be completely solid-state and self-healing and shall not require the use of fuses. Provide a single switch with an indicating light to deenergize the control power for each location. Each panel shall have a GFI, duplex, 15 ampere, 120-volt receptacle.
- F. If enclosure and back panel space is specified to be provided for the installation of future equipment, the enclosure and back panel shall be constructed to accommodate all future equipment. Supports and wireway shall be provided for future equipment, and openings in the enclosure shall be provided for future pilot devices and covered with neat cover plates matching the finish of the enclosure.
- G. Where equipment is necessary to perform a function as called for in one part of this specification, it shall be provided, even though the detailed enumeration at various control points may omit listing that equipment.
- H. Where a certain accuracy of sensing and transmitting flows, or other process conditions and controlling operations are called for, means shall be provided to read or determine that the process conditions are within the limits or accuracy specified for the sensing, transmitting, and controlling devices. Where no accuracy is specified, but a knowledge of process conditions is necessary to set operating points, provide accuracy consistent with the requirements for operation of the system.
- I. All control and auxiliary relays shall have indicating LEDs. All timing relays shall have On and timing Out LEDs.
- J. An anti-condensation heater shall be provided in all control panels located outdoors. The anti-condensation heater shall be as manufactured by Hoffman Model DAHX001, or equal, sized based on control panel and exterior temperature. Anti-condensation heater shall be rated for a minimum of 500,000 operating hours.
- K. Status signals for motors powered from VFDs and associated equipment, noted in the Section 26 09 90—I/O Listing to be communicated to the associated PLC via Ethernet shall be wired to inputs on the VFD and communicated to/from the PLC via the EtherNet/IP network.
- L. Hardwired Motor Controls:
 - 1. Equipment and wiring specified to be hardwired shall be physically wired independent of controllers, programmable relays, and communication systems to allow manual operation in the event of an emergency.
 - 2. Motor control wiring and logic shall be set up such that in the event of a power failure, equipment shall automatically restart if previously running, or remain off if previously off. A manual reset shall not be required to restart equipment following a power failure.
 - 3. All hardwired local controls for VFDs shall be fully functional in the event of an Ethernet communication failure between the VFD and the PLC.

1.12 GENERAL CONTROL ALGORITHMS

- A. In general, the following is a definition of I/O at each MCC:
 - 1. Run from auxiliary starter or VFD contact (dry contact or Ethernet).
 - 2. Fail from starter overload or VFD auxiliary contact (dry contact or Ethernet).
 - 3. Start/Stop maintained signal to starter or VFD, or as required (dry contact or Ethernet).
 - 4. In Auto/In Remote from selector switch on motor controller (dry contact or Ethernet).
 - 5. Any command to operate shall be acted upon within 5 seconds, and any status feedback signals shall be received within 5 seconds.
- B. All setpoints described in Part 3 of this Section shall be operator adjustable throughout the specified range of each setpoint, unless setpoint is noted to be hardcoded into the PLC logic.
- C. All alarm contacts or system changes following a command must exist or not change for 0 to 5 seconds to activate an alarm at the SCADA System.
- D. All analog and digital inputs shall be monitored in the PLC. This shall include, but not be limited to, flows (water, etc.) and electrical values. The following analog signals shall have minimum, maximum, and running average calculated values: all flows and kilowatts. Instantaneous values, totals, maximum, minimum, and average values shall be reset on a daily basis as described below. Minimum, maximum, and average values shall be stored in the PLC for the current day and previous day.
- E. PLCs shall calculate equipment runtimes and number of starts for all equipment where run signals are monitored. Runtimes and number of starts shall be read by the OIP software and be reset on a daily basis as described below.
- F. Totalized flow values and equipment runtimes as described above shall be stored in the PLC for a period of 7 days. The PLC shall indicate the specific date for each of the 7 previous days.
- G. Daily flow totals, runtimes, number of starts, and number of cycles as described above shall be reset on a daily basis. This reset shall occur based on a time (hour and minute) setpoint stored in the PLC through the OIP software. The operator shall set the time when the daily reset will occur. Once this time setpoint matches the current time of the processor clock, the PLC shall clear any totals that have accumulated.
- H. In addition to the totalizers described above, the PLC shall also calculate cumulative totals for all runtimes, number of starts and flows. Maximum, minimum, and running average for all analog inputs shall also be included as part of the cumulative total algorithm. Cumulative totals shall totalize until manually reset by the operator. The reset tag within the PLC shall be set by the operator at the OIP software and reset by the PLC. There shall be a manual reset for each signal. The PLC shall display the date of the last cumulative totalizer reset for each signal.
- I. Indication of time remaining for all timers (hardcoded and operator adjustable) within PLCs shall be made available for indication at the OIP.
- J. All analog signals shall be scaled to engineering units in the PLC with real or floating-point data types to prevent scaling values in the OIP. This shall include upper and lower limits for the associated device (i.e., 0 to 150 psi).

- K. The operator shall be able to set the processor clock and processor date in the PLC from the OIP software.
- L. For all analog input signals to the PLC I/O cards, provide a Transmitter Fail alarm at the OIP for each transmitter. Transmitter fail shall be defined as the signal from the transmitter being out of range.
- M. The following analog signals shall have associated high setpoints and alarms: amps.
- N. PLCs shall be set up so that the ranges of all analog input signals to the PLC I/O cards can be configured from the OIP. Provide two operator-adjustable setpoints for each analog input, one corresponding to 4 mA and the other corresponding to 20 mA. This feature is intended to be used for startup and calibration purposes.
- O. All equipment controlled automatically from the PLC shall have "Call-to-Run" signals generated from the PLC. These signals shall be displayed at the OIP. Each PLC shall also generate a Call-to-Run Fail alarm if the equipment is called-to-run but does not start within a specific time period. The Call-to-Run Fail alarm shall be generated within the PLC software and may not be combined with other fail signals such as hardwired motor fails, and overtemperature. Call-to-Run Fail alarms shall only be active when the selector switch on the motor controller is in the "Auto" position.
- P. All valves controlled automatically from the PLC that have position feedback shall have "Call-to-Open/Close" signals generated from the PLC. These signals shall be displayed at the OIP. The PLC shall also generate a Call-to-Open/Close Fail if the valve is called-to-open/close, but does not open/close within a specific time period. The Call-to-Open/Close Fail signal shall be generated within the PLC software and may not be combined with other fail signals such as hardwired actuator faults. For valves with analog 0 to 100% position feedback, provide an operator-adjustable deadband on the position feedback signal such that when the valve position feedback is within the deadband of the position setpoint, the valve shall be considered "in position."
- Q. In cases where the automatic alternation of equipment is provided by the PLC, indication of the lead, lag, and lag-lag pumps (where applicable) shall be made available for display at the OIP.
- R. All controlled equipment as described herein shall have the capability of manual control from the OIP through the manipulation of analog or digital variables. This shall be through the use of a "OIP H-O-A" switch or by forcing a single I/O point as a manual start command. All analog and digital outputs shall be capable of being manually set from the OIP.
- S. Where a manual reset is required at the OIP (i.e., level lockout, pressure lockout), the PLC shall be configured to set a discrete reset bit. Once the PLC receives the bit and the alarm condition has cleared, the PLC shall clear the alarm and place the associated equipment back in service.
- T. The OIP shall allow the operator to change all setpoints and operating parameters within the PLC as described herein. All control algorithms and alarms for equipment shall be programmed in the PLC. Control of each piece of equipment shall be accomplished as described herein and in Part 3–Execution of this section.
- U. Each alarm shall have a discrete PLC tag that is able to be toggled at the OIP to enable or disable the associated alarm from being activated.

- V. The OIP shall provide logged data of both alarm and utilization functions for the system. This data shall be capable of being printed out based on demand, hourly use, or 24-hour periods as desired by the operator. The system shall store this 24-hour data for periods of up to one year giving on-demand or as-required monthly reports.
- W. In the event of a power failure, when power is restored, the PLC shall automatically stagger the restart of any controlled equipment that is being called to run by the PLC. The stagger shall be operator-adjustable from 0 to 300 seconds from the OIP.
- X. Provide a hardcoded minimum speed within the associated PLC for each pump operating on a VFD. The minimum speed shall be the minimum speed at which the pump will still produce flow. Coordinate the minimum speed with the pump manufacturer during startup.

1.13 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization or Substantial Completion of the project.

PART 2-PRODUCTS

2.01 EQUIPMENT ENCLOSURES

- A. New enclosures shall be front access only, minimum No. 14 gauge steel, with continuously-hinged doors. Enclosures equal to or smaller than 24 inches wide by 24 inches high shall be equipped with at least two quarter turn latches. Enclosures larger than 24 inches in any dimension shall be equipped with 3-point latch with top and bottom bolts actuated by one rotating, lockable handle on each door. Provide a door stop kit for each door, data pocket for wiring diagrams, and minimum 12-inch, bolt-on, LED light and door switch. Panels over 48 inches wide shall have two lights. Painting shall include phosphate treatment, zinc chromate iron oxide primer, baked rust-inhibiting enamel, and white interior. All doors and panels shall be gasketed. All louvers shall be filtered and forced-air cooling shall be provided as necessary for conditions where installed. Provide enclosure dimensions as specified herein. Enclosures shall be as manufactured by Hoffman or Saginaw. MCC structures are not acceptable.
- B. Each MCP enclosure shall include, but not be limited to, the following equipment:
 - 1. PLC, I/O modules, and communication modules.
 - 2. Power supplies.
 - 3. Surge protective devices.
 - 4. DIN-rail mounted terminal blocks for field wiring terminations.
 - 5. Plastic wiring ducts.
 - 6. General purpose 15-amp, 120-volt AC duplex GFCI receptacle.
 - 7. 20-amp, 120-volt AC main circuit breaker and branch circuit breakers as required to feed the PLC and the I/O controlled field devices.
 - 8. Other accessories required to provide a complete and working PLC system.
 - 9. UPS backup for the MCP.
 - 10. Network switch.
 - 11. Front panel-mounted programming port with RJ-45 jack and 120-volt receptacle.

- C. The equipment mounted within the enclosures shall be mounted on the enclosure back panel, neatly organized, and shall be in accordance with the manufacturer's recommendations.
- D. Refer to Section 26 05 53—Electrical Identification for the control panel and field wiring color code.
- E. 24 VDC power supplies shall be provided in the enclosures to power all 24 VDC devices and loop-powered analog input signals, where required.
- F. NEMA ratings of enclosures shall be as required for the area where installed, unless specified otherwise.
- G. Manufacturer of Accessories:
 - 1. Plastic wiring duct shall be Panduit Panduct, or equal.
 - 2. Terminal blocks shall meet the requirements of Section 26 05 19—Wire.
 - 3. Wire markers shall meet the requirements of Section 26 05 53—Electrical Identification.
 - 4. Circuit breakers shall be Square D Type QO with mounting bases, or equal. Circuit breakers can be rail-mounted type, Square D, Class 9080, Type GCB-150, or equal.
 - 5. Signal conditioners shall be Action Instruments, DIN rail mount, or equal.
 - 6. Power supplies shall be Allen-Bradley Model 1606-XLS, or equal, and shall meet the following requirements:
 - a. Sized for the connected load plus inrush with capacity for a 50% power boost for up to 5 seconds.
 - b. Integral, dry-contact relay for monitoring "DC OK" status at the OIP.
 - c. UL Listed.
 - d. Conformal coated.
 - e. Temperature Range: -25°C to 60°C.
 - f. Protection Features:
 - (1) Over-voltage protection.
 - (2) Protection against no-load and short circuit conditions.
 - (3) Over-temperature protection.
 - (4) Internal input fuse.
 - (5) MOV-type input transient protection.
- H. All wiring within the enclosure shall be through plastic wiring troughs. Plastic wiring troughs shall have removable covers. Maximum fill for wiring troughs shall be 60%. All wiring in supervisory enclosures and control panels not in wiring troughs shall be bound with continuous-type spiral windings. Terminal strips located adjacent to wiring troughs shall have a minimum of 1 1/2 inches between terminal strip and wiring trough. All wiring labels shall be able to be read without removing wiring trough covers. Wiring troughs shall be provided for all field wiring.
- I. All wiring for new panels shall be done in the factory, Class II, Type C with master terminal strips for exterior connections. Terminal strips shall be located either at the bottom or on the side of the enclosure, depending on where the I/O conduits penetrate the enclosure. Splices are not allowed within enclosures or wireways. All enclosures must pass through doors to point of installation, and if enclosures are shipped in sections, all wiring and connections between sections shall be done by CONTRACTOR. The field wiring terminals shall be clearly identified as to which I/O terminals they are wired. Jumpers between adjacent terminal blocks shall be copper jumper bars supplied by the terminal block manufacturer. All wiring shall be labeled at each end with corresponding numbers matching the associated terminal block. This numbering shall be shown on the shop and Record Drawings.

- J. All door-mounted devices shall be furnished flush-mounted, and an exterior-engraved phenolic nameplate worded by OWNER (upon receipt of shop drawings) shall be provided for each component, device, and light. All components within the enclosures shall be identified with sticky-back adhesive, self-laminating, machine-printed marking labels with white background and black text; minimum size 12 font. Labels shall be installed on the enclosure back panel and not on the device or wireway. Devices shall be grouped for each device or unit being controlled.
- K. All panels with DIN rail-mounted equipment shall include a minimum of 25% spare DIN rail space.
- L. In addition to spare I/O specified herein, provide a minimum of 25% spare hot and neutral terminals wired to terminal strips. Spares shall be provided for all voltage sources within the panel (e.g., 120 V, 24 V).
- M. Enclosures that include motor controllers shall have a main disconnect for the enclosure.

2.02 COMPACTLOGIX PROGRAMMABLE LOGIC CONTROLLERS

- A. Construction:
 - 1. The PLC shall include a CPU, memory, embedded dual Ethernet ports, and embedded energy storage.
 - 2. The PLC and all system modules shall be DIN rail mounted.
 - 3. All system modules shall be able to operate in an industrial environment with an ambient temperature of 32°F to 140°F.
 - 4. All system modules shall be able to operate in a free airflow environment.
 - 5. All system modules shall have a conformal coating.
 - 6. All system modules shall be able to operate in high electrical noise environments.
- B. The system shall support a minimum of eight local I/O expansion modules in up to three chassis.
 - 1. Local expansion modules shall be installed in the local chassis or in chassis adjacent to the local chassis.
 - 2. The manufacturer shall have available a variety of I/O modules, including, but not limited to, AC or DC discrete input, AC or DC relay contact output, 4-20 mA analog input and output, and RTD.
 - 3. Each chassis in multiple-chassis installations shall be interconnected via Ethernet.
 - 4. Discrete I/O cards shall be 120 VAC 16 point maximum, unless otherwise noted.
 - 5. Isolated discrete I/O cards shall be 8 point maximum. Isolated discrete cards shall be used if there are multiple or external power sources associated with the signals, if wiring leaves the building, or if the card is driving a load (i.e., solenoids, etc.).
 - 6. Analog input cards shall be 8 point.
 - 7. Analog output cards shall be 4 point isolated type.
- C. CPU:
 - 1. The CPU shall be a self-contained unit, and shall be capable of providing control program execution, supporting remote and local programming, controlling all I/O scanning and inter-controller and peripheral communication and diagnostic functions as follows:

- a. 32 tasks (1,000 programs per task):
 - (1) Continuous—one allowed.
 - (2) Periodic—Run via an interrupt at a user-defined interval in 1 μ s increments from 1 ms to 2000 s.
 - (3) Event—Triggered by consumed tag or EVENT instruction.
 - b. 256 controller connections.
 - c. Network connections:
 - (1) Up to 256 EtherNet/IP.
 - (2) Up to 120 TCP/IP.
 2. The PLC shall organize user applications as tasks, which can be specified as continuous, periodic, or event based. Tasks shall be triggered by input point or instruction.
 3. The CPU shall have a real-time clock.
 4. When the main power supply is removed, the CPU shall have the ability to back up user program and all data, or a nonenergy storage option.
 5. The front of the CPU shall have a USB port.
 6. The front of the CPU shall have an integrated latching mechanism for securing the secure digital (SD) memory card. The PLC shall operate with the memory card removed.
 7. The processor module shall have LED indicators to indicate CPU status.
 8. The processor module shall have a mode switch.
- D. Memory:
 1. The PLC shall have a minimum of 3 MB of standard user memory. Provide processor configurations with additional memory as required.
 2. The program storage medium shall be solid-state, nonvolatile type.
 3. The PLC shall include a 2 GB SD memory card to store the user program and the firmware of all modules residing in the same chassis to protect against memory loss.
- E. Programming Environment:
 1. Programming shall be through the USB 2.0 port or through the EtherNet/IP network.
 2. The programming software shall run on the latest version of Windows and the programming methods shall be:
 - a. IEC 61131-3 compliant ladder diagram.
 - b. Structured text.
 - c. Function block diagram.
 - d. Sequential function chart.
- F. Communication:
 1. USB 2.0 port to support upload and download, online edits, firmware updates, and bridging to other modules.
 2. EtherNet/IP switch and dual 10/100/1000 Mbps EtherNet/IP ports with unique IP addresses or a single IP address when connected as part of a device level ring. The interface shall support:
 - a. IEEE 802.3 Physical and Data Link Standard.
 - b. Common Industrial Protocol (CIP), the protocol that provides real-time I/O messaging and information/peer-to-peer messaging.
 - c. Standard TCP/IP and UDP/IP communication.
 - d. 10/100/1000 Mbps auto sensing and auto switching.
 - e. Standard Ethernet media.
 - f. Subnet masking.
 - g. BOOTP and DHCP support.
 - h. Manual configuration using specified software.
 - i. Programmable Logic Controller messaging to peer controllers and workstations.

- j. I/O data, real-time interlocking and information.
 - k. Full-duplex communication.
 - l. Built-in web access to diagnostics.
 - m. I/O control.
 - n. Precision Time Protocol (CIP Sync, IEEE 1588).
- G. Power Supply:
- 1. The PLC shall be provided with separate, dedicated, field-side power supplies, quantity as needed, for sensor/actuator (SA) power, and a separate, dedicated, system-side power supply for power to the PLC and I/O modules (MOD) power.
 - 2. Provide field-potential-distributor modules as needed to transition SA power from AC to DC or from DC to AC input power for downstream I/O modules.
- H. PLCs shall be as manufactured by Rockwell Automation, CompactLogix 5380 L3 Series, or equal.
- I. PLC Programming and PLC Software: System Supplier shall provide all PLC programming and software required to meet this specification. The software shall include, but not be limited to, the following:
- 1. PLC logic programs to be written by System Supplier for the PLC systems to accomplish the monitoring and control functions as specified herein. The System Supplier shall document and annotate the programs, update them as required after startup, and then turn two copies of the programs over to OWNER on two USB flash drives with project-specific labels.
 - 2. All I/O addressing that is to be viewed or manipulated by the OIP software shall be organized into contiguous blocks of integer tags for discrete bits and floating point tags for all other values to facilitate block data transfer between computers and PLCs.

2.03 UNINTERRUPTIBLE POWER SUPPLIES

- A. Provide a UPS backup in each motor control panel that will provide continuous communication for at least 30 minutes following a power failure. UPS power shall be provided, at a minimum, to the following equipment:
- 1. PLCs and I/O cards, controllers, and OIPs.
 - 2. Network switches, signal converters, and other communication devices.
 - 3. Power fail and communication indicating lights and alarm devices.
 - 4. Power supplies for loop-powered instruments.
 - 5. Intrinsic safety barriers.
- B. Exterior control panels with PLCs shall be provided with a 24 VDC battery controller for a UPS system.
- 1. UPS shall have a rated current of 40 A, battery charging current of 2 A, and dry contacts rated for 30 VDC, 1 A for DC Bus OK, Battery Fail, and Battery Discharged.
 - 2. UPS shall be Delta Model DRU-24V40ABN, or equal, with external battery sizes and quantities needed meet the runtime requirements specified herein.

2.04 INDUSTRIAL CONTROL RELAYS AND CONTACTORS

- A. Industrial control and power relays shall be installed in motor control centers, pump control panels, and motor controller enclosures where required by System Supplier. Relays used to interface with PLC I/O, motor control circuits, hard-wired control logic, and for loads less than 8 amps shall be terminal style, interposing/isolation relays. Relays for inductive loads, alarm lights, alarm horns, field wiring, or loads up to 15 amps shall be industrial, general purpose

square base relays. Contactors for branch circuits, or loads greater than 15 amps shall be industrial, electrically-held lighting contactors. Contactors for motor power control shall be industrial, electrically-held power contactors.

- B. Relays shall meet the following requirements:
 - 1. Interposing/Isolation Relays:
 - a. Configuration: SPDT or DPDT as required by System Supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 120 VAC, or as required by System Supplier.
 - d. Contact Rating: 8 A (DPDT), 16 A (SPDT).
 - e. Mechanical Operating Life: 10 million cycles.
 - f. Status: On-Off flag-type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen-Bradley, 700-HK, or equal.
 - 2. General Purpose Relays:
 - a. Configuration: DPDT or 3PDT as required by System Supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 120 VAC.
 - d. Contact Rating: 15 A, minimum; 3/4 hp.
 - e. Mechanical Operating Life: 10 million cycles.
 - f. Status: On-Off flag-type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen-Bradley, 700-HB, or equal.
 - 3. Power Contactors:
 - a. Configuration: Electrically-held, 3 poles.
 - b. Mounting: DIN rail.
 - c. Voltage: 120 VAC.
 - d. Minimum Contact Rating: 20 A continuous, 1 hp.
 - e. Mechanical Operating Life: 1.3 million cycles.
 - f. UL listed.
 - g. NEMA rated.
 - h. Manufacturer: Allen-Bradley, Bulletin 300, or equal.

2.05 MAGNETIC FLOW METERS

- A. The magnetic flow meters shall be suitable for measuring sludge flows in the range indicated in the table below. The magnetic flow meters shall consist of a flanged flow tube with grounding rings and remote transmitter. The flow tube shall be of 304 stainless steel with hard rubber liner. Flanges shall be carbon steel and conform to ANSI B16.5, Class 150.
- B. The meters shall utilize bipolar DC coil excitation or other means to automatically rezero. Meters shall be provided with grounding rings made of material compatible with electrode material. Electrodes shall be bullet nose, 316 stainless steel suitable for sludge applications with up to 10% solids.
- C. The meter shall incorporate design features to minimize the effect of greasy (nonconductive) coatings or incorporate a means to automatically clean the electrodes during continuous operation. Meter accuracy shall not be affected by greasy coatings, and cleaning of the meter manually shall not be required.
- D. Meter accuracy shall be $\pm 0.5\%$ of rate from 1.0 to 30.0 ft/sec and 0.1% of scale below 1.0 ft/sec when installed with the appropriate upstream and downstream pipe diameters. The

meters shall be wet-calibrated in a primary flow laboratory traceable to the National Institute of Standards and Technology. Transmitters and flow tubes shall be interchangeable.

- E. The transmitter shall be designed to operate on 120 VAC, 60 Hz. Power consumption shall not exceed 20 watts. Connections at the flow tube shall be factory-potted. Outputs shall be 4-20 mA and totalizer scaled pulse, suitable for driving a solid-state counter. Pulse width and volume of flow per pulse shall be widely adjustable before or after installation to allow interface with PLC input cards and other devices.
- F. Outputs shall be field-adjustable for range changes. Response time or damping shall be adjustable from 0.8 to 8.0 seconds. The meters shall be operable in all liquids with 5.0 umhos/cm or more conductivity.
- G. The meters shall include empty pipe detection. Provide a single analog output representing instantaneous flow.
- H. Enclosure Ratings:
 - 1. Flow tube enclosure shall be NEMA 4 for FIT-43-01 and FIT-43-02. Flow tube enclosure shall be Class I, Division 2 for FIT-43-03.
 - 2. Remote transmitters shall be NEMA 4.
- I. The magnetic flow meters shall be Endress and Hauser ProMag 400, or Krohne Optiflux 2000. Meters shall be sized to match the nominal pipe diameter in which they are installed. Provide cable, length as required, to reach from the flow tube to the remote transmitter; CONTRACTOR shall coordinate. Flow meters shall be provided as follows:

Tag No.	Transmitter	Size (Inches)	Maximum Scale	Directional
FIT-43-01	Remote	10	1600 gpm	No
FIT-43-02	Remote	10	1600 gpm	No
FIT-43-03	Remote	6	500 gpm	No

- J. Remote trasnmittter shall be Endress and Hauser ProMag W400 transmitter, or Krohne IFC 300 converter.
- K. Transmitter shall be FM approved and CSA certified. Remote transmitter shall include back-lit display and push buttons or other means for local operation and maintenance. Display shall include instantaneous flow and totalized flow and indication of present faults.
- L. Provide stainless steel information tag that indicates instrument number, service, and calibration range.
- M. For all remote transmitters located outdoors, the transmitter shall be installed in a fiberglass, hinged-cover, NEMA 4X enclosure with window and front door-mounted, rotating handle, Hoffman Model Ultrx, or equal. Enclosures with side clamps or hasps are not allowed. Enclosure shall include a main circuit breaker disconnect, surge protection devices specified herein, anti-condensation heater, Hoffman DAH Series, or equal, with temperature control switch model ATEM. Mount the transmitter off the enclosure back panel so the display is visible at the enclosure window. Provide sun shield for all transmitters located outdoors.

2.06 OPERATOR INTERFACE PANEL

- A. The operator interface shall meet the following general specifications:
 - 1. Voltage: 85 VAC to 264 VAC.
 - 2. Temperature: 0°C to 55°C.
 - 3. Humidity: 5% to 95% noncondensing.
 - 4. RFI: MIL-STD-461B.
 - 5. EMI: IEEE 472-1974.
 - 6. Communication Port: Ethernet.
- B. The operator interface shall have the following minimum features:
 - 1. Type: Color Active Matrix Thin Film Transistor (TFT) touchscreen LCD.
 - 2. Display Size: 10.4-inch.
 - 3. Resolution: 800 by 600, 18-bit color graphics.
 - 4. Clock: Battery-backed real time.
 - 5. Application Memory: 512 MB.
 - 6. Enclosure: NEMA Type 12.
- C. The operator interface panel shall be as manufactured by Allen-Bradley, Panelview Plus 7 Performance, or equal.

2.07 SURGE PROTECTIVE DEVICES FOR CONTROL PANELS, INSTRUMENTATION, AND NETWORK EQUIPMENT

- A. The incoming power supply of each control panel shall be protected with a surge protective device (SPD). SPD unit shall be as manufactured by Citel, Model DS72US, or equal. Surge protection shall be provided for all phases and neutral.
- B. Each analog signal entering or leaving a motor control panel shall be provided with a DIN-rail mounted surge protection device as manufactured by Citel, Model DLA-24D3, or equal. Each transmitter shall be provided with a surge protection device as manufactured by Citel, Model TSP15M, or equal, on the output and Citel, Model DS72US, or equal, on the power supply. Surge protection shall be provided for all phases and neutral.

2.08 INTRINSIC SAFETY BARRIERS

- A. Instrumentation equipment located in hazardous areas as noted on the Drawings shall be wired to intrinsic safety barriers. Safety barriers for discrete devices shall include indicating LED and be DIN-rail mounted, as manufactured by Phoenix Contact, Model MACX MCR-EX-SL-2NAM, (voltage as required), PR Electronics, Model 5202B2, or equal.

2.09 INDUSTRIAL ETHERNET SWITCHES

- A. Managed Switches:
 - 1. Gigabit Uplink: Provide managed Ethernet network switches with Gigabit-Uplink SFP ports where shown on the Drawings. Network switches shall be as manufactured by Allen-Bradley Stratix 5200 series, or Hirschmann BRS30. Each switch shall include, but not be limited to, the following:
 - a. Selectable Gigabit Ethernet star or ring topology with redundant fail-over. Switches shall be configured for a ring topology, unless noted otherwise.
 - b. DIN rail mounting and redundant 24-volt DC power supply inputs. Provide redundant power supplies, Hirschmann Model RPS series, or equal.

- c. Command line interface, DHCP, and store and forward switching.
- d. SNTP real time clock.
- e. IP and MAC port security and SNMPv3.
- f. Compliance with the following IEEE Standards: 802.1D, 802.1p QoS, 802.3, 802.3u, 802.3x flow control, 802.1w RSTP, and 802.1Q VLAN.
- g. SNMP with web browsing for switch configuration, diagnostics, and monitoring.
- h. Dry contact alarm output for indication that the switch has failed.
- i. Two combo SFP, Gigabit Ethernet uplink ports for future fiber optic connection and provide as many copper 10/100 Fast Ethernet ports as needed as shown on the drawings.

2.10 THREE-PHASE VOLTAGE MONITORS

- A. Provide a voltage monitor in enclosures where specified herein. Voltage monitors shall be Timemark *269, Diversified Electronics SLM-440-ASE, or equal. System Supplier shall select the voltage to match the electrical distribution equipment being monitored.

2.11 NOTIFICATION DEVICES

- A. Warning Lights and Strobes:
 - 1. Nonhazardous locations:
 - a. General: The light shall provide a visual warning in the area where a potential hazard may occur in nonrated spaces.
 - b. Required Features:
 - (1) Beacon light: LED, field-selectable between steady-on mode (green) and flashing mode (amber and red), field-set to 65 flashes per minute.
 - (2) LED colors: Red, green, and amber. LED colors shall be capable of being individually controlled by a remote device. When the circuits for multiple LED colors are energized, the light shall automatically cycle through the energized colors.
 - (3) Lens color: Clear.
 - (4) Enclosure: UL listed; NEMA 4X.
 - (5) Power: 120 VAC.
 - c. Product and Manufacturer: Model 105XBRiRGA120A as manufactured by Edwards Signaling, or equal.
 - d. Provide Model 105BX outlet box attachment and 105BM mounting bracket as manufactured by Edwards Signaling, or equal, for wall mounting the lights.
- B. Alarm Horns:
 - 1. General: The horn shall provide an audible warning in the area where a potential hazard may occur.
 - 2. Required Features:
 - a. Decibel output: Minimum 100 dB at 10 feet.
 - b. Enclosure: Cast aluminum/epoxy-coated corrosion-resistant housing.
 - c. Horn diaphragm: Stainless steel.
 - d. Power: 120 VAC.
 - 3. Product and manufacturer: Series 876-N5 877-G1, as manufactured by Edwards Signaling, or equal.

PART 3–EXECUTION

3.01 MCC-A MODIFICATIONS

- A. Final Clarifier Drives (FCD-40-01) and FCD-40-02):
 - 1. O-O Selector Switch:
 - a. With the O-O selector switch in the On position, the motor shall start and run continuously.
 - b. With the O-O selector switch in the Off position, the motor shall be inoperable.
 - 2. There are two high torque switches at each clarifier: WSH-40-01 for FCD-40-01 and WSH-40-02 for FCD-40-02 are set at 40% torque for indication at the pilot light on the MCC bucket. Manual reset shall be required to deactivate the pilot light. The other two torque switches are WSHH-40-01 for FCD-40-01 and WSHH-40-02 for FCD-40-02 set 85% torque for shutdown. The shutdown torque switch shall be wired to the motor starter to shut down the unit upon activation of this switch. Manual reset shall be required to restart the motor. The shutdown torque switches shall be wired such that momentary power interruptions do not shut down the unit. The torque switches shall be hardwired to the motor control circuit via intrinsic safety barriers in the junction box at the unit. Provide a control power transformer for 120-volt power to the intrinsic safety barriers.
 - 3. Motor disconnect has an auxiliary contact that shall be wired to the MCC such that control power is disconnected when the disconnect is in the Off position.
 - 4. All the above controls shall be hardwired and not through the PLC.

3.02 CONTROL PANEL–GENERAL

- A. Control descriptions described herein are specific in nature to equipment associated with each Control Panel. CONTRACTOR shall refer to Paragraph 1.12–General Control Algorithms for additional programming requirements. Control descriptions shall reside in each local PLC.
- B. Each Control Panel shall have an exterior, panel-mounted receptacle and programming port for the Ethernet network mounted to the front of the panel. The receptacle and programming port shall be provided to allow for PLC programming via laptop without opening the panel door.
- C. Provide a control power fail relay in each Control Panel that shall be used to indicate an incoming control power fail alarm at the PLC. Provide a red indicating light on the inner-front door of each Control Panel to indicate a loss of incoming line power to the Control Panel. Control power fail wiring shall be hardwired and not through the PLC.
- D. There is a configurable network switch fail contact available at each managed network switch. This fail contact shall be wired to a relay, which shall be wired to the associated PLC for indication of a common network switch alarm. Each network switch shall be configured by System Supplier (via software) to provide this alarm.
- E. Refer to the Section 26 09 90–I/O Listing for all required I/O that shall interface with each PLC. For each PLC, provide the lesser of a minimum of 25% spares or one completely spare I/O module for analog and discrete inputs and outputs. All spare and unused I/O shall be wired to terminal blocks.

3.03 GENERAL OPERATOR INTERFACE PANEL (OIP) REQUIREMENTS

- A. Each OIP shall be programmed to allow the operator to enter all control and alarm setpoints associated with its Control Panel. Each OIP shall be set up such that it prompts the operator for the setpoints to be entered. Each OIP shall provide indication and operating functions for the system as follows:
1. A process overview and zoomed-view screens as required for additional details for all processes that are monitored and/or controlled from this PLC.
 2. System status.
 3. Control switches (e.g. Hand-Off-Auto, On-Off, Open-Close-Auto, etc.) and pushbuttons for each piece of equipment.
 4. Adjustment for all system setpoints.
 5. Running, failed, open, closed, required, etc. for each piece of equipment.
 6. Status of all equipment and equipment run times.
 7. Indication of all analog signals.
 8. Control system timers and indication of time remaining and time to start for each timed sequence.
 9. Indication of all alarm conditions on an alarm summary screen. This screen shall show the last 10 alarms, indicate whether the alarm is active, unacknowledged, or returned to normal. The operator shall be able to acknowledge all or individual alarms from this screen. When an alarm is received, the OIP shall default to this screen to show the current alarm. The current alarm shall blink until acknowledged. Alarms shall list the time and date of each occurrence and be listed in chronological order.
- B. The OIP graphics configuration shall follow a situational-awareness theme that avoids the excessive use of color for process screen backgrounds, menus, borders, headers, buttons, equipment symbols, and text displays. Equipment symbols shall adhere to a specific color code for indication of equipment status and alarms. Avoid non-animating colors on equipment graphics. Main process graphic and popups screens shall use a light gray background color. Simulated facility graphics, environments, and three-dimensional layouts shall not be included on the backgrounds. Piping shall be represented by thin, solid-gray lines and shall not include contour shading. Process structures and tanks shall be represented using simple shapes (e.g., squares, rectangles, circles, etc.) and process equipment should be represented by simple, equipment-specific shapes (i.e., no gradients or shading).
1. Equipment:
 - a. Light gray shall be used to indicate that the equipment is not operating or running and has been disabled from automatic operation.
 - b. Yellow shall be used to indicate that the equipment is not running or operating, but is in an automatic control state and ready to operate once the operating conditions are met.
 - c. Orange shall be used to indicate that the equipment is called to run, but is not yet running.
 - d. Green shall be used to indicate that the equipment is running or operating in the forward direction.
 - e. Blue shall be used to indicate that the equipment is running or operating in the reverse direction.
 - f. Red shall be used to indicate failure conditions for equipment and signals.
 2. Valves:
 - a. Light gray shall be used to indicate that the valve is closed.
 - b. Green shall be used to indicate that the valve is open.
 - c. Red shall be used to indicate a valve actuator fault or a valve out of position alarm.

- C. In addition to the color code for equipment statuses, text indicating when equipment is “Running” or “Not Running” and when equipment is “In Auto” or “Not In Auto” shall be displayed next to the equipment using blue text for indication that the text is dynamic. Blue shall be reserved only for dynamic text, excluding the analog process variables described below.
- D. Analog process variable displays shall use black text inside of a thin, dark gray border with light gray background. The text shall animate to white and the background shall animate to red during an alarm condition for the associated process variable (e.g., high level, low level, transmitter fail, etc.), and shall remain in that state until the alarm condition is cleared.
- E. Setpoint-entry boxes be sized similar to the analog process value displays, but shall instead use a thicker border. The background color for setpoint entry boxes shall be light green for process control and system setpoints and shall be light red for alarm setpoints.
- F. Text size and font requirements:
 - 1. Font shall be Segoe UI Bold or Arial Bold.
 - 2. Text for general labels on process screens and menus shall be size 12.
 - 3. Text for value displays shall be size 14.
 - 4. Text for process graphic titles and menu titles may be sized as needed by the software developer, minimum size 16.

3.04 MCP-43

- A. Motor Control Panel:
 - 1. Provide a NEMA 4X, stainless steel, freestanding, enclosure with inner-front door and 24-inch leg kit including, but not limited to, the following:
 - a. 50-amp main circuit breaker disconnect with door-interlocked, padlockable handle. Provide a defeater to allow opening the inner door without disconnecting the power feed. Power to the process control panel shall be 480-volts, three-phase.
 - b. The control panel fault current interrupting rating shall be minimum 42,000 amps. Provide fusing for individual motor branch circuits where necessary to limit the available fault current to the rating of the branch circuit.
 - c. Power distribution and overcurrent protective devices for all internal and external equipment powered from this control panel. External equipment powered from this control panel shall consist of the following:
 - (1) 120-volt, 20-amp circuit to RAS/WAS Flowmeters FIT-43-01, FIT-43-02, FIT-43-03.
 - (2) 120-volt, 20-amp circuit to RAS/WAS pump area receptacles, lighting and Canopy Convenience Receptacle.
 - (3) 480-volt, 15-amp circuit to Wasting Valve (MOV-43-01).
 - d. Variable frequency drives (VFDs), and overcurrent protective devices for the following equipment:
 - (1) RAS/WAS Pump RASP-43-01.
 - (2) RAS/WAS Pump RASP-43-02.
 - (3) RAS/WAS Pump RASP-43-03.
 - e. Control power transformer.
 - f. PLC, power supplies, communication modules, and I/O modules.
 - g. Thermostatically-controlled, anti-condensation heater.
 - h. Relays, terminal blocks, and control devices as needed for the process control system.
 - i. Managed network switch with copper quantities as shown on the Drawings and fiber ports as specified herein.

- j. 24-volt DC uninterruptible power supply (UPS).
- k. Mechanical cooling sized as needed to maintain internal ambient temperatures 10°F below the rated operating temperatures of all internal control panel equipment. Enclosure rating shall match the process control panel enclosure rating.
- l. SPD as specified in Section 26 43 13—Surge Protective devices. The SPD shall be fed from a 30-amp circuit breaker connected to the load side of the main circuit breaker.
- m. Three-phase monitor. The three-phase monitor shall be fed from fuses connected to the load side of the SPD circuit breaker.
- n. Alarm horn and strobe powered from the UPS-backed control circuit and mounted to the exterior side of the control panel. The alarm horn and strobe shall be energized when any of the following alarm conditions are active. Provide a momentary “Silence” pushbutton on the control panel inner door for the alarm horn. The strobe shall remain energized until all alarm conditions are inactive.
 - (1) Pump Failure (VFD Fault, Motor Overtemperature, or Call-to-Run Fail for each pump).
 - (2) Three-Phase Monitor Alarm.
- 2. The following devices shall be mounted on the inner-front door of the enclosure:
 - a. 10-inch Operator interface panel (OIP) with project-specific HMI screens.
 - b. Red “Control Power Fail” indicating light.
 - c. VFD human interface modules.
 - d. Programming port and receptacle.
 - e. The following pilot devices shall be provided for all pumps controlled from this control panel:
 - (1) Hand-Off-Auto selector switch.
 - (2) Reset pushbutton.
 - (3) Elapsed time meter.
 - (4) Green “Running” indicating light.
 - (5) Red “VFD Fault” indicating light.
 - (6) Red “Motor Overtemperature” indicating light.
 - f. The following pilot devices shall be provided for all valves controlled from this control panel:
 - (1) Open-Close-Auto selector switch.
 - (2) Red “Fault” indicating light.
- B. Hardwired Motor Controls: RAS/WAS Pumps (P-43-01 through P-43-03):
 - a. H-O-A Selector Switch:
 - (1) With the H-O-A selector switch in the “Hand” position, the motor shall start and run continuously at the speed set on the VFD HIM.
 - (2) With the H-O-A selector switch in the “Off” position, the motor shall be inoperable.
 - (3) With the H-O-A selector switch in the “Auto” position, the motor shall be controlled from the PLC as described under PLC-Based Controls.
 - b. The motor has internal thermostats that shall shut down the motor in the event of overtemperature (“Hand” and “Auto” modes). Manual reset shall be required to restart the motor. Provide a hardwired time delay (0 to 5 seconds) to prevent overtemperature lockouts due to momentary power interruptions.
 - c. The motor disconnect has an auxiliary contact that shall be wired to the VFD enclosure such that control power is disconnected when the disconnect is in the “Off” position.
 - d. All of the above controls shall be hardwired and not through the PLC.

C. PLC-Based Controls:

1. The RAS pumps (RASP-43-01 through RASP-43-03) shall be controlled from this PLC with an OIP Hand-Off-Auto switch as follows:
 - a. In "Hand" mode, the pump shall run at an operator-adjustable speed setpoint (0 to 100%).
 - b. In "Auto" mode, the operator shall be able to select a "Flow Pace" mode, or "Constant Flow" mode for control of the pumps as follows:
 - (1) RASP-43-01 pumps from Clarifier No. 1 (FCD-40-01) and shall be interlocked with RAS flow meter FIT-43-01, RASP-43-03 pumps from Clarifier No. 2 (FCD-40-02) and shall be interlocked with RAS flow meter FIT-43-02, and RASP-43-02 pumps from either Clarifier No. 1 or No. 2 and shall be interlocked with the associated flow meter as selected by the operator. The operator shall be able to assign one and only one pump to each clarifier.
 - (2) In the "Flow Pace" mode, the operator shall be able to select either the average influent flow or average effluent flow for control of the pumps.
 - (a) When the "Influent Flow" is selected, each pump in service shall be flow paced based on the average plant influent flow rate. The average influent flow value shall be calculated in this PLC based on the instantaneous influent flow over an operator adjustable "Running Influent Flow Average" time period (0.1 to 24.0 hours). The average influent flow based on this setpoint shall be displayed at the MCP.
 - (b) When the "Effluent Flow" is selected, each pump in service shall be flow paced based on the average plant effluent flow rate. The average effluent flow value shall be calculated in this PLC based on the instantaneous effluent flow over an operator adjustable "Running Effluent Flow Average" time period (0.1 to 24.0 hours). The average effluent flow based on this setpoint shall be displayed at the MCP.
 - (c) In addition to the selection of a flow signal, the operator shall be able to enter the desired percentage (15 to 150%) of the selected average flow rate that is to be returned by each RAS pump. The PLC shall then monitor the RAS flow (FIT-43-01, FIT-43-02) from the associated RAS pump and control the pump speeds in order to obtain the selected return flow rate.
 - (d) The operator shall also have the ability to set the range of the influent/effluent flow over which each RAS pump is to be controlled. There shall be operator adjustable maximum and minimum flow setpoints for each RAS pump in service such that when the RAS flow (FIT-43-01, FIT-43-02) from each RAS pump reaches either of these setpoints, the pump speed shall not be able to be increased/decreased even if the controlling flow increases/decreases.
 - (3) In the "Constant Flow" mode, the operator shall be able to enter the desired flow rate (200 to 1600 gpm) to be maintained through each RAS pump. This PLC shall then control the pump speeds in order to maintain each flow rate setpoint.
 - (4) There shall be an operator adjustable "Flush Interval" timer (0 to 168 hours) set up within this PLC for each pump. When the flush interval timer expires, this PLC shall ramp the associated pump to an operator adjustable "Flush Speed" setpoint. The RAS pump shall continue to operate at this speed for an operator adjustable "Flush Duration" setpoint (0 to 60.0 minutes). The pump shall return to its normal control mode once the "Flush Duration" timer expires. Each pump shall have an operator selectable switch to allow this control mode to be disabled. The PLC shall only allow one pump to be in flushing operation. In the event more than one pump is in flushing operation suspend flushing

operation for pump that was called to flush last. Resume flushing operation of suspended pump when other pumps finish flushing operation.

2. The Wasting Valve (MOV-43-01) shall be controlled from this PLC with a Hand-Off-Auto switch as follows:
 - a. In "Hand" mode, the valve shall modulate to an operator-adjustable percent open setpoint (0 to 100%).
 - b. In "Auto" mode control of the valve is as follows: The operator shall be able to set the "Gallons to Waste" (0.0 to 150.0 kgal) and the flow rate (150 to 400 gpm) to be maintained. There shall be six operator-adjustable time-of-day (hour and minute) start setpoints. Once a time-of-day start setpoint is reached, the valve shall modulate to maintain the flow rate setpoint based on the measured flow rate (FIT-43-03). The valve shall close once the gallons wasted is equal to the "Gallons to Waste" setpoint. If the gallons wasted is not equal to the setpoint, but the valve has been opened longer than an operator-adjustable maximum open time setpoint (0 to 24 hours), the valve shall be closed and indication of "Excessive Waste Duration" shall be provided at the OIP. If a time-of-day setpoint is reached before the previous setpoint has finished wasting, an alarm shall be indicated at the OIP, and the next setpoint shall begin. The total gallons wasted for the current and previous days shall be displayed at the OIP.

3.05 INTRINSICALLY SAFETY BARRIERS JUNCTION BOXES

- A. Provide a junction box, sized as needed, where shown on the Drawings with terminal blocks and intrinsic safety barriers for equipment and devices as shown on the Drawings. The junction box NEMA rating shall be as shown on the Drawings.

END OF SECTION

SECTION 26 09 10

CONTROLS AND INSTRUMENTATION DRAWINGS

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit drawings in accordance with provisions of Section 01 33 00–Submittals.

1.03 COORDINATION

- A. The requirements set forth in this section are intended to apply to the drawings provided as specified in Section 26 09 00–Controls and Instrumentation, and Section 26 24 19–Motor Control.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

3.01 GENERAL REQUIREMENTS

- A. A bound set of as-built drawings shall be provided in the associated equipment enclosure.
- B. All drawings shall have the following information:
 - 1. Project information, including name of OWNER and specific project name.
 - 2. Drawing title, accurately representing what is on the drawing.
 - 3. Unique drawing identifier, consisting of a unique drawing number or drawing number with individual sheet number. If sheet numbers are used, total number of sheets must be identified on each sheet.
 - 4. System Supplier company name, address, and phone number.
 - 5. Original design information, including person responsible for design, date of original design, person responsible for checking of design, and date of design check.
 - 6. Revision block indicating revision number, date, description of revision, and person responsible for revision.
- C. All drawings shall have line numbers that can be uniquely referenced from other drawings.
- D. All drawings showing wiring shall include unique wire numbers assigned to wiring that is installed between devices in the panel. The wire number shall be shown on the drawings.
- E. All drawings showing relays shall include reference to the drawings where the relay contacts are shown. Spare relay contacts that are not used shall be identified.

3.02 DRAWINGS REQUIRED

- A. Index of Drawings: Index of Drawings shall list drawing number, sheet number (if applicable), and drawing title for each drawing in drawing package.
- B. Symbol Sheet: Symbol Sheet shall include:
 - 1. Explanation of all symbols used on the drawings, including, but not limited to, normally open/normally closed contacts, flow switches, limit switches, pressure switches, selector switches, pushbuttons, timers, control relays, solenoids, fuses, circuit breakers, terminal blocks, and contactors. Symbol sheet does not need to be specific to project, but must contain explanation of all symbols used on the drawings (i.e., special symbols used for a particular project must be added to standard symbol sheets).
 - 2. List of abbreviations used on the drawings.
 - 3. Explanation of continuation method for circuits that cannot be shown on a single sheet.
- C. Exterior Enclosure Layout Drawing: Exterior layout drawing shall show location of all externally-mounted equipment. Exterior layout drawing shall include:
 - 1. Enclosure dimensions, enclosure NEMA rating (i.e., NEMA 1, NEMA 4X stainless steel, NEMA 4X nonmetallic, etc.), and enclosure color or finish.
 - 2. Location and actual depiction of panel latches, hinges, mounting holes and lifting eyes.
 - 3. Location and accurate representation of equipment mounted on enclosure (i.e., switches should look like actual switches being installed; indicating lights should look like actual lights being installed).
 - 4. Equipment nameplate location.
 - 5. Description for each piece of equipment or unique identifier and parts list, or bill of materials.
 - 6. Nameplate list including nameplate wording, size, construction (i.e., lamicoid with Black background and White letters), and mounting method (i.e., stainless steel screws). Label size must include size in inches or reference to standard sizes included on symbol sheet, or elsewhere in drawing package.
 - 7. Identification of area reserved for equipment located inside enclosure, but not actually mounted on enclosure back panel, such as UPSs and lighting packages.
- D. Interior Enclosure Layout Drawing: Interior layout drawing shall show location of all internally-mounted equipment. Interior layout drawing shall include:
 - 1. Back panel dimensions and finish.
 - 2. Location and accurate representation of equipment (i.e., terminal blocks should look like actual terminal blocks; receptacle should look like actual receptacle, etc.).
 - 3. Dimensions of internally-mounted equipment are not necessary, but equipment should be drawn to scale such that an accurate representation of the way equipment will be mounted is shown on the drawing.
 - 4. Description for each piece of equipment or unique identifier and parts list, or bill of materials.
- E. Interconnection Diagram, Network Diagram or Block Diagram: Interconnection Diagram, Network Diagram or Block Diagram shall show all cabling between system components and identify any station addressing or node numbers that are assigned to equipment. All cables shall be identified by cable type, including specific manufacturer and model/part number. Party responsible for furnishing and installing cable shall also be included. Some examples of cables that must be shown are:
 - 1. Communications cables between system components (copper). This includes Ethernet patch cables between switches and devices.

2. Communications cables (copper) between PLCs, and operator interface equipment that are not shown on the elementary schematics.
- F. Elementary Schematic: Elementary schematics shall be developed for each motor or supplied equipment and shall include:
1. Nominal voltage, AC or DC designation, number of phases (if AC), and frequency in hertz (if AC) for each source of electrical supply to the enclosure.
 2. Prospective short-circuit current available at the point of electrical supply to the enclosure.
 3. Type of power supply system grounding (e.g., wye phase midpoint grounded, delta phases corner grounded, wye phases midpoint grounded, delta phases ungrounded, etc.).
 4. Complete documentation of electrical circuit from supply to motor or supplied equipment. Documentation shall include disconnecting means, main overcurrent protection (when supplied), branch overcurrent protection (when supplied), control circuit and special purpose control protection, motor control, overload protection, local disconnect (when supplied) and motor horsepower, and full load amps from nameplate or supplied equipment full load amps.
 5. Documentation of PLC or controller inputs and outputs.
 6. Documentation of all circuit breaker/motor protector ratings, fuse sizes, control power transformer VA ratings, dip switch settings, etc.
 7. Documentation of all VFD settings (e.g., under-voltage shutdown, ramp time, overload, excessive starts/hour, etc.) which have been changed from the factory default setting.
- G. Wiring Diagram: Wiring diagrams shall show all terminations for all cables external to the enclosure. Terminations may be shown on the elementary schematics as long as the termination information is concise and easily understood by the personnel installing the field wiring. Termination information shall be shown for all devices, including devices that are not part of System Supplier's scope of supply. A box with two dots or continuation arrows indicating continuation to a piece of equipment are not acceptable. Information shown on System Supplier's wiring diagrams shall include a description of the drawings where terminations are found (i.e., drawing title), drawing number where the terminations are found, and terminal blocks referenced on the drawing. System Supplier shall coordinate with supplier of other wiring diagram to provide information on System Supplier's wiring diagrams.
- H. Calculations Summary: Calculations summary shall include calculations performed to:
1. Determine size of UPS.
 2. Determine air conditioning equipment requirement.
 3. Determine control power transformer sizing. Control power transformer sizing calculations may be generic based on typical circuits.
- I. Functional Testing Recommendations: Testing recommendations shall include description of functional tests that must be performed by operators. Functional test description shall be included for UPS, indicating lights, and other devices whose condition can only be determined by testing.

3.03 SAMPLE DRAWINGS

- A. Sample drawings showing an acceptable format are included in the appendix. The samples included in the appendix do not represent the only acceptable method of showing the required information.

END OF SECTION

SCADA SYSTEM I/O LISTING

STRAND ASSOCIATES, INC.®
CITY OF COPPERAS COVE
COPPERAS COVE, TEXAS
NORTHWEST WWTP CLARIFIER REHABILITATION PROJECT
CONTRACT 1-2025
BID NO. PW 2025-03-84
I/O LISTING - MCP-43

MCP	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
43	CONTROL POWER FAIL		1	0	0	0	2~#14	FROM CONTROL POWER FAIL RELAY IN THIS MCP
43	UPS DC BUS OK		1	0	0	0	2~#14	FROM UPS IN THIS MCP
43	UPS BATTERY FAIL		1	0	0	0	2~#14	FROM UPS IN THIS MCP
43	UPS BATTERY DISCHARGED		1	0	0	0	2~#14	FROM UPS IN THIS MCP
43	MCP-43 NETWORK SWITCH ALARM		1	0	0	0	2~#14	FROM NETWORK SWITCH IN THIS MCP
43	MCP-43 SPD FAIL		1	0	0	0	2~#14	FROM SPD IN MCP
43	MCC-43 POWER FAIL		1	0	0	0	2~#14	FROM PHASE MONITOR IN MCP
43	RAS PUMP NO. 1	RASP-43-01						
43	IN AUTO		X	0	0	0	ENET	FROM HOA SWITCH ON MCP VIA VFD
43	RUNNING		X	0	0	0	ENET	FROM VFD
43	VFD FAULT		X	0	0	0	ENET	FROM VFD
43	MOTOR OVERTEMP		X	0	0	0	ENET	FROM MOTOR THERMOSTATS VIA VFD
43	START/STOP		0	X	0	0	ENET	TO VFD
43	AMPS		0	0	X	0	ENET	FROM VFD
43	kW		0	0	X	0	ENET	FROM VFD
43	SPEED FEEDBACK		0	0	X	0	ENET	FROM VFD
43	SPEED CONTROL		0	0	0	X	ENET	TO VFD
43	RAS PUMP NO. 2	RASP-43-02						
43	IN AUTO		X	0	0	0	ENET	FROM HOA SWITCH ON MCP VIA VFD
43	RUNNING		X	0	0	0	ENET	FROM VFD
43	VFD FAULT		X	0	0	0	ENET	FROM VFD
43	MOTOR OVERTEMP		X	0	0	0	ENET	FROM MOTOR THERMOSTATS VIA VFD
43	START/STOP		0	X	0	0	ENET	TO VFD
43	AMPS		0	0	X	0	ENET	FROM VFD
43	kW		0	0	X	0	ENET	FROM VFD
43	SPEED FEEDBACK		0	0	X	0	ENET	FROM VFD
43	SPEED CONTROL		0	0	0	X	ENET	TO VFD
43	RASPUMP NO. 3	RASP-43-03						
43	IN AUTO		X	0	0	0	ENET	FROM HOA SWITCH ON MCP VIA VFD
43	RUNNING		X	0	0	0	ENET	FROM VFD
43	VFD FAULT		X	0	0	0	ENET	FROM VFD
43	MOTOR OVERTEMP		X	0	0	0	ENET	FROM MOTOR THERMOSTATS VIA VFD
43	START/STOP		0	X	0	0	ENET	TO VFD
43	AMPS		0	0	X	0	ENET	FROM VFD
43	kW		0	0	X	0	ENET	FROM VFD

STRAND ASSOCIATES, INC.®
CITY OF COPPERAS COVE
COPPERAS COVE, TEXAS
NORTHWEST WWTP CLARIFIER REHABILITATION PROJECT
CONTRACT 1-2025
BID NO. PW 2025-03-84
I/O LISTING - MCP-43

MCP	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
43	SPEED FEEDBACK		0	0	X	0	ENET	FROM VFD
43	SPEED CONTROL		0	0	0	X	ENET	TO VFD
43	WASTING VALVE	MOV-43-01						
43	IN REMOTE		1	0	0	0	2~#14	FROM ACTUATOR
43	ACTUATOR FAULT		1	0	0	0	2~#14	FROM ACTUATOR
43	POSITION FEEDBACK		0	0	1	0	SH. PR.	FROM ACTUATOR
43	POSITION CONTROL		0	0	0	1	SH. PR.	TO ACTUATOR
43	RAS FLOW METER NO. 1	FIT-43-01						
43	INSTANTANEOUS FLOW		0	0	1	0	SH. PR.	FROM FLOW METER TRANSMITTER
43	TOTALIZED FLOW		1	0	0	0	2~#14	FROM FLOW METER TRANSMITTER
43	RAS FLOW METER NO. 2	FIT-43-02						
43	INSTANTANEOUS FLOW		0	0	1	0	SH. PR.	FROM FLOW METER TRANSMITTER
43	TOTALIZED FLOW		1	0	0	0	2~#14	FROM FLOW METER TRANSMITTER
43	WASTING FLOW METER	FIT-43-03						
43	INSTANTANEOUS FLOW		0	0	1	0	SH. PR.	FROM FLOW METER TRANSMITTER
43	TOTALIZED FLOW		1	0	0	0	2~#14	FROM FLOW METER TRANSMITTER
43	INFLUENT FLOW METER INSTANTANEOUS FLOW	FIT-01	0	0	1	0	SH. PR.	FROM SIGNAL SPLITTER IN FLOW METER TRANSMITTER ENCLOSURE
43	EFFLUENT FLOW METER INSTANTANEOUS FLOW	FIT-110	0	0	1	0	SH. PR.	FROM SIGNAL SPLITTER IN UV MAIN CONTROL CABINET A
	TOTALS		12	0	6	1		

SECTION 26 24 19

MOTOR CONTROL

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Motor control devices, accessories, and general requirements.
 - 2. Manual motor starters.
 - 3. Magnetic motor starters.
 - 4. Variable frequency drives.
- B. Related Sections and Divisions:
 - 1. Applicable provisions of Division 01 shall govern work in this section.
 - 2. All other sections of Division 26.

PART 1–GENERAL	1
1.01 SUMMARY.....	1
1.02 REFERENCES	1
1.03 QUALITY ASSURANCE.....	1
1.04 SUBMITTALS.....	2
1.05 OPERATION AND MAINTENANCE DATA	2
1.06 DELIVERY, STORAGE, AND HANDLING	2
1.07 COORDINATION	2
1.08 WARRANTY	2
PART 2–PRODUCTS.....	3
2.01 ACCEPTABLE MANUFACTURERS	3
2.02 MOTOR CONTROL DEVICES, ACCESSORIES, AND GENERAL REQUIREMENTS.....	3
2.03 MAGNETIC MOTOR STARTERS	4
2.04 VARIABLE FREQUENCY DRIVES	5
PART 3–EXECUTION	8
3.01 INSTALLATION	8

1.02 REFERENCES

- A. ANSI/NEMA ICS 6–Enclosures for Industrial Controls and Systems.
- B. NEMA AB 1–Molded Case Circuit Breakers.
- C. NEMA ICS 2–Industrial Control Devices, Controllers, and Assemblies.
- D. NEMA ICS-18–Motor Control Centers.
- E. NEMA KS 1–Enclosed Switches.

1.03 QUALITY ASSURANCE

- A. Manufacturers of Motor Control Equipment: Firms regularly engaged in the manufacture of motor control equipment of the types and capacities required whose products have been in satisfactory use in similar service for not less than 10 years.

- B. UL Labels: Provide motor control devices, manual motor controllers, magnetic motor starters, variable frequency drives, motor control centers, etc., which have been listed and labeled by Underwriters Laboratories.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Provide product data on motor starters and VFDs, relays, pilot devices, and switching and overcurrent protective devices.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01 33 00–Submittals.
- B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.07 COORDINATION

- A. To provide proper coordination between Section 26 09 00–Controls and Instrumentation, and equipment specified herein, all equipment specified in this section shall be supplied as part of the Controls and Instrumentation package described in Section 26 09 00. This shall include, but not be limited to, equipment such as MCPs and stand-alone motor controllers. Drawings for MCCs, motor controllers, and motor control equipment shall be provided by the Section 26 09 00 System Supplier. Drawings from equipment manufacturers will not be accepted as shop drawings or O&M documents.

1.08 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization or Substantial Completion of the project.

PART 2-PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Motor control devices, motor starters, variable frequency drives, and motor control centers shall be as manufactured by Allen-Bradley, or equal, as approved by CONSULTANT and in accordance with substitutions under provisions of the General Conditions. All equipment specified in this section and provided by CONTRACTOR shall be by the same manufacturer.
- B. The Drawings and Specifications were prepared based on Allen-Bradley. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or Specifications by CONSULTANT.

2.02 MOTOR CONTROL DEVICES, ACCESSORIES, AND GENERAL REQUIREMENTS

- A. Auxiliary Contacts: NEMA ICS 2; two field convertible contacts minimum, in addition to seal-in contact, or as necessary.
- B. Push buttons: NEMA ICS 2; heavy-duty, oiltight (30 mm) as specified herein and shown on the Drawings. Pushbuttons in exposed, outdoor locations shall be rated NEMA 4X.
- C. Indicating Lights: NEMA ICS 2; heavy-duty, oiltight (30 mm), LED, push-to-test type as specified herein and shown on the Drawings. Indicating lights in exposed, outdoor locations shall be rated NEMA 4X.
- D. Selector Switches: NEMA ICS 2; heavy-duty, oiltight, (30 mm) as specified herein and shown on the Drawings. Selector switches in exposed, outdoor locations shall be rated NEMA 4X.
- E. Contactors: NEMA ICS 2. All contactors for starters specified herein, including VFDs shall be NEMA rated. IEC contactors are not allowed. Contactors shall be Allen-Bradley, Bulletin 509, or equal.
- F. Control Power Transformers: 240/120-volt secondary. Each motor controller shall have a dedicated control power transformer.
- G. Elapsed Time Meters: Redington/Engler 722 series, or equal, 3 inches round, flush door mounted, capable of reading up to 99,999.9 hours, nonreset type.
- H. Industrial control and power relays shall be installed in motor control centers, motor control panels, and motor controller enclosures where required by System Supplier. Relays used to interface with PLC I/O, motor control circuits, hard-wired control logic, and for loads less than 8 amps shall be terminal style, interposing/isolation relays. Relays for inductive loads, alarm lights, alarm horns, field wiring, or loads up to 15 amps shall be industrial, general purpose square base relays. Relays for loads greater than 15 amps shall be industrial, electrically held power relays. Relays shall meet the following requirements:
 - 1. Interposing/isolation relays:
 - a. Configuration: SPDT or DPDT as required by System Supplier.
 - b. Mounting: DIN rail with screw terminal base socket.

- c. Voltage: 120 VAC, or as required by System Supplier.
 - d. Contact Rating: 8A (DPDT), 16 A (SPDT).
 - e. Operating Life: 10 million cycles.
 - f. Status: On-Off flag-type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen-Bradley, 700 HK, or equal.
 - 2. General purpose relays:
 - a. Configuration: DPDT or 3 PDT as required by system supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 120 VAC.
 - d. Contact Rating: 15 A, minimum; 3/4 hp.
 - e. Operating Life: 10 million cycles.
 - f. Status: On-Off flag type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen-Bradley, 700-HB, or equal.
 - 3. Power relays.
 - a. Configuration: Electrically-held, 2-12 poles.
 - b. Mounting: DIN rail, square base.
 - c. Voltage: 120 VAC.
 - d. Contact Rating: 20 A continuous; 1 hp.
 - e. Operating Life: 10 million cycles.
 - f. UL listed.
 - g. NEMA rated.
 - h. Manufacturer: Allen-Bradley, 700-PK, or equal.
 - 4. All timing relays shall have On and timing Out LEDs. Timing relays shall be Allen-Bradley, 700-HN, or equal.
- I. Manufacturer of Accessories:
- 1. Terminal blocks shall meet the requirements of Section 26 05 19–Wire.
 - 2. Wire markers shall meet the requirements of Section 26 05 53–Electrical Identification.
- J. All motor control power shall be 120 volts with suitable protection (fuses or breakers). Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- K. All motor controllers shall be equipped with the auxiliary devices to meet the requirements of the Drawings and Specifications. Each motor controller operating at other than 120-volt, single-phase shall be equipped with a control transformer providing 120-volt secondary for control power. Transformer shall have fused primary and secondary connections and shall be sized per manufacturer's recommendations. Coils and pilot lights in all motor controllers shall be 120 volts.
- L. Enclosures for Stand-Alone Controllers, Starters, and Control Devices:
- 1. Enclosures in indoor damp or wet locations, outdoor locations, or locations below grade shall be NEMA 4X, stainless steel.
 - 2. All wiring within motor controller enclosures shall be landed on terminal blocks. This shall include internal control wiring, field wiring, and any spare or unused wiring.

2.03 MAGNETIC MOTOR STARTERS

- A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Each magnetic starter shall be equipped with a

solid-state overload relay. Starters for motors installed outdoors shall include ground fault protection.

- B. Full-Voltage Starting: Nonreversing type as shown on the Drawings.
- C. Coil Operating Voltage: 120 volts, 60 Hz.
- D. Size: NEMA ICS 2; size as shown on the Drawings. Contactors shall be Allen-Bradley or Bulletin 509 (Nonreversing), or equal.
- E. Overload relays shall be Allen-Bradley E100, Bulletin 592-1EF, or equal, and have the following features:
 - 1. Self-powered, solid-state.
 - 2. Up to 5:1 adjustment range.
 - 3. DIP switch settings for trip class and reset mode.
 - 4. Current transformers (no heaters).
 - 5. Thermal memory.
 - 6. Ambient temperature compensation.
 - 7. Visible trip indicators.
 - 8. Phase loss protection.
 - 9. Low energy consumption.
 - 10. Ground fault protection as specified herein.
- F. Magnetic motor starters in motor control centers shall be combined with magnetic only molded case circuit breakers.
- G. Through-the-door overload reset pushbuttons shall be provided for all magnetic starters installed in motor control centers.

2.04 VARIABLE FREQUENCY DRIVES

- A. VFDs shall be provided to match the load type (constant or variable torque) of the specified application, as well as the full load amps of the motor furnished for the project.
- B. System Operating Conditions:
 - 1. 480 VAC $\pm 10\%$.
 - 2. Three-phase, 3-wire, any phase sequence.
 - 3. 60 Hz $\pm 2\%$.
 - 4. Storage temperature -25°C to +55°C.
 - 5. Operating temperature 0 to 40°C.
 - 6. Altitude: 3,300 feet above sea level maximum.
 - 7. Humidity: 95% noncondensing maximum.
- C. Variable Frequency Unit:
 - 1. Conform to NEMA and NEC standards.
 - 2. CSA and ETL approved and/or UL approved.
 - 3. Overall VFD efficiency shall be a minimum of 96.5%, $\pm 1\%$, at 100% speed and motor load at nominal line voltage. Efficiency rating shall include control power supplies, control circuits, and all cooling fans.
 - 4. Input:
 - a. Withstand without component failure line voltage transients up to 3,000 volts per ANSI C37.

- b. Design shall include DC bus chokes (two) used in conjunction with one or more capacitors. The DC bus chokes shall be incorporated in the design to minimize line-side harmonics. Magnetic-only designs shall include line filters to limit harmonics to a value no greater than in a system using dual DC bus chokes.
 - c. Include MOV line-side protection.
 - d. Inverter input for six pulse VFDs shall have a true power factor of 0.95 or better at rated load and nominal line voltage throughout the entire speed range.
 - e. Units shall be capable of operating attached to the same power bus without affecting each other's operations. If operational problems occur, an isolation transformer shall be added to each drive at no additional Contract cost.
 - f. Three percent line reactors (drives smaller than 100 hp).
- 5. Inverter Output:
 - a. Inverter shall utilize latest generation IGBTs, be microprocessor based, and isolated from power circuits.
 - b. Match motor specified.
 - c. Three-phase, 3-wire.
 - d. Pulse width modulated wave form with selectable Sensorless Vector, Flux Vector, Volts/Hertz, and adjustable voltage control modes.
 - e. Maximum output 460 volts.
 - f. Frequency 2 to 650 Hz.
 - g. Frequency accuracy $\pm 1\%$ of setting at any point in the specified speed range in a 24-hour period.
 - h. Full load output current shall be rated in excess of the AC motor selected.
 - i. Motor performance:
 - (1) 3% regulation in the manual speed control mode.
 - (2) Normal duty overload rating: 110% continuous current for 1 minute; 150% for 3 seconds.
 - (3) Heavy-duty overload rating: 150% continuous current for 1 minute; 180% for 3 seconds.
 - (4) 110% starting torque minimum.
- 6. AC drive features:
 - a. Embedded I/O for discrete and analog signals. Analog signals shall include 4-20 mA circuitry mounted on separate printed circuit board to include offset, slope, minimum clamp, and separate acceleration and deceleration adjustments from 0 to 3600 seconds. An internal manual speed potentiometer is to be provided for simulating the 4-20 mA input for start-up and maintenance. The circuit is to be designed to accept either a positive or negative signal, grounded or ungrounded.
 - b. Embedded 100BASE-TX Ethernet port supporting the EtherNet/IP protocol.
 - c. Slot-based architecture for expansion control and communication cards.
 - d. Real-time clock with battery for date/time stamping of events.
 - e. Integral thermostat control of door-mounted cooling fans.
 - f. Current limit circuitry: 20% to 160% of drive-rated amps.
 - g. Additional features for constant torque units shall include:
 - (1) IR compensation to provide automatic voltage boost or reduction to optimize both starting torque and system input kW.
 - (2) Slip compensation to provide 0.5% regulation with a 100% load change.
 - (3) Inner current loop regulator.
- 7. Enclosures:
 - a. The VFD system shall be furnished with NEMA-rated (as previously specified) floor-mounting enclosure.
 - b. Items to be mounted in the VFD structure or structures:
 - (1) Inverter.

- (2) Incoming door interlocked, thermal-magnetic, molded-case circuit breaker.
- c. NEMA 4/13 items to be door-mounted on the enclosure:
 - (1) Control devices, pilot lights, selector switches, etc., as shown on the Drawings and specified herein.
 - (2) Interface to the drive shall be via a removable human interface module (HIM) with integral display. This unit shall be a 7-line by 21-character backlit LCD display with graphics capability. HIM shall be used to display drive-operating conditions, fault/alarm indications, and programming information with full text support in multiple languages. The LCD HIM shall be rated IP20/Type 1 and may also be used as a handheld terminal by connecting via a separate cable. The HIM keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog, and Speed Control), numeric keys for direct entry and an ALT (alternate function) key to allow drive programming or operating functions to be accessed directly without knowledge of programming structure. The HIM unit shall be mounted on the front of the enclosure door so the operator does not have to open the enclosure to access the HIM.
- 8. VFD protection:
 - a. Adjustable current limit of 20 to 160% minimum.
 - b. Instantaneous overcurrent trip.
 - c. Electronic ground fault and short-circuit protection to shut down the drive without fuse or component failure. Electronic ground- and short-circuit protection to be functional with an input line of 480 VAC $\pm 10\%$. The drive manufacturer is to be prepared to demonstrate ground fault and short-circuit protection without the use of an isolation transformer at drive start-up.
 - d. Input thermal-magnetic ambient compensated circuit breaker with a through-the-door interlocked operator.
 - e. Shut down on loss of any input phase for longer than 3 cycles.
 - f. Output phase sequence to be independent of input phase sequence.
 - g. High- or low-sustained voltage.
 - h. 120 VAC grounded control circuits.
 - i. Electrically and/or optically isolated low voltage logic.
 - j. Corrosion protection:
 - (1) Gold-plated plugs (male and female section) on all printed circuit boards.
 - (2) Protective board coating (conformal coating).
 - k. MOV converter protection.
 - l. DC bus chokes to minimize line side current harmonics.
 - m. Additional features for constant torque units:
 - (1) I^2T protection to provide 150% current for one minute.
 - (2) Regenerative override protection.
- 9. VFD adjustments:
 - a. Maximum speed: 50 to 100%.
 - b. Minimum speed: 0 to 70%.
 - c. Current limit: 20 to 110%, 160% on constant torque units.
 - d. Linear acceleration 0 to 3,600 seconds.
 - e. Linear deceleration 0 to 3,600 seconds.
 - f. Output volts/Hz trim.
 - g. Voltage boosts.
 - h. Additional features for constant torque units:
 - (1) Slip compensation.
 - (2) IR compensation.
 - i. All drives shall attempt to restart three times prior to indicating failure.

10. Inverter digital or LED diagnostic features:
 - a. Current limit signal.
 - b. Regenerative override signal.
 - c. External fault (e.g., motor overload).
 - d. Low line voltage.
 - e. High line voltage.
 - f. Current overload.
 - g. High DC bus voltage.
 - h. Current trip.
 - i. Short-circuit.
 11. Inverter construction:
 - a. Modular construction for ease of maintenance.
 12. Mount modules on enclosure subpanel:
 - a. Easily accessible from front.
 - b. Interconnect with plugs.
 - c. Construct boards of fire-retardant materials in accordance with NEMA grade FR4 specifications.
- D. Inverter Quality Control:
1. Test all power devices at rated temperature and current for dv/dt, tq, TRR, and leakage.
 2. Test integrated circuits for programmed parameters at rated temperature.
 3. Treat printed circuit boards for corrosion resistance (conformal coating).
 4. Provide gold-plated connections at all points where plugs are used.
 5. Thermal cycle all printed circuit boards for 10 cycles between 0°C to 65°C prior to installation in inverter.
 6. All units to be tested at a rated load and temperature after assembly.
- E. The 6-pulse variable speed drives shall be Allen-Bradley, or equal, Powerflex 755. All drives shall be by the same manufacturer.
- F. Minimum, maximum, and harmonic skip speed setpoints shall be programmed into each VFD. CONTRACTOR shall coordinate these setpoints with the manufacturer of the equipment served. CONTRACTOR shall provide a table listing the minimum, maximum, and skip setpoints programmed into each VFD on the project to CONSULTANT and OWNER.
- G. Provide manufacturer certified start-up and warranty service for each VFD. Service shall be for 2 years and include all travel and expenses. Warranty service shall commence at the date of substantial completion.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Provide motor control equipment in accordance with manufacturer's instructions and Drawings.
- B. Overloads shall be selected on the basis of nameplate horsepower and service factor. Selection of overloads based on horsepower shown on the Drawings is not acceptable.

Where power factor correction capacitors are provided, overload protection shall be compensated for the lower motor running current because of improved power factor.

- C. All motor control wiring shall be installed in accordance with control wiring diagrams furnished.
- D. Wireways in MCCs shall be used only for routing of conductors. Splices are not allowed within wireways.
- E. All wiring within MCCs shall be landed on terminals inside buckets or equipment compartments and not left unterminated within wireways. This shall include all internal MCC wiring and external field wiring, including spare wires.
- F. Motor Data: Provide neatly typed label inside each motor controller enclosure identifying motor served, nameplate horsepower, full-load amperes, code letter, service factor, and voltage/phase rating.
- G. Control wiring and field wiring (120 V and below) within MCCs shall be separated from power wiring (277 V and above). Where possible, route control and field wiring in separate raceways or wireways. Provide a minimum of 2 inches separation between control wiring, field wiring, and power wiring.
- H. All motors will be provided by other divisions, ready for connections. CONTRACTOR shall be responsible for electrical connections for power and control circuit wiring, proper phase relationships, and correct motor rotation.
- I. Provide motor circuit wiring for each motor from the source of supply to the terminal box on the motor including all intermediate connections at devices such as motor starters, VFDs, disconnect switches, etc.
- J. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits, as specified in Section 26 05 19–Wire.
- K. Provide motor controllers as specified for all motors, unless shown or specified that motor controllers or control equipment will be furnished by others.
- L. Provide motor circuit disconnect devices for all motors, unless shown or specified that disconnect devices or starters are furnished with other equipment.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Wall Switches.
 - 2. Receptacles.
 - 3. Cover Plates.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. NEMA WD 1—General-Color Requirements for Wiring Devices.
- B. NEMA WD 5—Specific-Purpose Wiring Devices.
- C. Drawings—Bill of Materials.

1.03 QUALITY ASSURANCE

- A. Manufacturers of switches, outlets, boxes, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical material, etc., which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

PART 2–PRODUCTS

2.01 WALL SWITCHES

- A. A-C general use Industrial specification grade, snap switch, 20 amperes, 277 volts, one of the following: Eaton 122*, Leviton 122*, or Pass and Seymour PS20AC*.
- B. Provide white-colored handles.

2.02 RECEPTACLES

- A. Weather-Resistant Receptacle: Weather-resistant receptacles shall include GFCI protection and be UL 498 listed, 20 ampere, 125-volt, NEMA 5-20R, heavy-duty, commercial grade, with WR marking on the face, Eaton WRS GF20, or equal.

2.03 COVER PLATES

- A. NEMA 4X and weatherproof switch covers shall be Thomas and Betts, Industrial Gray, toggle switch cover, Model E98TSCN-CAR, Eaton S2983 or equal.
- B. While in use receptacle covers for exterior use shall be Leviton IUM1V-GY, or equal.

2.04 OUTDOOR PHOTOCELLS

- A. Photocell type shall be silicone diode and shall have electronic photocontrols. Photocell shall accept an input voltage range from 120 volts AC to 277 volts AC, be rated for a 1000 watts tungsten range, and be rated for 1,650 watts at 277 volts AC for LED installations. Photocell controller shall be gasketed for outdoor installation
- B. Photocell shall instantly turn on when activated and shall have an adjustable sensor-off time delay (2 to 5 seconds) to prevent false off switching. On activation shall occur at 1.5 foot-candles and off activation shall occur at 4.5 foot-candles. In the event the photo controller fails, the photo controller shall fail on.
- C. Operational temperature range shall be -40°F to 158°F. Photocell shall be UL listed and include an 8-year warranty.
- D. Photocells shall be model EK4436SM, as manufactured by Intermatic, or equal. Photocell shall be stem mount style with neoprene gasket and die-cast zinc housing. Photocell mounting shall be suitable for installation on an approved surface-mounted, outdoor outlet box. Provide a light shield accessory model 6LV1352, as manufactured by Intermatic, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Weather-resistant receptacles shall be provided in all damp and wet locations.
- B. GFCI receptacles shall not be series wired.

- C. Install wall switches 48 inches above floor (top of box), "Off" position down, unless otherwise noted
- D. Install receptacles vertically with the grounding pole on the top and at the heights shown on the Drawings, unless otherwise noted. Heights listed on the Drawings are to the bottom of the box.
- E. Install devices and cover plates flush and level.
- F. Back wiring is not allowed for switches and receptacles. Wires shall be terminated with the device screw terminal.
- G. Individual labels shall be placed on the back of all switch faceplates and receptacle faceplates indicating the lighting panel and circuit from which the switch or receptacle is fed. Labels shall be white background with black lettering no smaller than 12-point font. Provide permanently attached self-adhesive type, machine fed, and self-laminating labels, or equal. All labels must be by the same manufacturer, same size, and same font. Handwritten labels are not acceptable.

END OF SECTION

SECTION 26 28 00

OVERCURRENT PROTECTIVE DEVICES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Provide overcurrent protective devices as shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit shop Drawings and product data in accordance with provisions of Section 01 33 00–Submittals, including electrical ratings, physical size, interrupt ratings, trip curves, I²t curves, and manufacturer's detailed specifications.

1.03 QUALITY ASSURANCE

- A. Comply with the following requirements:
 - 1. NFPA 70 National Electrical Code (NEC).
 - 2. Local codes and ordinances.
 - 3. Provide overcurrent protective devices by same manufacturer for each type of device.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Comply with pertinent provisions of Section 01 60 00–Materials and Equipment.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

PART 2–PRODUCTS

2.01 CIRCUIT BREAKERS

- A. General:
 - 1. Comply with UL 489 requirements.
 - 2. Provide thermal and magnetic protection unless noted otherwise.
- B. Main Breakers:
 - 1. Circuit breakers shall have a short-circuit interrupting rating as indicated on the Drawings.
 - 2. Provide solid-state circuit breakers with an integral LED ammeter, electronic sensing, timing, and tripping circuits with adjustable settings. Provide adjustable long-time pickup, long-time delay, short-time pickup, short-time delay, and instantaneous pickup settings.

- C. Feeder Breakers:
 - 1. Circuit breakers shall have a short-circuit interrupting rating as indicated on the Drawings.
 - 2. Field-Adjustable Thermal-Magnetic Trip Circuit Breaker: NEMA AB1. Provide circuit breakers with frame sizes less than 400 amperes with adjustable instantaneous pickup setting for automatic operation. Range of adjustment shall be three to ten times the trip rating.
 - 3. Field-Changeable Magnetic-Only Ampere Rating Circuit Breakers/Motor Circuit Protectors: UL 489. Provide circuit breakers with frame sizes 200 amperes and larger with changeable trip units.
- D. All lugs shall be rated to accept copper conductors.

2.02 ENCLOSURES

- A. Circuit breakers shall be installed within MCC and motor control panel as shown on the Drawings.

2.03 ACCESSORIES

- A. Provide accessories as scheduled as listed below:
 - 1. Handle Lock: Include provisions for padlocking.
 - 2. Mechanical trip device.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Install overcurrent protective devices in accordance with manufacturer's recommendations.

3.02 ADJUSTMENT

- A. Set and record adjustable settings on circuit breakers to provide selective coordination and proper operation.

END OF SECTION

SECTION 26 28 16

DISCONNECT SWITCHES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Disconnect switches.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. NEMA KS 1–Enclosed Switches.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Include outline drawings with dimensions and equipment ratings for voltage, capacity, horsepower, and short-circuit.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Disconnect Switches: Square D Class 3110 or Eaton Type DH.
- B. Substitutions: Under provisions of the General Conditions.

2.02 DISCONNECT SWITCHES

- A. Nonfusible Disconnect Switches: NEMA KS 1; heavy-duty, quick-make, quick-break, load interrupter enclosed knife switch with externally-operable handle interlocked to prevent opening front cover with switch in “On” position. A defeater shall be provided to bypass this interlock. Handle lockable in “Off” position. Provide auxiliary contacts to remove control power associated with field devices or instruments interlocked with equipment served. Auxiliary contacts shall be by the disconnect manufacturer.
- B. Manual Motor Switches: Where noted on the drawings, manual motor switches shall be provided for three-phase motors with circuit rating of 30 amps, or less. Manual motor switches shall have toggle operator without overload protection or indicator light. Provide cover plate for all switches to meet the finish or classification of the space. Cover plate shall have provisions for locking the switch in the “On” or “Off” position.

2.03 ENCLOSURES

- A. Provide disconnect switch enclosures as listed below, unless noted otherwise on the Drawings:
 - 1. Outdoor, corrosive, or wet locations: NEMA 4X, stainless steel.
 - 2. Hazardous locations: NEMA 7, cast aluminum.
- B. Provide manual motor switch enclosures as listed below, unless noted otherwise on the Drawings. Outdoor or wet locations: NEMA 4, die cast zinc.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Provide disconnect switches where indicated on the Drawings. Maximum mounting height shall be 42 inches above finished floor unless noted otherwise, or acceptable to CONSULTANT based on field conditions.
- B. Disconnect enclosures that house wiring powered from a source separate from the motor power wiring (e.g., MAS units, space heaters) shall have a nameplate installed on the front of the disconnect indicating that power may be present at the motor when the disconnect is in the "Off" position.
- C. Wiring within disconnects shall only be for loads or equipment served by that disconnect. Foreign wiring within disconnect enclosures is not allowed. All wiring within disconnect enclosures shall be landed on lugs or terminals provided by the disconnect manufacturer, or on dedicated terminal strips for instrumentation equipment or field devices. Splices and spring wire connectors are not allowed within disconnect enclosures.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTIVE DEVICES (SPD)

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Service entrance devices.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/IEEE C62.41 and C62.45.
- B. NFPA 70 and 75.
- C. UL 1449, most recent issue.

1.03 QUALITY ASSURANCE

- A. Manufacturers of SPDs: Firms regularly engaged in the manufacture of these products of the types and ratings whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide surge protective devices which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing, and construction diagram as described in ANSI/NEMA ICS 1. Test reports certified by the manufacturer shall be provided to CONSULTANT upon request for each model submitted.

1.05 WARRANTIES

- A. Manufacturer shall provide a minimum 10-year warranty from the date of Substantial Completion to cover repair or replacement of the device.

PART 2-PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The Drawings and Specifications were prepared based on MCG. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, upsizing overcurrent protective devices to meet manufacturer recommendations. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or Specifications by CONSULTANT.

2.02 GENERAL

- A. These specifications describe the electrical and mechanical requirements for high energy SPDs.
- B. The system individual units shall be UL listed under UL1449, latest edition, Standard for Surge Protective Devices (SPD). Surge ratings shall be permanently affixed to the SPD.
- C. Operating Temperature: Operating temperature range shall be -40 to +70°C (-40 to 158°F).
- D. Storage Temperature: Storage temperature range shall be -40 to +85°C.
- E. Relative Humidity: Operation shall be reliable in an environment with 0% to 95% noncondensing relative humidity.
- F. Operating Altitude: The system shall be capable of operation up to an altitude of 13,000 feet above sea level.
- G. Design Life: >15 years.
- H. Operating Voltage: Maximum continuous operating voltage shall be no less than 125% of the nominal rated line voltage.
- I. Power Frequency: SPD power frequency shall be rated for use on 50 and 60 Hertz power systems.
- J. All SPDs shall be MOV type. Noise filtering capabilities shall be provided as an option for the devices specified herein.

2.03 SERVICE ENTRANCE DEVICES

- A. The maximum surge current capacity of the specified system, based on the standard IEEE 8/20 microsecond waveform, shall be at least 160 kA per phase. The surge life for delta models (8/20) shall be at least 20kA for 1,500 occurrences (Lx-G modes) and 20kA for 1,500 occurrences (Lx-Lx mode). The transient suppression capability shall be bidirectional and suppress both positive and negative impulses. SPD shall have a nominal discharge rating (I_n) of 40 kA.

- B. The SPD shall have a minimum Short Circuit Rating (SCCR) of 200 KAIC. The interrupt capability must be confirmed and documented by a recognized independent testing laboratory.
- C. The suppressor shall be designed so as to minimize the internal surge path impedance. Direct point-to-point internal wiring is inherently inductive and not acceptable. Connection to the power service shall be constructed as shown in the manufacturer's installation notes for best performance.
- D. The system shall be constructed using field replaceable plug-in modules. The module shall consist of multiple fuse protected metal oxide varistors. The status of each module shall be locally monitored with a red LED that will illuminate if the module protection is reduced. Protector shall provide redundant protection within each phase module with multiple surge rated fuses per module or one fuse per MOV.
- E. Red and green solid-state LED indicators shall be provided on the hinged front cover to indicate protection status. An illuminated green LED indicates power is present at the protector on all phases, and an illuminated red LED shall indicate that one or more of the modules have reduced protection. Both front panel and internal LEDs are required to provide power and fault indications. Relay operation shall be in a failsafe operating mode, i.e., continuously energized so that power failure, reduced protection, or a break in the remote monitoring line will cause a fault indication at the remote monitor. Neon indicators are not permitted.
- F. Relay alarm contacts shall be provided for remote alarm monitoring capability of unit status. Surge protected normally open and normally closed contacts shall be provided.
- G. The system shall be equipped with an audible alarm which shall be activated when any one or more of the modules has a reduced protection condition. A mute switch shall be provided for the audible alarm.
- H. The SPD shall provide effective energy surge diversion for application in ANSI/IEEE C62.41-2002 location Category C3 environments. Testing shall be per ANSI/IEEE C62.45-2002 using ANSI/IEEE C62.41 Category C3 waveforms and amplitudes.
- I. A NEMA 4 powder-coated steel enclosure with corrosion-resistant hardware shall be provided for the unit. Unless otherwise noted, SPDs installed within distribution or control equipment enclosures do not require a separate enclosure.
- J. Service entrance devices shall be as manufactured by MCG 200M Series, Square D EMA/IMA Series, Eaton SPD Series, or equal.
- K. SPD shall be suitable for use in Type 2 locations.
- L. Unit shall provide maximum ANSI/UL 1449 VPRs for 480-volt, three-phase systems.
 - 1. L-G = 2000 V.
 - 2. L-L = 2000 V.

PART 3-EXECUTION

3.01 INSTALLATION

- A. The installation and testing of the system shall be in full accordance with the manufacturer's installation and maintenance instructions and all national and local codes.
- B. Each installed device shall be fed by an appropriately sized circuit breaker, per the manufacturer's installation notes, in the protected panel. No SPD shall be installed without an upstream overcurrent device.
- C. Units shall be installed as close as practical to the electrical panel. Low impedance cabling furnished by the manufacturer shall be utilized for installations with lead lengths greater than, or equal to, 5 feet. Low impedance cabling furnished by the manufacturer or appropriately-sized standard cable, if acceptable to CONSULTANT, may be utilized for installations with lead lengths less than 5 feet. SPD leads shall be as short as possible.

END OF SECTION

SECTION 26 51 13

LIGHTING

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes a complete functional lighting system.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. Underwriters Laboratories: Lighting fixtures shall be manufactured in accordance with the standards of the Underwriters Testing Laboratories and shall bear the UL label where practicable. In all cases the lighting fixtures shall be constructed with UL listed components.
- B. Applicable Codes: Fixtures shall be made and installed in accordance with the current version of the National Electrical Code, the Uniform Building Code, the Federal Occupational Safety & Health Act, and other applicable regulations.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.
- D. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material and construction and testing where applicable.
- E. Lighting Standards:
 - 1. LM-79-08 or latest—IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
 - 2. LM-80-08 or latest—IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
 - 3. NEMA SSL 1-2016 or latest—Electronic Drivers for LED Devices, Arrays, or Systems.
- F. Fire Codes: Where necessary to meet Code requirements, enclosure housings shall be constructed to provide a 1-hour fire rating.

1.03 SYSTEM DESCRIPTION

- A. Intent: It is the intent of these specifications to obtain a completed lighting fixture and lighting controls installation by CONTRACTOR. Completed means cleaned, adjusted, tested, and ready for occupancy and operation in accordance with the above-indexed paragraphs and in accordance with the other sections of these Contract Documents. It is the responsibility of CONTRACTOR to point out discrepancies, errors, and other problems.

- B. All lighting fixtures are to be provided complete with all necessary accessories for a proper installation. Catalog numbers shown are basic fixture types, and additional features, accessories, and options specified, scheduled or required, are to be included for all fixtures provided.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals. Shop drawings shall include, but not be limited to, the following:
 - 1. Manufacturer's dimensioned scale drawings showing in complete detail the fabrication of all lighting fixtures including overall and detail dimensions, finishes, prefinishes, metal thickness, fabrication methods, support method, ballasts, drivers, sockets, type of shielding, reflectors, wiring sizes and insulation types, lenses, provisions for relamping, and all other information to show compliance with the Contract Documents.
 - 2. Installation instructions.
 - 3. Certified photometric test data and reports.
 - 4. Shop drawings shall not only clearly indicate the assigned fixture type, but also the equipment location.
 - 5. Submittal should include, but not be limited to, wattage, lumen output, color temperature, and CRI value.

1.05 QUALITY ASSURANCE

- A. Standards: Materials, equipment, and parts, as well as workmanship provided under this section, shall conform to the highest commercial standard as specified and as indicated on Drawings. Fixture parts and components not specifically identified or indicated shall use materials most appropriate to their intended use or function and as such be resistant to corrosion and thermal mechanical stresses encountered in the normal application and function of the fixtures.
- B. Measuring and Testing Equipment: CONTRACTOR shall have available at all times, instruments for the measurement of voltage, luminaire temperature, lighting level, and fixture brightness level.
- C. Manufacturers: Firms regularly engaged in the manufacture of lighting fixtures of the types and ratings for the project, whose products have been in satisfactory use in similar service for not less than 5 years.
- D. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Luminaires and lighting equipment shall be delivered to the project complete, including mounting devices and components necessary for the proper operation of the equipment.
- B. Marking: All equipment must be clearly and boldly identified as to the fixture type and, where practicable, the fixture location.

- C. Timely Purchasing: Luminaires and other appurtenances shall be ordered in a timely fashion and securely stored to be available to meet the project schedule.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization or Substantial Completion of the project.

PART 2–PRODUCTS

2.01 LED LUMINAIRES

- A. LED Luminaires shall meet the following technical requirements:
 - 1. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
 - 2. Luminaire efficacy shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings.
 - 3. Luminaire Color Rendering Index (CRI) shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings; a minimum of 80 for interior luminaires and a minimum of 70 for exterior luminaires.
 - 4. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
 - 5. Luminaire lumen output shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings.
 - 6. Wattage shall be equal to that of the fixture model numbers shown in the fixture schedule on the Drawings.
 - 7. Luminaire color temperature shall match that of the fixture model numbers shown in the fixture schedule on the Drawings.
- B. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- C. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- D. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- E. Luminaire and driver shall be provided from a single manufacturer to promote compatibility.
- F. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10%.
- G. Luminaire shall have a maximum Total Harmonic Distortion (THD) of $\leq 20\%$ at full input power and across specified voltage range.

2.02 WIRING

- A. All wiring within lighting fixtures or from the splice with the building wiring shall be as specified in Section 26 05 19–Wire.
- B. Wiring within fixture construction shall be concealed, except where the fixture design or mounting dictates otherwise.

- C. Wiring channels and wireways shall be free from projections and rough or sharp edges throughout and all points or edges over which conductors must pass and may be subject to injury or wear.
- D. Insulated bushings shall be installed at points of entrance and exit of flexible wiring.

2.03 LED DRIVERS

- A. General:
 - 1. Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated in the model numbers in the fixture schedule shown on the Drawings.
 - 2. Driver shall have a minimum rated life of 50,000 hours.
 - 3. Driver shall have a minimum power factor of 0.9 and a maximum crest factor of 1.5 at full input power and across the specified voltage range.
 - 4. Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
 - 5. Driver shall have a maximum Total Harmonic Distortion (THD) of $\leq 20\%$ at full input power and across specified voltage range.
 - 6. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
 - 7. Fuse Protection: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected per Class 2 UL listing.
 - 8. All fixtures located outdoors shall be provided with surge protection.

2.04 MARKING OF FIXTURES

- A. Voltage Identification: Fixtures designed for voltages other than 110- to 125-volt circuits shall be clearly marked.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install fixtures, lenses, etc., after environmental conditions are nominally the same as expected for the complete spaces. All glassware, reflectors, and refractors shall be clean and free of chips, cracks, and scratches.
- B. All fixtures shall be securely and adequately supported and installed.
- C. Stanchion-mounted fixtures shall be attached to and supported from structural part of the structure in a manner acceptable to CONSULTANT.
- D. Metal decking shall not be pierced for fixture support.
- E. All fixture whips shall be constructed of minimum No. 12 AWG conductors.

3.02 SUPPORTS

- A. Mounting Accessories: Fixtures shall be securely attached to prevent movement up, down, or sideways. Fixtures shall be mounted to permit access to wiring. Fastening devices shall

be of a positive, locking type, and shall not require the use of special tools to apply or remove. Tie wires shall not be used in place of fastening devices.

- B. Stanchion Mounting: Provide stanchion-mounted fixtures with required mounting accessories, including hickey, stud extensions, ball aligners, canopies, and stems.

3.03 ADJUSTMENT

- A. Focusing/Adjustment: After the installation of lighting fixtures is completed, fixtures so requiring, shall be adjusted after dark under the observation of OWNER.

3.04 CLEANING

- A. Installation Sequence: Lighting fixture mounting frames, plaster rings, etc., shall be installed prior to the finishing assembly which shall not be installed until the Project is at Final Completion. When the fixture location or construction prevents sequential installation, CONTRACTOR shall carefully protect all reflectors, lenses, flanges, and other visible surfaces.
- B. Cleaning: Before final acceptance by OWNER, all protective (strippable) coatings, dust, finger marks, paint spots, and any other materials deleterious to the appearance or functioning of the lighting fixtures must be removed. Abrasive cleaners are not permitted.

3.05 FINAL INSPECTION

- A. Upon completion of the installation, lighting equipment must be in first-class operating order and free from defects in condition and finish:
 - 1. Fixtures shall be completely clean and free from finger marks, dust, plaster, or paint spots.
 - 2. Any reflectors, lenses, diffusers, side panels, or other parts damaged prior to the final inspection, shall be replaced at no expense to OWNER.
 - 3. Housing shall be rigidly installed and adjusted to a neat flush fit with the ceiling.

END OF SECTION

SECTION 31 23 00

EXCAVATION, FILL, BACKFILL, AND GRADING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Excavating, filling, backfilling, and grading for this work includes, but is not necessarily limited to:
 - 1. Excavating for footings, foundations, roads, utilities, sidewalks, driveways, parking lots, restoration, and miscellaneous areas.
 - 2. Furnishing and placing all fill and backfill.
 - 3. Provide compaction of all fill and backfill.
 - 4. Furnishing and placing vapor barrier and granular cushion below interior slabs on grade.
 - 5. Furnishing and placing of crushed stone mat below tank slabs and manhole/vault slabs, basement floors, or other structures where required.
 - 6. Rough and finish grading prior to paving, seeding, etc.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Payment:
 - 1. All common excavation shall be included in the Lump Sum Bid. Changes which require additions to or deductions from the excavation will be adjusted on the basis of the unit price for changes contained in the Contract.

1.02 REFERENCED STANDARDS

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications within this section shall refer to the State of Texas Department of Transportation, Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, current edition, including all issued supplemental specifications.
- B. ASTM C33—Standard Specification for Concrete Aggregates.
- C. ASTM D698—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- D. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).

1.03 SUBMITTALS

- A. Submit sources and gradations for materials proposed for use as compacted fill, utility trench backfill, trench bedding and cover material, crushed stone mat, and granular cushion.
- B. Submit samples of materials proposed for use in Paragraph 1.03.A to a soils testing laboratory for analysis of its suitability and for recommendations on moisture content during compaction, compaction methods, or other appropriate information.

- C. Submit sufficient samples of each different type or classification of soil to obtain representative values.

1.04 JOB CONDITIONS

- A. The elevations shown for existing work and ground are reasonably correct, but are not guaranteed to be absolutely accurate. No extras will be allowed because of variations between drawings and actual grades.
- B. Soil borings were made and the soils information will be made available upon request. The information contained is not guaranteed to be indicative of conditions to be encountered during construction. It is CONTRACTOR's responsibility to make its own investigations to determine physical conditions at the site, which may affect the work.

PART 2-PRODUCTS

2.01 COMPACTED FILL

- A. All fill and backfill material designated to be compacted fill shall be granular with no stones larger than 4 inches and shall be reasonably well-graded throughout the particle size range. Soils shall have a plastic index between 7 and 20 with greater than 40% retained on No. 4 sieve. A minimum 65% of the material shall pass the 3/4-inch sieve, and the material shall be capable of being compaction tested in accordance with ASTM D1557, as determined by the Testing Firm.
- B. Native material may be used as compacted fill if it meets the above specification. CONTRACTOR shall determine whether native material meets the above specification. CONTRACTOR shall provide all needed fill material whether from on-site or off-site at no additional cost to OWNER.

2.02 CRUSHED STONE MAT

- A. Crushed stone mat below slabs shall be 3/4-inch clear crushed stone and shall meet all requirements of ASTM C33 size No. 67.

2.03 GRANULAR CUSHION

- A. Granular cushion beneath slabs-on-grade shall meet requirements of Standard Specification 247.

2.04 EMBANKMENT FILL

- A. Embankment fill shall contain no stumps, brush, rubbish, or other perishable material. The top 12 inches of the earth embankment shall be earthy material free from large stones.

2.05 FLOWABLE FILL

- A. Flowable fill shall be a self-compacting, self-leveling, material consisting of a mixture of fine aggregate and filler (as needed), water, and cementitious materials (Portland cement, fly ash, granulated blast furnace slag) that is in a flowable state at the time of placement meeting the requirements of the National Ready Mixed Concrete Association Guide Specification for

Controlled Low Strength Materials (CLSM). The flowable fill shall be proportioned by the ready mixed concrete supplier on the basis of field experience and/or laboratory trial mixtures to produce a cohesive and nonsegregating mixture.

PART 3-EXECUTION

3.01 GENERAL

- A. Prior to all excavating, CONTRACTOR shall become thoroughly familiar with the site and site conditions.

3.02 PROTECTION

- A. CONTRACTOR shall provide all necessary sheeting, shoring, or other soil retention systems including all labor, material, equipment, and tools required, or as necessary to maintain the excavation in a condition to provide safe working conditions, to permit the safe and efficient installation of all items of Contract work, and to protect adjacent property. CONTRACTOR shall be held liable for any damage which may result to property from excavation or construction operations. Sheeting, shoring, and other soil retainage systems shall be withdrawn or removed in a manner so as to prevent subsequent settlement of structures, utilities, and other improvements.
- B. Design of sheet piling and other soil retaining systems shall be the sole responsibility of CONTRACTOR. Where such systems are shown on the Drawings, no parameters such as embedment depth, section profile, presence or lack of walers, etc., nor system type or suitability shall be inferred. CONTRACTOR is responsible for designing and providing a fully functional system compatible with construction and site requirements.
- C. Nothing in this specification shall be deemed to allow the use of protective systems less effective than those required by the Occupational Safety and Health Administration (OSHA) and other applicable code requirements.

3.03 FINISH ELEVATIONS AND LINES

- A. CONTRACTOR is responsible for establishing finish elevations and lines.
- B. Where lasers are used, CONTRACTOR shall check the Work against intermediate grade stakes. Prior to initial use of the laser, CONTRACTOR shall set up laser on ground surface and check line and gradient controls. Lasers not functioning properly shall be immediately removed.
- C. If existing property stakes, not within the limits of the trench or street slope limits, are removed or damaged by CONTRACTOR, CONTRACTOR shall bear the cost of replacement. Replacement shall be made by a legal survey performed by a licensed Land Surveyor hired by OWNER. Cost for survey shall be deducted from the Contract Price.

3.04 COMMON EXCAVATION

- A. After the site has been cleared and stripped, the site shall be cut and filled to the indicated subgrade as shown or specified.

- B. CONTRACTOR shall place the excess material on the site in locations as designated by OWNER. The hauling cost shall be at CONTRACTOR's expense unless otherwise specified.
- C. All material other than suitable bearing soil or bedrock, as determined by the Testing Firm, shall be removed from under concrete to be poured on ground.
- D. Excavation for all footings, foundation walls, pits, etc., shall be large enough to provide adequate clearance for the proper execution for the work within them.
- E. Excavations scheduled to extend below groundwater shall not be started until the area has been dewatered. See Section 31 23 19–Dewatering.
- F. No footings or slabs shall bear on the top 2 feet of existing soil. Where planned subgrade is within 2 feet of existing grade, remove soils to 2 feet below existing grade and backfill with compacted fill up to subgrade elevation.
- G. When excavations reach subgrade elevations as shown on the Drawings or as specified herein, the Testing Firm will observe the bottom material. Where, in the opinion of the Testing Firm, unsuitable foundation material is found at the level of the subgrade, unsuitable foundation material shall be removed and replaced with material and placing methods as specified under compacted fill and backfill.
- H. Excavations that are undercut beneath the foundation shall extend beyond the perimeter of the foundation 1 foot plus a distance at least equal to the depth of undercut below footing grade.
- I. CONTRACTOR shall backfill and compact all overexcavated areas.

3.05 PREPARATION OF SUBGRADE

- A. After the site has been cleared, stripped, and excavated to subgrade, thoroughly compact subgrade to the requirements specified for compacted fill below. Scarify and moisture condition the subgrade as recommended by the Geotechnical Engineer.
- B. Remove all ruts, hummocks, and other uneven surfaces by surface grading prior to placement of fill.
- C. All slab-on-grade and road subgrades shall be proofrolled with a heavy rubber-tired construction vehicle (such as a fully loaded tandem-axle dump truck) in the presence of the OWNER and Testing Firm.

3.06 COMPACTED FILL AND BACKFILL

- A. All fill and backfill, except as otherwise specified, shall be compacted fill placed to within 4 inches of the bottom of the topsoil or to the bottom of the structure or other improvement.
- B. In fill areas above existing grade around structures, compacted fill shall be placed within a minimum of 10 feet from the structure.
- C. No fill shall be placed under water or over unsuitable subgrade conditions.
- D. All fill and backfill, except embankment fill and clay fill, shall be compacted as follows:

1. Class 1 Compaction: This class of compaction shall apply to all fill areas under buildings, structures, piping, bituminous roadway and parking areas, curb and gutter, and backfill within 10 feet of structure walls. All compacted material shall be placed in uniform layers not exceeding 8 inches in loose thickness prior to compaction. Each layer shall be uniformly compacted to a dry density at least 95% of the maximum dry density as determined by a laboratory compaction test at the optimum moisture content (ASTM Test Designation D1557). Compaction shall be obtained by compaction equipment appropriate for the conditions.
 2. Class 2 Compaction: This class of compaction shall be used in excavated areas beyond 10 feet of structures without any piping or adjacent foundations. Material for backfill shall be granular material as specified above. The material shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer of the fill shall be compacted to at least 90% of the maximum dry density (testing same as Class 1). Compaction shall be obtained by compaction equipment appropriate for the conditions.
- E. No frozen material shall be placed nor shall any material be placed on frozen ground.
- F. Four inches of clay fill shall be placed and compacted to at least a firm consistency in areas to be seeded or sodded prior to placement of topsoil.

3.07 EMBANKMENT FILL

- A. Embankment fill may be placed in fill areas to be seeded or sodded if no piping exists in the fill and the areas are at least 10 feet from any structure.
- B. Embankment fill shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer shall be compacted to the degree that no further appreciable consolidation is evidenced under the action of the compaction equipment. The required compaction shall be obtained for each layer before any material for a succeeding layer is placed thereon. Compaction shall be obtained using the hauling and leveling equipment, and in addition, tamping rollers, pneumatic-tired rollers, vibratory rollers, or other types of equipment required to produce the desired results.

3.08 CONCRETE FILL

- A. In areas where there is inadequate room for compaction equipment and in other areas as shown or specified, flowable fill shall be used as fill material.

3.09 TRENCH BACKFILL CONSOLIDATION

- A. All trenches shall be consolidated as specified in this section for the entire depth and width of the trench.
- B. Consolidation shall be achieved by use of smooth surface vibratory compactors or backhoe operated hydraulic compactors for granular materials and rotating sheepsfoot type mechanisms for loam/clay soils. The lift height shall not exceed 8 inches for walk behind, hand operated, vibratory compactors and sheepsfoot. Lift height shall not exceed 24 inches for self-propelled vibratory drum or backhoe operated hydraulic compactors. Smaller lift heights shall be provided as necessary to achieve the degree of compaction specified.

- C. Unless specified otherwise, backfill material beneath paved areas or future paved areas and within 5 feet of paved areas or future paved areas shall be consolidated as follows: Within 3 feet of the surface 95% of maximum dry density, below 3 feet from the surface to 1 foot above the pipe 90% of maximum dry density, as determined by the modified Proctor Test (ASTM D1557).
- D. Unless otherwise specified, backfill material placed in all other areas shall be compacted to the point where no additional consolidation can be observed from the compaction and backfill equipment being used.
- E. Backfill material not meeting the compaction specification shall be recompacted by CONTRACTOR at no cost to OWNER. Cost for additional testing on recompacted material shall be at CONTRACTOR's expense.

3.10 GRADING

- A. CONTRACTOR shall perform all rough and finish grading required to attain the elevations shown on the Drawings.
- B. Grading Tolerances:
 - 1. Rough Grade: Buildings, parking areas, and sidewalks— ± 0.1 feet.
 - 2. Finish Grade: Granular cushion or crushed stone mat under concrete slabs— ± 0.03 feet.
 - 3. Lawn areas away from buildings, parking areas, and sidewalks— ± 0.25 feet.

3.11 MAINTENANCE OF SURFACE

- A. CONTRACTOR shall maintain all backfilling, resurfacing, repaving, and other surface improvements constructed under this Contract. CONTRACTOR shall, upon proper notice from OWNER, make all repairs in surfaces of trenches and excavations. All expenses incurred by OWNER and/or CONTRACTOR in making repairs and all expenses in maintaining trench and excavation surfaces shall be at the expense of CONTRACTOR regardless of the material used in backfilling trench excavations. OWNER reserves the right to make all emergency repairs necessary to make safe all streets and walks at the expense of CONTRACTOR regardless of the material used in backfilling trench excavations. A maintenance guarantee fund, if specified, will be withheld from the final amount due CONTRACTOR for a period of 6 months, after acceptance of the Work, to provide such maintenance.
- B. CONTRACTOR shall be responsible for controlling dust dispersion during utility and street construction. Remedial actions required as a result of inadequate dust control shall be CONTRACTOR's responsibility. To control dust, CONTRACTOR shall apply calcium chloride or ammonium lignin sulfonate in 12 to 14% solution or other dust control palliative acceptable to OWNER. Prior to application of dust palliative, the street shall be graded smooth.

3.12 COMPACTION TESTING

- A. Compaction tests shall be done by the Testing Firm. Location and frequency of the tests shall be as recommended by the Testing Firm and paid for by CONTRACTOR.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Removal of groundwater to allow belowgrade construction.
 - 2. Site grading to prevent surface water from entering the excavation.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Payment:
 - 1. The expense for making all extra excavations necessary to prevent water from interfering with the proper construction of the work and for forming all dams or diversions, digging of sumps or pump wells, bailing, and installation and pumping of wells shall be borne by CONTRACTOR.
 - 2. The cost for removal of groundwater and surface water shall be included in the prices bid for the work. No separate payment will be made for dewatering whether accomplished by use of sumps and pumps, well point systems, deep wells, or any other method.
 - 3. Any permits necessary for the dewatering operations shall be obtained and paid for by CONTRACTOR.

1.02 REFERENCES

- A. See Division 01, Section 01 41 00—Regulatory Requirements for permit requirements and water, erosion, and sediment control.

1.03 SYSTEM REQUIREMENTS

- A. CONTRACTOR shall, at its own expense, keep the excavation clear of water while structures, mains, and appurtenances are being built, utilities are being installed, and fill and backfill are being compacted. Under no conditions shall the work be laid in or under water. No water shall flow over the work until the joints are complete or the concrete has set.
- B. Wherever necessary, CONTRACTOR shall excavate in advance of the completed work, lead the water into sumps or pump wells, and provide erosion control measures to prevent water or sediment damage.
- C. CONTRACTOR's dewatering system shall perform so that the soils within the trench will not be destabilized by hydrostatic uplift pressures from adjacent groundwater. If conditions warrant, CONTRACTOR shall furnish and install well point systems or deep wells.
- D. Dewatering shall be sufficient to lower the piezometric level to at least 2 feet below the bottom of the excavation. Additional lowering shall be provided as necessary to create a stable subgrade.

- E. In areas where rock is encountered, the water level shall be kept at or below top of rock, but at least 6 inches below bottom of concrete. Additional rock shall be removed as needed to provide clearances.
- F. The control of groundwater shall be such that softening or heaving of the bottom of excavations or formation of "quick" conditions or "boils" shall be prevented.
- G. Dewatering systems shall be designed and operated so as to prevent the migration or removal of soils.

1.04 QUALITY ASSURANCE

- A. All dewatering shall be done in accordance with applicable federal, state, and local code requirements.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

3.01 DEWATERING

- A. Dewatering shall be started, and the water level shall be lowered as specified herein prior to beginning excavation and shall be continued until structure, main, or appurtenance has been completed and fill has been placed and compacted to final grade.
- B. CONTRACTOR shall provide at least two groundwater observation wells near each area to be excavated to aid CONTRACTOR in determining whether the minimum specified requirements have been met prior to excavation. The observation well shall be a minimum 2-inch-diameter slotted PVC pipe. The observation well shall be installed and backfilled in such a way as to allow an accurate determination of actual groundwater levels. The observation well shall be properly abandoned after use unless specified otherwise.
- C. CONTRACTOR shall provide all necessary materials and equipment to keep the excavation free from water during construction. CONTRACTOR shall at all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outages, and shall have available at all times competent workers for the operation of the pumping equipment. The dewatering systems shall not be shut down between shifts, on holidays or weekends, or during the work stoppages.
- D. CONTRACTOR shall meet all requirements of applicable TCEQ permits for construction pit or trench dewatering.
- E. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted fill or backfill, and prevent floatation or movement of all structures and pipelines.

3.02 PROTECTION

- A. CONTRACTOR shall take all necessary precautions during the dewatering operation to protect adjacent structures against subsidence, flooding, or other damage. The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property. Any such facilities and structures damaged shall be repaired or replaced to the satisfaction of their owner.
- B. Prior to dewatering, CONTRACTOR shall take into account the effect of its proposed dewatering operation on existing private water supply systems and shall make arrangements with property owners for protecting their supplies or providing alternative means of supply.
- C. In the event that CONTRACTOR's dewatering operation adversely affects private water supply systems, CONTRACTOR shall provide property owners with alternative potable and nonpotable supplies until dewatering operations are ceased and groundwater levels return to normal. If the water in private water supply wells is contaminated, through no fault of CONTRACTOR after restoration of original groundwater levels, OWNER will provide measures to restore water potability. CONTRACTOR is responsible for restoration of the water supply, not its potability after restoration.
- D. In areas where continuous operation of dewatering pumps is required, CONTRACTOR shall avoid noise disturbance to nearby residences to the greatest extent possible by using electric-driven pumps, or intake and exhaust silencers or housing to minimize noise from engine-driven generators or engine-driven pumps.

END OF SECTION

SECTION 31 23 23.46

CEMENT STABILIZED SAND

PART 1–GENERAL

1.01 SUMMARY

- A. This section provides for the use of cement stabilized sand as a utility bedding or backfill material or for structural backfill.

1.02 RELATED SECTIONS

- A. Section 31 23 00–Excavation, Fill, Backfill, and Grading.

1.03 MEASUREMENT AND PAYMENT

- A. Unless otherwise stated in the Bid Form, no separate payment will be made for work performed under this specification. Unless otherwise stated in the Bid Form, all costs shall be included in the related items of work listed in the Bid Form.

1.04 REFERENCES

- A. The applicable provisions of the following standards shall apply as if written here in their entirety: ASTM–American Society of Testing Materials.

1.05 SYSTEM DESCRIPTION

- B. Provide sand-cement mixture that will produce a minimum unconfined compressive strength of 100 pounds per square inch (psi) in 48 hours.

1.05 QUALITY ASSURANCE

- A. Upon request of CONSULTANT, CONTRACTOR or their supplier will furnish samples of the sand and cement for testing before and/or during project construction. Samples shall be submitted two days prior to stabilized sand being delivered to the project site. If the material source is changed during project construction, new samples shall be submitted.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Material not in place within three hours of mixing will be rejected.

PART 2–PRODUCTS

2.01 MATERIALS AND/OR EQUIPMENT

- A. Sand: Use clean durable sand containing not more than the following:
 - 1. Deleterious Materials.
 - a. Clay lumps, ASTM C142; less than 0.5 percent.
 - b. Lightweight pieces, ASTM C123; less than five percent.

- c. Organic impurities, ASTM C40; shall not show a color darker than the standard color.
- d. Other deleterious materials such as coal, shale, coated grains of soft flaky particles; less than two percent.
- 2. Plasticity index shall be 4 or less when tested in accordance with ASTM D43 and ASTM D424.
- 3. Gradation Requirements:

	% Retained
3/8-inch sieve	0%
1/4-inch sieve	0%–5%
10-mesh sieve	5%–35%
20-mesh sieve	15%–55%
40-mesh sieve	35%–85%
60-mesh sieve	60%–95%
100-mesh sieve	80%–97.5%
200-mesh sieve	95%–100%
270-mesh sieve	100%

- 4. Color test ASTM C40. Color not darker than standard color.
- B. Portland Cement. Furnish Portland cement to conform with ASTM C-150, Type 1.
- C. Water. Water shall be reasonably clean and free from injurious amounts of oil, acid, alkalies, salt, organic matter, or other deleterious material.

PART 3–EXECUTION

3.01 PREPARATION

- A. Add not less than 1 1/2 sacks of Portland cement to stabilize 1 cubic yard of sand mixture. Mix thoroughly in an approved pug-mill type mixer. Stamp batch ticket with the time of loading.

3.02 ERECTION/INSTALLATION/APPLICATION AND/OR CONSTRUCTION

- A. Bedding:
 - 1. Place cement-sand in a trench or excavation prepared for utility pipe to the depth shown on the Drawings.
 - 2. After bedding material is in place, set pipes in position to grade.
 - 3. Add additional cement-sand material around pipe, filling to at least 12 inches above pipe crown. Place cement-sand material at optimum moisture content, and in layers not to exceed 6 inches measured loose.
 - 4. Compact with mechanical hand tamps to at least 95 percent of Standard Proctor Density, ASTM D698.
- B. Foundations: Use cement stabilized sand for stabilizing below the foundation for precast manholes, inlets or concrete structures.
- C. Backfill:
 - 1. When required, place cement-sand in utility trenches as backfill for lines under existing or future pavement.

2. Place cement-sand material at optimum moisture content in layers not to exceed 12 inches, measured loose.
3. Compact with mechanical hand tamps to at least 95 percent of Standard Proctor Density, ASTM D698.

3.03 FIELD QUALITY CONTROL

- A. Allow access to completed portions of bedding or backfill for field density testing by nuclear method.

END OF SECTION

SECTION 31 50 00

EXCAVATION SAFETY

PART 1—GENERAL

1.01 SUMMARY

- A. This section covers the minimum requirements and responsibilities of CONTRACTOR for excavations and shoring/safety of same.

1.02 MEASUREMENT AND PAYMENT

- A. The cost for performing the safety requirements set forth herein shall be paid for on a linear foot basis according to the depth of cut as set forth in the Bid or as otherwise provided for in the Bid and shall include all labor, materials, services, and equipment to perform this item of work.

1.03 REFERENCES

- A. OSHA—Occupational Safety and Health Administration, 29CFR, Part 1926.

1.04 SYSTEM DESCRIPTION

- A. CONTRACTOR shall shore or otherwise protect excavations from cave-ins, protect employees from exposure to vehicular traffic, falling loads, hazardous atmospheres, water accumulation and unstable structures in and adjacent to excavations and provide acceptable means of access to and egress from excavations. Notwithstanding these suggestions, CONTRACTOR is solely responsible for the safety of their employees and the general public as they interface with this construction project.

1.05 SUBMITTALS

- A. CONTRACTOR shall furnish an excavation or trench safety plan for any excavation exceeding 20-foot depth. The safety plan must be signed and sealed by a Texas licensed professional engineer.
- B. The design calculation and design drawings are not shop drawings, but shall be submitted to CONSULTANT separately from any other shop drawings for any system, material, or equipment specified. These calculations will be forwarded to OWNER for their records.

1.06 QUALITY ASSURANCE

- A. Excavation safety system shall meet the current standards established by OSHA, 29CFR, Part 1926, Subpart P-Excavations.
- B. Any construction not in accordance with OSHA regulations may not be eligible for payment and delays in construction to bring the project into OSHA regulations will not be the responsibility of OWNER or CONSULTANT.

1.07 PROJECT/SITE CONDITIONS

- A. CONTRACTOR shall develop and implement an excavation safety program based on the actual conditions encountered on the project.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

3.01 GENERAL

- A. CONTRACTOR has the sole responsibility for providing an adequate excavation safety system. CONTRACTOR agrees that neither OWNER nor CONSULTANT has such responsibility and CONTRACTOR shall not rely on OWNER or CONSULTANT or any of their representatives for inspection, design, supervision, construction, or any other aspect of excavation safety.

END OF SECTION

SECTION 31 64 00

CAISSONS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Concrete caissons.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 MEASUREMENT AND PAYMENT

- A. The cost of concrete caissons, including all labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete, and other items for complete installation shall be included in the Lump Sum Bid for the number, size, and length of caissons indicated on the Drawings.
- B. There will be no additional compensation for excavation, concrete fill, reinforcing, casings, or other costs because of unauthorized overexcavating shafts or bells. No payment will be made for rejected caissons.

1.03 REFERENCES

- A. AASHTO M036—Standard Specification for Corrugated Metal Steel Pipe, Metallic-Coated for Sewers and Drains.
- B. ACI 336.1—Specification for the Construction of Drilled Piers.
- C. ASTM A36—Standard Specification for Carbon Structural Steel.
- D. ASTM A252—Standard Specification for Welded and Seamless Steel Pipe Piles.
- E. ASTM A929—Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe.

1.04 SUBMITTALS

- A. Reports: Submit the following reports directly to CONSULTANT with copy to others as designated. Concrete Materials Test Reports as proposed for use in concrete mixes.

1.05 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of American Concrete Institute (ACI) “Standard Specification for the Construction of End Bearing Drilled Piers” ACI 336.1, and as herein specified. Where provisions of above standard conflict with building regulations in effect for this project, building regulations will govern, but only to establish minimum requirements.

PART 2–PRODUCTS

2.01 CONCRETE AND RELATED MATERIALS

- A. Concrete shall be Class B as specified in Section 03 30 00–Cast-In-Place Concrete.

2.02 STEEL CASING

- A. Steel Pipe Casings: ASTM A 252, Grade 2, or ASTM A 36, or ASTM A 929 corrugated steel, as specified, or as shown on the Drawings.

PART 3–EXECUTION

3.01 PREPARATION

- A. Use placement method which will not cause damage to nearby structures.
- B. Protect structures near the work from damage.
- C. Prepare to place piles from existing site elevations.

3.02 CAISSON EXCAVATION

- A. General: Excavate holes for caissons to required bearing strata or elevation as shown on Drawings and/or specified herein. Excavate holes for closely spaced caissons and those occurring in fragile or sand strata only after adjacent holes are filled with concrete and allowed to set.
 - 1. Caisson design dimensions shown are minimums. The design of caissons is based on assumed strata bearing capacity. If bearing strata is not capable of maintaining bearing capacity assumed, foundation system will be revised as required. Revisions will be paid for in accordance with Contract conditions relative to changes in work.
 - 2. If required, install casings as excavation proceeds so that earth walls are maintained without spilling into shaft. When assumed elevation of top of bell portion is reached, casing may be stopped with a smaller inner section, if required, for safety of personnel, carried down to bearing strata. Do not extend inner section beyond actual top of bell to maintain designed caisson shaft diameter.
- B. Construction Tolerances: Locate centerline of caissons within the following tolerances:
 - 1. Maximum permissible variation of location not more than one-twenty-fourth of shaft diameter or 3 inches, whichever is less.
 - 2. Shafts out of plumb, not more than 1.5% of length nor exceeding 12.4% of shaft diameter or 15 inches, whichever is less.
 - 3. Concrete cutoff elevation, +1 inch to 3 inches.
 - 4. If above tolerances are exceeded, provide corrective construction to compensate for excessive eccentricity. Submit proposed corrective construction methods to CONSULTANT for review before proceeding.
- C. Temporary Shaft Protections: When required, provide full-length watertight steel casings of sufficient thickness to withstand compressive displacement and withdrawal stresses and to

maintain shaft walls. Temporary casings may be left in place or may be withdrawn as concrete is placed at CONTRACTOR's option.

- D. Obstructions: If rock, boulders, or other unforeseen obstructions are encountered which cannot be removed by standard caisson excavation methods, and if such obstructions will be paid for in accordance with terms of Contract relative to changes in work. Remove such obstructions by hand labor using air-powered tools or by other safe methods recognized in construction industry.
- E. Classification of Rock: Rock is defined as material which cannot be drilled with a conventional earth auger or under reaming tool and requires use of special rock augers, core barrels, air tools, blasting, or other methods of hand excavation. For pay purposes, earth layers and seams and voids less than 12 inches thick, sandwiched between rock, shall be considered rock for full volume of shaft from initial contact with rock. The work of this section includes demolition and removal of rock, boulders, concrete, masonry, and other subsurface obstructions which are clearly indicated by Contract Documents or by available subsurface exploration data, and such work will not be considered a change in work.
- F. Dewatering: Provide and maintain pumping equipment to keep excavations free of water before placing concrete. If excessive water is encountered and drilling operations must be halted, consult with CONSULTANT before using alternative methods of construction. Conduct water to general site runoff ditches and disposal areas with discharge lines. Provide ditching as required to conduct water to site drainage facilities.
- G. Overexcavation: No payment will be made for extra length when caisson shafts are excavated to a greater depth than required or authorized by CONSULTANT because of overdrilling by CONTRACTOR. Complete caisson and fill extra depth with concrete if other conditions are satisfactory. Overexcavated shafts will be measured and paid for to original design or authorized depth.
- H. Excavated Material: Excavated material shall be handled in accordance with Section 31 23 00–Excavation, Fill, Backfill, and Grading.

3.03 REINFORCING STEEL AND DOWELS

- A. Before placing, clean reinforcing steel and dowels of loose rust, scale, dirt, grease and other material which could reduce or destroy bond.
- B. Fabricate and erect reinforcing cages in shafts as one continuous unit using inner ring resteel. Place reinforcement accurately and symmetrically about axis of hole and hold securely in position during concrete placement.
- C. Use template to set anchor bolts, leveling plates and other accessories furnished under work of other sections. Provide blocking and holding devices to maintain required position during concrete placement.
- D. Protect exposed ends of dowels and anchor bolts from mechanical damage and exposure to weather.

3.04 CONCRETE PLACEMENT

- A. General: Fill caissons with concrete immediately after inspection and approval by testing laboratory. Use protection sheets (cut out to receive concrete) over excavation openings, extending at least 12 inches beyond edge.
 - 1. Place concrete continuously and in a smooth flow without segregating the mixed materials. Provide mechanical vibration for consolidation of at least top 25 feet of each shaft.
 - 2. Place concrete by means of a bottom discharge bucket, flexible drop chute, elephant trunk hopper, or tremie. Use chutes or tremies for placing concrete where a drop of more than 25 feet is required or pump concrete into place.
 - 3. Place concrete in-the-dry unless placing under water is acceptable to CONSULTANT. If CONSULTANT determines that it is impractical to dewater caisson excavation and reasonable attempts to seal off water flow have failed, allow water level to attain its normal level and place concrete by tremie method. Control placement operations so that tremie is not broken during continuous placing from bottom to top. Other methods of depositing concrete under water may be used if acceptable to CONSULTANT.
 - 4. Maintain a sufficient head of concrete to prevent reduction in diameter of caisson shaft by earth pressure and to prevent extraneous material from mixing with fresh concrete. Coordinate withdrawal of temporary casings with concrete placement operations to maintain a head of concrete at least 5 feet above casing bottom and/or above groundwater level.
 - 5. Stop concrete placement at cutoff elevation shown, screed level, and apply a scoured, rough finish. Where cutoff elevation is above ground elevation, form top section above grade and extend shaft to required elevation.
 - 6. Interrupted placing operations of over 1 hour duration will require a cold joint installation. Leave resulting shaft surface approximately level and insert steel dowels as shown on Drawings. At resumption of concrete placing, clean off surface laitance, roughen as required, and slush with a 1-to-1 cement grout or commercial bonding agent before remainder of concrete is placed.
- B. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures in compliance with ACI 306R and as herein specified.
- C. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F and not more than 80°F at point of placement.
- D. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
- E. Do not use calcium chloride, salt, and other minerals containing antifreeze agents or chemical accelerators, unless otherwise accepted by CONSULTANT.
- F. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305R and as herein specified.
- G. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F. Mixing water may be chilled, or chopped ice may be used to control concrete temperature provided water equivalent of ice is calculated to total amount of mixing water.

- H. Place concrete immediately upon delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means.
- I. Do not use retarding admixtures without acceptance of CONSULTANT.

3.05 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction: Sample test and report concrete for quality control during placement as required by Section 03 30 00–Cast-In-Place Concrete.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Preparation of subsoil.
 - 2. Topsoil.
 - 3. Seeding, mulching or erosion mat, and fertilizing.
 - 4. Maintenance.
- B. Except for paved, riprapped, or built-up areas, all areas of the site which are disturbed and areas noted on the Drawings shall be seeded. Prior to seeding, disturbed areas shall be graded to subgrade for placement of topsoil.
- C. CONTRACTOR shall proceed with restoration of property and cleanup of all disturbed areas concurrently with the installation of utilities and street construction.
- D. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 MEASUREMENT AND PAYMENT

- A. Payment: Payment for topsoil, seeding, fertilizer, mulching, erosion mat, and maintenance of restored areas shall be included in the Lump Sum Bid.

1.03 REFERENCES

- A. FS O-F-241–Fertilizers, Mixed, Commercial.
- B. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Texas Department of Transportation, Standard Specifications for Construction and Maintenance of Highways, Latest Edition Items 160, 162, 164, 166, and 168, including all issued supplemental specifications and special provisions.

1.04 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.
- B. Sod: Minimum age of 18 months, with root development that will support its own weight without tearing when suspended vertically by holding the upper two corners. Submit sod certification for grass species and location of sod source.

1.05 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

- B. Deliver sod on pallets or in rolls. Protect exposed roots from dehydration. Do not deliver more sod than can be laid within 24 hours.
- C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2–PRODUCTS

2.01 SEED MIXTURE

- A. Seed materials shall conform to Item 164.
- B. Weed content shall not exceed 0.5% in mixture.

2.02 SOIL MATERIALS

- A. Topsoil shall consist of salvaged topsoil or hauled-in topsoil in accordance with Item 160 of the Standard Specification.

2.03 ACCESSORIES

- A. Mulching material shall conform to Items 162 and 164 of the Standard Specifications.
- B. Fertilizer materials shall conform to Item 166 of the Standard Specifications and shall consist of the following proportions: Nitrogen 12%, phosphoric acid 12%, soluble potash 12%. Submit composition deviations to suit site conditions for CONSULTANT's review.
- C. Water shall be clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.
- D. CONTRACTOR shall be responsible for watering in accordance with Item 168 of the Standard Specifications.

PART 3–EXECUTION

3.01 GENERAL

- A. CONTRACTOR shall proceed with restoration of property and cleanup of all disturbed areas concurrently with the installation of utilities and street construction.

3.02 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this section.

3.03 PREPARATION OF SUBSOIL

- A. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.

- B. Remove foreign materials, weeds, and undesirable plants and their roots. Remove contaminated subsoil in accordance with local, state, and federal regulations.
- C. Scarify subsoil to a depth of 3 inches where topsoil is to be placed. Repeat deep (> 12 inches) subsoiling or cultivation in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.04 PLACING TOPSOIL

- A. Place topsoil in accordance with Item 160 of the Standard Specifications.
- B. Spread topsoil to a minimum depth of 6 inches over area to be seeded. Rake until smooth.
- C. Place topsoil during dry weather and on dry unfrozen subgrade.
- D. Remove vegetable matter and foreign nonorganic material from topsoil while spreading.
- E. Grade topsoil to eliminate rough, low or soft areas, and to provide positive drainage.
- F. Manually spread topsoil around trees, plants, and buildings to prevent damage.
- G. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.05 FERTILIZING

- A. Apply fertilizer in accordance with Item 166 of the Standard Specifications.
- B. Apply fertilizer after smooth raking of topsoil and prior to installation of seed or sod, no more than 18 hours before seeding or 48 hours before sodding.
- C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
- D. Mix fertilizer thoroughly into upper 2 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3.06 SEEDING

- A. Apply seeding in accordance with Item 164 of the Standard Specifications. Apply evenly in two intersecting directions. Rake in lightly or roll the seeded area after seeding.
- B. Planting season shall be between February 1 and May 15, or between September 1 and November 30.
- C. Do not sow immediately following rain, when ground is too dry or during windy periods.
- D. Seeding shall be maintained by CONTRACTOR until grass is well established. Grass is well established when it covers the entire seeded areas to a height of 2 inches.

3.07 MAINTENANCE

- A. Seeding shall proceed concurrently with the main construction. Seeding shall be maintained by CONTRACTOR until grass is well established. Grass is well established when it covers the entire seeded areas to a height of 2 inches.

END OF SECTION

SECTION 33 00 10

BURIED PIPING AND APPURTENANCES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. All underground piping, valves, and appurtenances of every description.
 - 2. Excavation, dewatering, and backfilling for all work under this section unless otherwise noted.
 - 3. Concrete foundations and anchor bolts for all equipment furnished under this section.
 - 4. Underground piping connections to all equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Measurement and Payment: Payment for all work included, materials, equipment and miscellaneous items necessary to complete the installation will be made at the lump sum price bid for buried piping and appurtenances.

1.02 REFERENCED SPECIFICATIONS

- A. Texas Commission on Environmental Quality, Title 30 Texas Administration Code (30 TAC), Chapter 290, Rules and Regulations for Public Water Systems and 30 TAC, Chapter 217, Design Criteria for Systems and Processes.
- B. Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.

1.03 CODES AND STANDARDS

- A. Comply with the requirements of:
 - 1. The Railroad Commission of Texas Pipeline Safety Rules and applicable standard(s).
 - 2. NFPA 54—National Fuel Gas Code (Current Edition).
 - 3. Polyethylene gas distribution piping shall be installed in accordance with CFR 49, Part 192, Subpart G (mains), Subpart H (service lines), applicable codes and regulations, and ASTM D2774.
- B. Before any polyethylene fusion welding is performed, CONTRACTOR shall submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.
- C. CONSULTANT and OWNER reserve the right to test the work of any welder employed on the project, at CONTRACTOR's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

1.04 SUBMITTALS

- A. Shop Drawings: General arrangement drawings of 3 inches or larger exterior (belowground) ductile iron piping shall be submitted to CONSULTANT for approval. Drawings shall include proposed materials, length, location, and elevation of pipe, fittings, pipe restraint, valves, and appurtenances.

PART 2—PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

- A. All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. All materials in contact with water to be used for potable water supplies shall be National Sanitation Foundation (NSF)-approved.
- B. Size and Type:
 - 1. All materials shall conform to the size and type shown on the Drawings or called for in the specifications.
 - 2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event standard fittings are not available, the method of joining shall be standard selected by CONTRACTOR and submitted for review by CONSULTANT.
- C. Materials provided shall be suitable for the conditions in which they are being installed and used. CONTRACTOR shall review installation requirements of the Contract with material suppliers and incorporate any additional installation requirements necessary to meet the required use within the price bid for the Work.
- D. All pipe and materials used in performance of the Work shall be clearly marked as to strength, class, or grade. Pipe and materials not so marked shall be subject to rejection.
- E. When requested by CONSULTANT, material suppliers shall furnish certificates of compliance indicating that all tests required by various Standards have been conducted and that the test results comply with the Standards.
- F. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be selected by CONTRACTOR and submitted for review by CONSULTANT.

2.02 MANHOLES

- A. General: All other provisions shown in the Drawings, except those contrary to provisions delineated herein or on the Drawings shall apply to manholes.
- B. Unless otherwise specified or shown on the Drawings for special manholes, all manholes shall be reinforced concrete precast manholes. Reinforced concrete manhole base sections, riser sections, cones, and flat slabs shall conform to the requirements of ASTM C478. Solid precast manhole bottoms shall be provided except where shown on the Drawings. Manholes shall be provided with minimum diameters as shown on the Drawings.

- C. A concrete water proofing admixture with red dye shall be added to each manhole during the concrete batching process and shall be Xypex Admix C-1000 Red dosed at 20 pounds per cubic yard of concrete, Krypton KIM-HS (K301) dosed at 2% by weight of cementitious materials, including fly ash, Penetron Admix RP dosed at the rate of one 6.6 pound soluble bag per cubic yard of concrete, or equal.
- D. Manhole top sections shall be precast reinforced concentric cones unless precast reinforced flat slabs are specifically required or shown on the Drawings or are necessary because of shallow depth. Flat slabs shall have opening offset unless otherwise required or shown. Flat slabs shall be designed for HS20 loadings.
- E. Concrete Manhole Chimney Adjusting Rings:
 - 1. Provide concrete manhole adjusting rings.
 - 2. Precast concrete adjusting rings for standard manholes shall have an inside diameter of 30 inches, be not less than 2 inches nor more than 6 inches high, and shall have a wall thickness of 6 inches unless otherwise specified. The rings shall contain a minimum of one No. 2 reinforcing rod centered within the ring. The joints between rings and between rings and castings shall be sealed with preformed flexible joint sealant as specified herein.
 - 3. CONTRACTOR shall supply ring materials, adhesive, labor, and equipment to permanently install the rings in strict accordance to manufacturer's recommendations. Manhole casting rims shall be set flush with constructed road surface. Ring inside diameter shall be 24-inch nominal, or larger to match frame.
- F. Frames and Covers:
 - 1. Cover for underground utility structure shall be provided with pumps and delivered to underground structure manufacturer. Other covers shall be Bilco Type JD (double leaf), Nystrom, or equal, aluminum covers. The covers shall include a positive hold open arm with release handle and a tubular compression spring operator. Provide covers with slam lock with inside handle and removable key wrench. All aluminum surfaces in contact with concrete shall be painted with bitumastic coating. Hardware shall be stainless steel throughout.
 - 2. Covers shall be reinforced for minimum 300 pounds per square foot live load for HS20 loading. Provide stainless steel or fiberglass unistruts as necessary attached to covers to mount accessories, guides, etc.
- G. Manhole Chimney Seals:
 - 1. CONTRACTOR shall provide internal manhole frame chimney seal. The seal shall be made of a rubber type product, with a minimum thickness of 3/16 inch, a minimum unstretched width of 8 inches and be extruded or molded from a high-grade rubber compound conforming to the applicable requirements of ASTM C923. The bands used for compressing the sleeve against the manhole shall be fabricated from stainless steel conforming to ASTM A240, Type 304, for sheet and ASTM A479, Type 304, for rods. Any screws, bolts, or nuts used on these bands shall be stainless steel conforming to ASTM F593 and F594, Type 304. The internal seal or its appurtenances shall not extend far enough into the manhole opening to restrict entry into or exit from the manhole.
 - 2. Manhole frame-chimney seals shall be designed to prevent the leakage of water into the manhole at the area of the joint between the manhole frame and chimney continuously throughout a 20-year design life. The seal shall remain flexible, allowing repeated vertical movements of the frame because of frost lift, ground movement, or other causes of up to 2 inches and/or repeated horizontal movements of the frame

because of thermal movement of the pavement or other causes of up to 1/2 inch, both rates of movement occurring at rates not less than 0.10 inch per minute.

3. The seal shall be made of only materials that have been successfully used in sanitary sewer construction for at least 10 years and have proven to be resistant to sanitary sewage; corrosion or rotting under wet or dry conditions; the gaseous environment in sanitary sewers and at road surfaces including common levels of ozone, carbon monoxide and other trace gases at the sites of installations; the biological environment in soils and sanitary sewers; chemical attacks by road salts, road oil and common street spillages or solvents used in street construction or maintenance; the temperature ranges, variations and gradients in and between manhole frames and chimneys in the climate of the location of construction; variations in moisture conditions and humidity; fatigue failure caused by a minimum of 30 freeze thaw cycles per year; or vibrations because of traffic loadings; fatigue failure because of repeated variations of tensile, compressive and shear stresses and repeated elongation and compression; and any combination of the foregoing. The materials used shall be compatible with each other and the manhole materials.

H. Valve Boxes:

1. A valve box shall be provided for fire hydrant auxiliary valves and for valves in the main. The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of valve boxes so that the bottom of the base is about 2 inches away from contact with the valve bonnet. A Gate Valve Adaptor by Adaptor Inc., or equal, shall be provided. The valve box shall not transmit shock or stress to the valve.
2. Valve boxes shall be made of cast iron conforming to ASTM A48. The castings shall be free from blowholes, porosity, hard spots, shrinkage defects or cracks, or other injurious defects and shall have a normal smooth casting finish. The castings shall be thoroughly coated with a 1 mil minimum thickness bituminous coating. Valve boxes shall be 5 1/4 inches in diameter. Valve boxes shall have a maximum length of 7 feet when extended without extension sections. Extensions shall be provided for deeper mains.
3. Valve boxes shall consist of a base section, tubular mid and top sections, both with cast threads by which one can be telescoped on the other, extension sections if required, and a circular drop cover unless indicated otherwise.
4. Valve boxes shall be installed in accordance with the Drawings.
5. Valve boxes shall be Tyler/Union 6850 Series, 4 inches through 12 inches, or equal. Extension heights shall be provided as required. Lids shall be marked for appropriate use. CONTRACTOR shall verify that all valve boxes are large enough to accommodate all operating nuts and wrenches. Provide one "Tee" valve key operator for each valve manhole and one for each tank with tank or channel drain.

I. Precast Reinforced Concrete Manholes:

1. Lengths of manhole riser (barrel) shall be furnished in such combinations as to conveniently make up the depth of the manhole. A maximum of two handling holes per length of riser will be permitted.
2. Drop entrances to sanitary sewer manholes shall be installed where indicated on the Drawings. Drop entrances shall be of the same diameter as the sewer main from sizes 8 inches through 18 inches. For larger diameters, the drop shall be 18 inches unless otherwise shown on the Drawings. Drop entrances for storm sewer manholes are not required.

3. The interior bottom of sanitary sewer and storm sewer manholes shall be constructed of concrete benches which shall be precast or poured in place in the field. Benches shall be constructed, at a minimum, to the spring line of pipe for diameters less than 15 inches and to 3/4-pipe-diameter for pipe diameters between 15 and 24 inches. Benches shall extend to the top of each pipe that is greater than 24 inches in diameter. Flow lines shall be made smooth with uniform curves to promote flow through the manhole.
4. All joints between manhole pipe sections and top shall be tongue and groove conforming to ASTM C443. Manhole joints for sanitary sewers shall use circular O rings. Manhole joints for storm sewers shall be sealed with circular O ring or preformed flexible joint sealant that shall be Ram-nek, Kent-Seal, Mas-stik, or equal.
5. Manhole connections for sanitary sewer mains shall be made using flexible, watertight connections, PSX Press Seal, Kor N Seal, or equal, for sewers up through 18 inch diameter. All other sanitary sewer manhole connections shall be made with A Lok, PSX Press Seal, Kor N Seal, or equal. The joint shall provide a flexible, watertight connection between pipe and manhole. Manhole connections for storm sewer mains and leads may be made with cast-in-place concrete during completion of manhole interior in lieu of above.
6. Manhole bottoms for sanitary sewer shall be monolithically precast with the bottom section for manholes up through 6-foot diameter. Bottoms for larger diameter manholes shall be precast but need not be monolithically cast with the bottom section. All other manhole bottoms shall be either poured in place or precast concrete.
7. Manhole bottoms for air release manholes, force main cleanout manholes and water system valve manholes shall have an 18-inch diameter sump hole. Sump hole shall have a solid concrete bottom where groundwater is above the bottom of the manhole.
8. Manholes shall be furnished of minimum diameters as shown on the Drawings. Manholes shall be furnished large enough to provide a minimum distance, between adjacent pipe, measured tangentially along the inside face of the manhole, equal to one half the outside diameter of the intersecting sewer pipe. In any event, manholes shall be furnished in the diameter necessary to accommodate intersecting sewer pipe and the pipe to manhole connection as proposed for use.
9. Precast reinforced concrete manhole risers and tops shall be tested in accordance with ASTM C497. Precast reinforced concrete manhole risers and tops meeting the strength requirements will be considered acceptable and shall be stamped with an appropriate monogram. When requested, copies of test reports shall be submitted to CONSULTANT before the manhole sections are installed in the Project. Final acceptance will be made after field inspection upon delivery to the jobsite.
10. Precast reinforced concrete manhole sections shall be subject to rejection for failure to conform to any of the requirements of the Standard Specifications. In addition, individual sections of manhole risers and tops may be rejected because of any of the following reasons:
 - a. Fracture or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint.
 - b. Defects that indicate imperfect proportioning, mixing, and molding.
 - c. Surface defects indicating honey combed or open texture.
 - d. Damaged ends, where such damage would prevent making a satisfactory joint.
 - e. Noticeable infiltration into manhole.
 - f. Variation in diameter of the manhole section of more than 1% from the nominal diameter.
 - g. Any continuous crack having a surface width of 0.01 inch or more and extending for a length of 12 inches or more regardless of position in the section wall.

- J. Each precast reinforced concrete manhole riser and top section shall be clearly marked with the name or trademark of the manufacturer and the date of manufacture. This marking shall be indented into the manhole section or shall be painted thereon with waterproof paint.
- K. Manhole and Inlet Castings:
1. All manhole and inlet castings shall be gray iron and meet the requirements of ASTM A48. Unless otherwise shown on the Drawings, standard manhole castings shall be Neenah R1550 with machined frame, Type B solid lid, concealed pick holes and self-sealing gaskets, East Jordan Iron Works, or equal. Floodproof castings shall be Neenah R1916 C with machined frame, type B solid lid, concealed pick holes and self-sealing gaskets, East Jordan Iron Works, or equal.
 2. Inlet castings for locations with curb and gutter shall be Neenah R3067 with type L grates on slopes and type R grates at low points, East Jordan Iron Works, or equal. For driveway areas, inlet castings shall be Neenah R3290 with Type C grates, East Jordan Iron Works, or equal.
 3. Frames for valve manholes shall be Neenah R-6065 with Type B lid, R-5900-F with Type C lid with two concealed pickholes equipped with self-sealing gaskets, or equal. Catch basin grates shall be Neenah R-1550 with machined frame and Type D open grate, or equal. Interior mud basin castings shall be Neenah R-6118, or equal, with grey iron Class 35 frame and grating for heavy-duty use.
- L. Mortar: Mortar shall meet the requirements of ASTM C270. Mortar shall be one part Portland cement and 2 1/4 parts washed mortar sand.
- M. Preformed Flexible Joint Sealant: Preformed flexible joint sealant shall be EZ Stik, Kent Seal, Ram Nek, or equal, meeting the requirements of ASTM C990.
- N. O-Rings: O-rings shall meet the requirements of ASTM C443.

2.03 BURIED PIPING

- A. Ductile Iron Piping and Fittings:
1. Unless otherwise shown or specified, all underground piping 3 inches in diameter or larger shall be ductile iron conforming to AWWA C151/A21.51 with mechanical joints or push-on joints. Pipe wall thickness shall be furnished as required by AWWA C150 for buried piping with the depth of cover as shown on the Drawings for laying condition 4, minimum Special Thickness Class or Pressure Class as listed below, unless otherwise shown or specified.

Pipe Size (Inches)	Special Thickness (Class)	Pressure Class
3	53	---
4	53	---
6	53	---
8	53	---
10	53	---
12	53	---
14	52	---
16	52	---
18	52	---
20	---	250

Pipe Size (Inches)	Special Thickness (Class)	Pressure Class
24	---	250
30	---	250

2. Each pipe and fitting shall have the weight, class or nominal thickness, country where cast, casting period, manufacturer's mark, the year in which the pipe was produced, and the letters DI or DUCTILE cast or stamped thereon. Improper or incomplete marking will be cause for rejection of the pipe or fitting.
3. CONTRACTOR shall furnish certification data representing each class of pipe or fitting furnished. The certification report shall clearly state that all pipe and fittings furnished meet the appropriate AWWA specification. Ductile iron pipe shall consist of pipe centrifugally cast in metal or sand-lined molds. Pipe wall shall be homogeneous from inside to outside and shall be completely free of laminations, blisters, or other imperfections. Defects may be removed at the factory only.
4. Except as otherwise specified, underground pipe shall have mechanical joints or push-on joints conforming to AWWA C110 and C111, as well as AWWA C153 (compact), with vulcanized styrene butadiene rubber gaskets conforming to AWWA C111. Gaskets that include metal locking segments vulcanized into the gasket to grip the pipe and provide joint restraint are not acceptable. Bolts on mechanical joints shall be high-strength low-alloy steel (Corten, or equal), conforming to AWWA C111. Certificate to that effect shall be provided.
5. For ductile iron pipe systems requiring pressure testing, restrained joints shall be provided in accordance with Part 3–Execution. Mechanical joints shall be restrained with MEGALUG® Series 1100 or 1100 SD, by EBAA Iron Sales, Inc., UNIFLANGE Series 1400 by Ford Meter Box Co., Inc., or equal, restraint. Push-on joints for ductile iron piping shall be restrained with MEGALUG® Series 1700 or 1100 HD, by EBAA Iron Sales, Inc., UNIFLANGE Series 1450 by Ford Meter Box Co., Inc., Flex-Ring or Lok-Ring by American Cast Iron Pipe Company, TR Flex by U.S. Pipe Company, TR Flex by McWane, or equal.
 - a. Pipe restraint fittings shall be provided as follows:
 - (1) For ductile iron pipe with ductile iron mechanical joints MEGALUG® Series 1100 or 1100SD by EBAA Iron Sales, Inc.; Series D SLDE or SSLD by Sigma; Series 3000 or 3000S by Star Pipe Products; or equal.
 - (2) For ductile iron pipe with ductile iron push on joints MEGALUG® Series 1100HD or 1700 by EBAA Iron Sales, Inc.; Series SLDEH or SSLDH by Sigma; Series 3100P or 3100S by Star Pipe Products; Flex Ring or Lok Ring by American Cast Iron Pipe Company; TR Flex by U.S. Pipe Company; or equal.
 - (3) For PVC pipe with ductile iron mechanical joint fittings–MEGALUG® Series 2000 PV, 1100SV, or 2000SV by EBAA Iron Sales, Inc.; Series D SLCE or PVM by Sigma; Series 1000C or 4000 by Star Pipe Products; or equal.
 - (4) For PVC pipe with PVC push on joints (not solvent welded)–MEGALUG® Series 1100HV, 1900, or 2800 by EBAA Iron Sales, Inc.; Series SLCEH, PWP (greater than 12-inch only), or D PWP (12 inches or less) by Sigma; Series 4100P by Star Pipe Products; or equal.
 - b. Gland body, wedges, and wedge actuating components shall be ductile iron conforming to ASTM A536 Grade 65 45 12. Bolts and tie rods shall be high strength low alloy steel conforming to AWWA C111.
 - c. Gaskets that include metal locking segments vulcanized into the gasket to grip the pipe to provide joint restraint are not acceptable.

6. Joint restraint is not required for gravity sewers, drains, and those pipes designated in Paragraph 3.02.G.1. Infiltration/Exfiltration Tests.
7. Underground pipe shall have mechanical joint or push-on joint ductile iron fittings conforming to AWWA C110 and C111 or AWWA C153 compact fittings with a minimum rated working pressure of 150 psi. Gaskets for fittings shall be as specified for underground piping.
8. Ductile iron wall pipes shall be provided as shown on the Drawings. For piping over 24 inches that does not require restraints, wall pipes shall be provided with push-on joint connection at exterior end of wall pipe. For piping over 24 inches that requires restraint, wall pipes shall be provided with Flex Ring or Lok Ring by American Ductile Iron Pipe Company, TR Flex by U.S. Pipe Company, TR Flex by McWane, or equal, connection. For piping over 24 inches, wall pipes may also be provided with mechanical joint connection at exterior end of wall pipe. For piping that requires restraint, mechanical joint connections at exterior end of wall pipe shall be restrained as specified for mechanical joints.
9. Unless otherwise specified, all exterior ductile iron piping and fittings shall be cement-mortar lined and asphaltic-coated inside. Cement-mortar lining shall be in accordance with AWWA C104. Unless otherwise specified, underground piping and fittings shall be shop primed or asphaltic-coated outside. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings.
10. Piping and fittings for installation in manholes, wet wells or other such structures, and elsewhere exterior as shown on the Drawings or specified shall be flanged and provided as specified in Section 40 05 00—Piping and Appurtenances.
11. Drainage Piping: All process drain piping and all underground piping designated as drain (D) shall be ductile iron. All underground drainage piping more than 2 feet from building walls shall be ductile iron as specified. Connections to drainage piping from buildings shall be made within 2 feet from the building wall and shall be made with a Fernco, or equal, flexible coupling.
12. All buried ductile iron piping and appurtenances shall be polyethylene encased in accordance with AWWA C105. Polyethylene encasement shall be Class C (carbon black) and shall be minimum 8 mil thickness for low density polyethylene and 4 mil thickness for high density polyethylene. Tape for securing the film shall be a thermoplastic material with a pressure sensitive adhesive face capable of bonding to metal, asphaltic coating, and polyethylene. Tape shall have a minimum thickness of 8 mils and a minimum width of 1 inch. The polyethylene film envelope shall be as free as is commercially possible of gels, streaks, pinholes, particles of foreign matter, and undispersed raw materials. There shall be no other visible defect, such as holes, tears, blisters, or thinning out at folds.
13. Tapping and Bonding:
 - a. In cases where corporation stops are to be tapped into mains, pipe wall thickness shall be furnished as specified in AWWA C151 to provide four threads or pipe saddles shall be furnished as approved by manufacturer.
 - b. Cable bond conductor or electrobond conductivity straps shall be installed on all ductile iron piping to maintain electrical continuity across joints. Continuity across valves and fittings shall be made with multiple conductivity straps connected in series. Lead-tipped gaskets or bronze wedges will not be allowed.
14. Cutting in and Repair Tees and Sleeves and Tapping Tees: Cutting-in and repair tees and sleeves and tapping tees shall be of ductile or cast iron with the same rated working pressure of the pipe in which they are installed but no less than 150 psi.
15. Exterior Joints, Fittings, and Gaskets: Joints, fittings, and gaskets shall have the same rated working pressure of the pipe in which they are installed but no less than a minimum rated working pressure of 150 psi.

B. Solid Wall PVC:

1. Polyvinyl chloride (PVC) pipe shall meet the requirements of ASTM D3034 for pipe sizes 4 inches through 15 inches and ASTM F679 for pipe sizes 18 inches through 60 inches.
2. PVC material for ASTM D3034 pipe shall have cell classification 12454 or 12364 as defined in ASTM D1784 with minimum modulus of elasticity of 400,000 psi. Pipe stiffness shall be minimum 46 psi when tested in accordance with ASTM D2412. Pipe shall have a maximum standard dimension ratio (SDR) of 35.
3. PVC material for ASTM F679 pipe shall have cell classification 12454 or 12364 as defined in ASTM D1784 with a minimum modulus of elasticity of 500,000 psi. Pipe stiffness shall be a minimum 115 psi when tested in accordance with ASTM D2412.
4. Pipe and fittings shall be the product of one manufacturer, and the manufacturer shall have experience records substantiating acceptable performance of the pipe and fittings to be furnished. The minimum wall thickness of fittings shall be the same as the pipe to which it connects.
5. Acceptance of piping and fittings shall be subject to tests conducted in accordance with ASTM D3034 and/or ASTM F679.
6. Fittings such as saddles, elbows, tees, wyes, and others shall be of material and construction corresponding to and have a joint design compatible with the adjacent pipe. Approved adapters shall be provided for transitions to other types of pipe.
7. Joints shall be of the elastomeric type for pipes 4 inches or larger and elastomeric or solvent cement for pipes less than 4 inches.
8. Elastomeric joints shall be a bell and spigot joint conforming to ASTM D3212 sealed by a rubber gasket conforming to ASTM F477 so that the assembly will remain watertight under all conditions of service, including the movements resulting from the expansion, contraction, settlement, and deformation of the pipe. Bells shall be formed integrally with the pipe and shall contain a factory-installed positively restrained gasket.
9. Solvent cement joints shall be assembled using solvent cement obtained from the pipe manufacturer, which conforms to the requirements of ASTM D2564.
10. The assembled joint shall pass the performance tests as required in ASTM D3212.

C. Miscellaneous Pipe:

1. Piping needed for repair or reconstruction of existing utilities and appurtenances shall be of the same type and strength as the existing. The type of jointing used in repair and reconstruction shall be reviewed by CONSULTANT. Special fittings shall be furnished and installed as necessary for repair, reconstruction, or connection of existing facilities.
2. All special fittings on or for connection to utilities shall be specifically built for the type of gasket used. Special fittings shall have joints of the same type as the utility to which the connection is being made.
3. When sanitary sewer construction is within 50 feet of a potable well, 200 feet of a municipal well, or as requested by CONSULTANT, a water main equivalent pipe shall be used. To transition from water main equivalent pipe to pipe normally supplied, a transition pipe with suitable joints to mate the two different pipes shall be supplied. No field constructed transitions will be allowed unless reviewed by CONSULTANT and approved by OWNER. Construction shall not proceed until proper transition pipe is supplied.

2.04 CONCRETE

- A. All concrete poured under this Contract, unless shown or specified otherwise, shall conform to the requirements of Division 03.

2.05 AGGREGATE SLURRY (FLOWABLE) BACKFILL:

- A. Aggregate slurry (flowable) backfill shall consist of fine and coarse aggregate conforming to ASTM C33. Coarse aggregate shall be size number 67 and fine aggregate shall be size number 4. The material shall be mixed with water to provide an approximate 3-inch slump. The mix shall be deposited in the trench from ready-mix concrete transit mix trucks and shall be consolidated using concrete vibrators or vibratory plate compactors.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Underground Piping:
 - 1. Utility lines shall be laid and installed to the lines and grades specified with valves, fittings, manholes, and other appurtenances at the specified locations; spigots centered in bells; and all manholes and riser pipes plumb. Force main shall be installed at the depth indicated. Gravity sewer mains and laterals shall maintain a minimum two feet of cover but shall be deep enough to provide service to buildings. Water main, force main, and other pressure mains shall be installed to within (plus or minus) 0.1 feet of designed grades. Sanitary and storm sewer and laterals shall be installed to within (plus or minus) 0.03 feet of designed grades. Service lines shown on the Drawings are approximate. Staking shall be completed in conformance with Division 01.
 - 2. Deviations Occasioned by Underground Facilities: Wherever significant obstructions not shown on the Drawings are encountered during the progress of the Work, CONTRACTOR shall proceed in accordance with the General Conditions to notify owners and protect the facilities. Existing items unnecessarily damaged during the performance of the Work shall be repaired and replaced at the expense of CONTRACTOR.
 - 3. Prior to commencing pipe laying, CONTRACTOR shall notify CONSULTANT of the intended date for starting Work. CONSULTANT may request at CONTRACTOR's expense the removal and relaying of pipe which was installed prior to notification of CONSULTANT.
 - a. Proper implements, tools, and facilities shall be provided and used by CONTRACTOR for the safe and convenient prosecution of the Work. All pipe, fittings, and appurtenances shall be carefully lowered into the trench piece by piece with a crane, rope, or other suitable tools or equipment, in such manner as to prevent damage to materials. Under no circumstance shall pipe be dropped or rolled into the trench.
 - b. Materials shall be as shown on the Drawings or as specified herein.
 - 4. Material Inspection: CONTRACTOR shall inspect the pipe, fittings, and appurtenances for defects when delivered to the jobsite and prior to lowering into the trench. Defective material shall be removed from the jobsite. All material shall be clean and free of deleterious substances prior to use in the Work.
 - 5. Except where noted or specified, all ductile iron underground piping shall be laid in accordance with AWWA C600 with the conditions that (a) blocking shall not be used to support pipe and (b) all bends and fittings shall be restrained as specified below, and

pipe joints shall be restrained in all directions from all bends and fittings to the length as specified below.

6. Pipe Length:
 - a. The minimum length of pipe to be restrained shall be as shown in the following table.
 - b. This table assumes horizontal orientation of fittings, 150 psi test pressure plus a 100 psi water hammer allowance, ductile iron pipe, and a 3-foot bury. Lengths shall be adjusted for other conditions and fittings. For other fittings and for more specific requirements, see the Drawings:

REQUIRED LENGTH OF RESTRAINED PIPE BEYOND FITTING IN FEET

Fitting	Minimum Length—Ft
90 Degree Bend (≤ 6 inches)	36
90 Degree Bend (8 inches to 10 inches)	54
90 Degree Bend (12 inches to 14 inches)	72
90 Degree Bend (16 inches)	84
45 Degree Bend (≤ 8 inches)	18
45 Degree Bend (10 inches to 16 inches)	36
22 1/2 Degree Bend ≤ 16 inches	18
11 1/4 Degree Bend ≤ 16 inches	9
Fire Hydrant Leads	All Joints
Tees (≤ 4 inches)*	18 (Along Branch)
Tees (6 inches to 8 inches)*	36 (Along Branch)
Tees (10 inches to 12 inches)*	54 (Along Branch)
Tees (14 inches to 16 inches)*	72 (Along Branch)

*Restrained run length on tees assumed 18 feet on each side of fitting.

7. Force main and water main shall be installed in accordance with AWWA C600 for iron pipe, AWWA C605 for PVC pipe, and AWWA M55 for HDPE pipe. All plugs, caps, tees, hydrants, bends, and other fittings for water mains and force mains shall be provided with restrained joints.
8. PVC sewer and plant drain piping shall be installed in accordance with ASTM D2321. Except where noted or specified, PVC or other thermoplastic pressure piping shall be installed in accordance with ASTM D2774.
9. Except where noted or specified, reinforced concrete pipe shall be installed in accordance with ASTM C12.
10. Plumbing system shall be installed and tested in accordance with local and state plumbing code requirements. Where requirements conflict, the stricter standard shall apply.
11. CONTRACTOR shall lay all gravity pipe to the line and grade shown on the Drawings with bell ends uphill wherever possible. If not possible, CONTRACTOR shall lay pipe to the line and grade shown on the Drawings with bell ends in the direction of laying. Water piping and chemical solution piping shall have a minimum of 3 feet of cover. Unless shown otherwise, drainage piping shall clear floor slabs or footings by a minimum of 6 inches.
12. Any pipe or fittings cracked in cutting or handling or otherwise not free from defects shall not be used. Pipe must be kept clean of mortar, cement, clay, sand, or other material. When PVC piping is installed during hot weather, it shall be laid in the trench with slack or permitted to cool to ground temperature before it is cut to length for making final connections. PVC expansion joints shall be provided where needed.

13. At times when pipe laying is not in progress, the open ends of pipe shall be closed with plugs to prevent the entry of foreign material. Acceptable plugs include Foreman Nite Caps by APS, mechanical joint cap or plug, bladder plug, or test plug. All foreign material shall be removed from the pipe prior to acceptance.
14. The locations and elevations of existing piping and manholes are approximate. Where necessary, existing piping shall be exposed by CONTRACTOR to confirm location and elevation before installing new piping. Any changes in pipe location or elevation shall be approved by OWNER.
15. General Excavation:
 - a. Pipe Laying:
 - (1) All pipe shall be laid accurately to the line and grade as designated. Preparatory to making pipe joints, all surfaces of the portions of the pipe to be joined or of the factory made jointing material shall be clean and dry. Lubricants, primers, adhesives, and other joint material shall be used and installed as recommended by the pipe or joint manufacturer's specifications. The jointing materials or factory fabricated joints shall then be placed, fitted, joined, and adjusted in such a workmanlike manner as to obtain the degree of watertightness specified. Pertinent specifications from the joint and pipe manufacturer which outline procedures to be followed in making the joint shall be furnished to CONSULTANT.
 - (2) Wyes, tees, and special fittings shall be installed as called for on the Drawings, or as requested by CONSULTANT. Wyes, tees, and special fittings, shall, in general, be jointed with the same type of joint as used in the pipe.
 - (3) In joining two dissimilar types of pipe, manufactured adapters and fittings shall be used. Adapters and fittings shall be configured to maintain invert elevations at same level.
 - (4) Joint deflections shall not exceed the limits established by the pipe manufacturer for the pipe and joint being used.
 - (5) Joints that are damaged because of carelessness, improper handling, or failure to prevent imperfections in manufacture shall be subject to rejection and gaskets shall be subject to rejection whenever they show surface cracking, tears, or splice separation.
 - (6) At times when pipe laying is not in progress, the open ends of pipe shall be closed with plugs to prevent the entry of foreign material. All foreign material shall be removed from the pipe prior to acceptance.
 - (7) After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with specified backfill material tamped around it except at the bells.
 - (8) Pipe shall be brought home by using a cross member and levers or jacks. It will not be permissible to push pipe home with motor powered excavation equipment.
 - (9) Force main and water main shall be installed in accordance with AWWA C600 for iron pipe, AWWA C605 for PVC pipe, and AWWA M55 for HDPE pipe. All plugs, caps, tees, hydrants, bends, and other fittings for water mains and force mains shall be provided with restrained joints.
 - b. Manholes:
 - (1) Manholes shall be installed in accordance with the Drawings for water main and as shown on the Drawings for sewers. For sanitary sewers, openings shall be located over the bench and not the sewer flow line itself.

- (2) All manholes shall be made watertight and shall show no visible signs of leakage at the time of final review and within the correction period. Any leakage shall be sealed from the exterior of the manhole.
- c. Abandoning Utilities: Utilities to be abandoned shall, unless otherwise noted on the Drawings, be abandoned in place. Open ends of pipes shall be plugged with 12 inches of concrete. Manhole barrels, valve boxes and other such structures shall be removed to a point 3 feet below existing or final ground surface, whichever is lower, and shall then be filled with backfill material compacted to that of the trench backfill. An approximate 9-inch-diameter opening shall be made in the bottom of the structure to allow for groundwater movement.
- d. Connections to and Modifications of Structures and Mains:
 - (1) Unless otherwise noted on the Drawings, openings in existing structures to allow for connection of mains shall be core drilled, and the mains themselves shall be connected by use of watertight connections as specified in the Standard Specifications. Flow channels in the bottoms of existing structures shall be modified as necessary to provide smooth transition for incoming flow and/or orientation of mains. These modifications may include breaking out and reforming flow channels.
 - (2) Where mains, new and existing, are to intersect, dog house manholes shall be provided to facilitate connection and to gain access to the intersecting mains. Manholes shall be provided at the manufacturing plant with arched openings in lower barrel section to span each of the intersecting mains. Reinforcing shall be cut and bent back. In the field, manhole shall be set on concrete blocks, with reinforcing provided according to the Drawings for the bottom slab. Concrete shall be poured under and around the manhole to seal all openings, cover and adhere to the slab and bent reinforcement, and provide for benches or fillets in the manhole. Sanitary and storm sewer mains shall be kept intact until the bench or fillet is poured. Then the top of pipe to springline shall be removed to provide access.
- 16. Valve Boxes: The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of valve boxes so that the bottom of the base is about 2 inches away from contact with the valve bonnet. The valve box shall not transmit shock or stress to the valve.
- 17. Yard Hydrants: Yard hydrants shall be set on a slab of concrete at least 1 cubic foot in size and against a 3-cubic-foot minimum concrete brace laying against undisturbed earth. Backfill at base of hydrant shall be 1 cubic yard of coarse gravel. It shall be the responsibility of CONTRACTOR to set the hydrants at to the proper grade. Extensions or fittings shall be provided as required.

3.02 FIELD QUALITY CONTROL

- A. CONTRACTOR shall include the cost of all televising, testing, cleaning, and disinfection in the price bid.
- B. Work shall be tested as specified in this section. Unless indicated in writing before testing begins, tests shall be witnessed by CONSULTANT and others as necessary. Test results shall be recorded, and reports or appropriate certificates shall be submitted to CONSULTANT in triplicate.
- C. New piping shall be tested. Prior to conducting the pressure and leakage test, CONTRACTOR shall backfill the trench for its full depth. All bends and special connections

to the main shall be adequately blocked and tied prior to the test. Any damage caused to the main or its appurtenances during performance of these tests shall be corrected by CONTRACTOR at its expense. Should underground piping fail test, CONTRACTOR shall be responsible for removal and replacement of backfill, and relay new pipe if necessary, to repair the defective pipe. Under no circumstances shall defects be sealed from the interior of the pipe, and only where specifically allowed by CONSULTANT, shall defects be sealed from the exterior of the pipe. Piping, interior or exposed, shall be subject to test before being covered with insulation or paint. Piping and appurtenances shall be watertight or airtight and free from visible leaks. Manholes and appurtenances shall be free of any visible leaks. Any leakage shall be sealed by methods acceptable to OWNER, from the exterior of the manhole or structure. Precast reinforced concrete manhole risers and tops shall be tested in accordance with ASTM C497.

- D. Piping shall be flushed or blown out after installation prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents for testing.
- E. Pressure Tests:
1. Pressure tests shall be performed as required by AWWA C600 and AWWA C605, unless otherwise noted herein.
 2. When test medium for piping is water, all air shall be removed from piping by flushing, opening vents, loosening flanges, utilizing equipment vents and/or installation of corporations at high points in system. Test pumping equipment used shall be centrifugal pumps or other pumping equipment that will not place shock pressures on the main. Power plunger pumps will not be permitted for use on closed pipe systems. Pumps shall be disconnected during test periods. Presence or absence of air will be determined during pressurization of the piping system.
 3. The test pressure in all lines shall be held for two hours during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests. All piping conveying a combination of fluids, such as SCM/WAS, shall be tested at the higher test pressure.
 4. During performance of the hydrostatic pressure test, water main shall be subjected to a minimum pressure of at least 25% above normal working pressure, at the highest point, with a minimum pressure 125 psi. Force main shall be tested to 200% of normal operating pressure in the main, but to no more than the pressure rating of the pipe.
 5. CONTRACTOR shall keep a record of all tests performed. These records shall show the individual lengths of main tested and test results.
 6. Where connections are made to existing mains, it shall be the responsibility of CONTRACTOR to provide the necessary hydrostatic tests on all new mains installed. This may necessitate, but is not limited to, the installation of temporary valves and restraint to isolate the new system from the existing system. All materials, Work, and equipment necessary for this Work shall be furnished by CONTRACTOR at its expense.
 7. All testing of pipelines shall proceed concurrently with installation. CONTRACTOR is encouraged to conduct daily preliminary testing of its Work.
 8. Water from disinfection testing shall not be discharged to a stream, creek, river, storm sewer tributary thereto, or to a navigable water without first neutralizing the chlorine residual in the water and complying with local, state, and federal laws thereto.

9. Gauges used for testing shall have increments as follows:
 - a. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
 - b. Tests requiring a pressure of greater than 10 psi by less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
 - c. Tests requiring a pressure of greater than 100 psi shall use a testing gauge having increments of 2 psi or less.

Fluid Abbreviation or Name	Minimum Test Pressure in psi	Test Medium	Leakage Allowance Designation
ML, PI, PRE, SCM, SE, RAS (Gravity Flow)	10	Water	"A" ⁽¹⁾
DS, RAS (Pump Discharge), WAS	50	Water	"A"
PE, PRS, NPW, PW	150	Water	"A"

⁽¹⁾ Leakage allowance designation "A" shall mean not more than 0.002 gallons per hour per inch diameter per 100 feet of buried pipe for all piping except buried mechanical joint or push-on joint pipe. Buried mechanical and push-on joint pipe shall meet the leakage specifications of AWWA C600.

- F. Prior to making final connection between new and existing piping, new piping shall be tested as specified above.

G. Infiltration/Exfiltration Tests:

1. Leakage Testing:
 - a. All sanitary sewer gravity mains, drains shall be tested for leakage after installation of laterals and placement of backfill. Leakage testing of thermoplastic and iron sanitary sewer gravity mains shall be conducted in accordance with ASTM F1417. CONTRACTOR shall keep a record of all tests performed. These records shall show the individual lengths of main tested and test results.
 - b. Sewers 18 inches and larger may be tested for leakage by infiltration or exfiltration in lieu of vacuum testing. Concrete pipe shall be tested per ASTM C969 except as modified herein. If groundwater is 2 feet or more above the sewer, measurements will be taken to determine the rate of infiltration into the sewer. If groundwater is below 2 feet above the sewer, the stretch of sewer shall be plugged at its downstream end and water shall be placed inside the sewer to provide a minimum of 4 feet of head above the upstream end.
 - c. Measurements will then be taken to determine the rate of leakage out of the sewer. CONTRACTOR shall furnish all labor and materials necessary for making the tests. The allowable leakage shall be as indicated below for final acceptance.
 - d. At the conclusion of construction and before final acceptance of the Work, the downstream end of all sanitary sewer will be measured for infiltration. Allowable infiltration shall not exceed 100 gallons/inch of pipe diameter/mile/day for that portion of the Work under groundwater. If infiltration is exceeded, the leak or leaks shall be located and repaired.
 - e. CONTRACTOR shall prepare all pipeline for testing and shall furnish all equipment, materials, tools, and labor necessary for performance of the tests. Equipment for the low pressure air test of gravity mains shall be equal in all

- operational aspects to that as furnished by Cherne Industries, Inc., United Survey, or equal.
- f. Test apparatus and gauges shall be located such that CONSULTANT or OWNER do not have to enter a confined space to verify readings.
 - g. Air and leakage testing of storm sewers will not be required.
2. Deflection Testing:
- a. All PVC pipe used for sanitary sewer shall be tested for vertical deflection. Maximum deflection after completion of backfilling shall be 5% of the inside pipe diameter. Testing shall not be started until trench backfill has been in place for 30 days. CONTRACTOR shall keep a record of all tests performed. These records shall show the individual lengths of main tested and test results. Deflection shall be measured by pulling a mandrel with a vertical diameter equal to 95% of the pipe inside diameter through the line, after thoroughly flushing the lines to be tested. The testing device shall be controlled using cables at both the upstream and downstream manholes. The testing device must pass freely through the sewer without the use of unreasonable force on the control cables. Any line that will not pass the test cylinder will not be accepted until the faulty sections have been removed and replaced and the line retested.
 - b. Deflection testing of thermoplastic storm sewer shall be provided in accordance with the above requirements.
- H. Manhole Testing:
- 1. Sanitary sewer and process piping manholes shall be vacuum tested in accordance with ASTM C1244 or via Hydrostatic Exfiltration Test. Pipes entering the manhole shall be plugged and the seal inflated in accordance with manufacturer's recommendations. CONTRACTOR shall provide all required test apparatus, including vacuum pump and gauges.
 - 2. Hydrostatic Exfiltration Testing: All collection lines shall be plugged and the manhole filled with water. If the leakage exceeds 0.025 gallons per foot of diameter of head per hour, repairs shall be made to reduce leakage, and retests shall be performed until the leakage is below 0.025 gallons per foot of diameter per foot of head per hour. Concrete manholes may be filled for 24 hours prior to testing to allow for saturation of the concrete. For all manholes within 9 feet of a potable water line, the manhole shall be water tight and tested to have no leakage using the Hydrostatic Exfiltration Testing Method.
 - 3. Vacuum testing of storm sewer and other manholes or structures may not be required.
- I. Televised Inspection: A color televised survey of installed sanitary sewer and storm sewer shall be provided after testing to confirm branch locations, verify cleanliness of sewer, and confirm presence or absence of sags or deviations in sewer alignment. Sewers shall be cleaned immediately prior to the survey. The survey shall conform to NASCO PACP standards.
- J. Continuity Testing: CONTRACTOR shall provide all equipment, labor, and materials necessary to perform continuity testing of all ductile iron water mains installed. Tests shall be performed using an ohmmeter to demonstrate that electrical continuity exists across all joints. CONTRACTOR shall make all necessary repairs to establish continuity across joints.

3.03 CLEANING

- A. All equipment and materials shall be clean before installation.

- B. Upon completion of the work, all improvements disturbed by CONTRACTOR's operations shall be repaired or replaced. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.
- C. All waste disposal areas and all areas used for the storage of materials or the temporary deposit of excavated earth shall be leveled off, cleaned up, and returned to condition that existed prior to construction. All surplus material, tools, and equipment shall be removed, and the premises shall be left free of everything of the kind.
- D. All pipes and manholes shall be flushed until clean, and all debris and mud shall be removed.

3.04 DEMOLITION

- A. All exterior piping removals, including manholes and appurtenances and abandonment, shall be by CONTRACTOR. The locations and elevations of existing piping are approximate. Where necessary, existing piping shall be exposed before installing new piping. Any changes in pipe location or elevation shall be reviewed by CONSULTANT.
- B. CONTRACTOR shall remove or abandon all existing piping and appurtenances as noted. Unless otherwise shown or specified, piping and appurtenances to be removed shall become the property of CONTRACTOR and shall be removed from the site for salvage or disposal. Unless otherwise shown or specified, piping shown or specified to be abandoned shall have each end plugged with concrete or nonshrink grout. Nonshrink grout shall be as specified in Division 03. Wherever excavations cross piping to be abandoned, piping shall be removed to the limits of the excavation and the ends shall be filled as specified above.
- C. Valve boxes and exposed valves and operators on piping to be abandoned shall be removed. All concrete surfaces to remain shall be patched as required to provide a smooth surface. Repiping and connections to new piping shall be as specified for new piping.
- D. It is the responsibility of CONTRACTOR to remove the items as specified, and patch all holes resulting therefrom unless specified or shown otherwise. The intent of these specifications is to require that the removal of materials, patching of all existing holes, and repiping be done in a workmanlike manner. All costs shall be included in the Lump Sum Bid.

END OF SECTION

SECTION 40 05 00

PIPING AND APPURTENANCES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. All piping, valves, and appurtenances of every description except for pipe as specified in Divisions 33, 43, and 46.
 - 2. Concrete foundations and anchor bolts for all equipment furnished under this section.
 - 3. Piping connections to all equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. CONTRACTOR shall coordinate with Section 40 05 57—Actuators for Process Valves.

1.02 SUBMITTALS

- A. Applicable provisions of Section 01 33 00—Submittals cover requirements for shop drawings and Operation and Maintenance Manuals.
- B. General arrangement drawings, including support system of 3 inches or larger interior and 3 inches or larger exterior (aboveground) ductile iron, PVC piping shall be submitted to CONSULTANT for approval. Shop drawings for all interior and aboveground exterior piping shall be two-line drawings drawn to scale. Drawings shall include proposed materials, length, location, and elevation of pipe, fittings, supports, and valves and appurtenances. Plug valve orientation, including operator and plug orientation, shall be shown on Drawings.
- C. Grooved joint couplings and fittings shall be referred to on arrangement drawings and product submittals, and be identified by the manufacturer's listed model or series designation.

PART 2—PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

- A. Materials of Construction: All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. Products used in potable water systems shall be UL classified in accordance with ANSI/NSF-61 for potable water service and shall meet the low-lead requirements of NSF-372.
- B. Size and Type:
 - 1. All materials shall conform to the size and type shown on the Drawings or called for in the specifications.

2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event standard fittings are not available, the method of joining shall be selected by CONTRACTOR and submitted for review by CONSULTANT.
- C. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be subject to approval of CONSULTANT. All grooved joint couplings and fittings shall be of the same manufacturer.

2.02 PIPE AND PIPE FITTINGS

- A. Ductile Iron Piping and Fittings:
1. Unless otherwise shown or specified, all interior piping 4 inches in diameter or larger shall be ductile iron conforming to AWWA C151.
 2. Interior piping shall be minimum Special Class 53 with a minimum rated working pressure of 250 psi.
 3. Except where shown, interior pipe joints shall be flanged. Flanged joints shall conform to applicable flanged joint sections of AWWA C110, C111, and C115 and shall be compatible with ANSI B16.1 Class 125. Flanges shall be ductile iron.
 4. Gaps between flanges and all locations where a gap exists at flange hub/pipe intersection shall be caulked prior to finish painting with Masterseal NP1 by Master Builders Solutions, Sikaflex-1A by Sika Corporation, or equal. CONTRACTOR shall verify compatibility of caulk with finish painting system specified in Division 09.
 5. Flanged gaskets shall be minimum 1/8-inch-thick, styrene butadiene rubber (SBR), full-face, Toruseal, Flange-Tyte, Maloney, or equal, gaskets. Thicker gaskets shall be provided as recommended by the manufacturer to meet joint tolerance. All aeration piping shall have FKM gaskets designed for a minimum of 300°F service.
 6. Flange bolts, nuts, and fastening hardware installed in wet wells, valve manholes, final clarifiers, digesters, and other submerged locations shall be 316 stainless steel. In other locations, flange bolts, nuts, and fastening hardware shall be standard zinc-plated steel. All flange bolts shall have hex head and hex nuts rated for the working pressure and installation conditions specified or shown.
 7. Flanged fittings shall be of ductile iron with ductile iron flanges. Flanged fittings shall conform to AWWA C110 and ANSI B16.1, as applicable, with a minimum rated working pressure of 150 psi.
 8. All flanged sections of pipe shall be made up in accordance with AWWA C115 specifications. No field makeup flanges will be allowed unless they are approved in advance by CONSULTANT and strictly conform to AWWA C115, with facing done after turning pipe through flange.
 9. Unless otherwise specified, all ductile iron piping and fittings shall be cement mortar lined and asphaltic-coated inside. Cement mortar lining shall be in accordance with AWWA C104. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings. Exterior exposed, submerged, and interior piping shall be furnished with outside surfaces prepared by abrasive blasting in accordance with NAPF 500C-03. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. It is the intent of this specification that all piping, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

10. Unless otherwise specified, piping and fittings in manholes and wet wells shall be asphaltic-coated outside. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings.
11. All ductile iron piping and fittings designated shall be ceramic epoxy lined.
12. All ductile iron piping and fittings designated, S (Scum), shall be glass-lined and shall receive exterior coating as specified above. Glass lining shall be provided in accordance with
ASTM B1000-15 and shall fully comply with the latest national standard specific to glass-lined pipe and fittings. The glass lining shall be fused to the inside metal base prepared by blasting by placing the pipe or fitting into a furnace at the appropriate maturing temperature above 1,400°F. The entire coating shall be from 0.008 inch to 0.012 inch thick. It shall have a hardness from 5 to 6 on the Mohs Scale and a density from 2.5 to 3.0 grams per cubic centimeter. The glass lining shall be capable of withstanding a thermal shock of 350°F without crazing, blistering, or spalling. It shall be resistant to corrosion by solutions between pH3 and 10 at 125°F. There shall be no visible loss of surface gloss on the glass lining after immersion of a normal production run sample in an 8% sulfuric acid solution at 148°F for a period of ten minutes. In addition, when tested according to ASTM C283, it shall show a weight loss of not more than 3 milligrams per square inch. Taps in glass-lined piping and fittings shall be made prior to glass-lining. Piping manufacturer shall submit glass lining repair instructions with shop drawings. Fittings shall be glass-lined after all fitting fabrication has been completed. Welding of pipe, fittings, and wall pipes shall not be allowed to occur after glass lining has been applied.
13. Drainage Piping: All process drain piping shall be ductile iron.

B. PVC Piping and Fittings:

1. PVC material shall conform to ASTM D1784, Class 12454-B. PVC piping and fittings shall be PVC 1120, Schedule 80, high impact pipe conforming to ASTM D1785 with bells conforming to ASTM D2672. Solvent weld fittings shall conform to ASTM D2467, and for threaded, ASTM D2464.
2. All piping shall be approved for use by the National Sanitation Foundation. All pipe delivered to the job site shall be properly marked for type, grade, and design stress rating. Expansion joints shall be provided where needed. In general, all joints shall be solvent weld, except where flanges are required or where transition to another pipe material is required.
3. All exterior exposed or PVC piping in open tanks shall be formulated with sufficient ultraviolet light screeners to provide for long-term outdoor exposure with no deleterious effects.

2.03 VALVES

A. Gate Valves:

1. Shutoff valves in ductile iron lines containing wastewater and shutoff valves in potable and non-potable water lines 4-inch diameter and larger shall be AWWA C515, ductile iron, resilient seat, nonrising stem, 150 psi working pressure with O-ring packing box, Kennedy, American, American AVK, or equal.
2. Where shown or specified, gate valves in lines 4 inches in diameter or larger shall be AWWA C500 iron body, bronze-mounted, nonrising stem, double-disc, parallel seat, Class 150, O-ring stem seals.
3. Shutoff valves in non-potable water lines, grit flush water lines, pump vent and drain lines 1-inch diameter through 3-inch diameter shall be gate valves, Class 150, bronze

- or iron body bronze-mounted, solid wedge disc, threaded, rising stem, Nibco T-131, Milwaukee Valve 1150, or equal. Provide unions for ease of valve removal.
4. Underground valves shall have extended stem, cast iron telescopic valve box, and key. Exposed valves not in reach of the floor (7 feet to centerline, or greater) shall have chain wheel operator. All other valves shall have handwheels. Right angle operators shall be provided, if required, because of valve position.
 5. Asphaltic varnish and coal tar coating are not allowed on interior valves. Exterior buried valves shall be fusion-bonded epoxy-coated or epoxy-coated (prime and finish coats) as specified in Division 09. Interior and exterior exposed valves shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valve once assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

B. Plug Valves:

1. Shutoff valves in ductile iron lines containing wastewater and all sludge (including RAS, WAS) lines, scum lines, drainage lines, and digester lines shall be DeZURIK Series PEC or PEF 100% port Eccentric, or equal. Shutoff valves in sample lines and 2 1/2 inches or smaller air piping shall be DeZURIK PEC Eccentric, Val-Matic Cam-Centric Series, or equal.
2. Eccentric-type valves shall be nonlubricated rectangular-ported with resilient faced plugs and end connections as shown on the Drawings. The plug profile shall be of a cylindrical eccentric shape so that the vertical face of the plug is straight and the horizontal face is eccentrically curved in relation to the plug shafts. Segmented ball valves with spherical plugs shall not be acceptable. Port areas shall be at least 100% (PEF) or 80% (PEC) through 20 inches and 70% (PEC) for 24 inches and above of full pipe area. Valve bodies shall be of ASTM A126, Class B cast iron. Valve bonnets shall be of the same material as the body. Resilient plug facings shall be chloroprene or Buna-N, suitable for use with wastewater.
3. Valves shall be furnished with corrosion-resistant seats, replaceable oil-impregnated permanently lubricated 316 stainless steel sleeve-type bearings and grit shaft seals on both upper and lower bearing journals that comply with the latest edition of AWWA C517. All valves except for valves in buried or digester gas service shall include grease fittings on upper and lower journals. Bodies of 3-inch and larger valves shall be furnished with a minimum 1/8-inch-thick machined smooth-welded overlay seat of not less than 90% nickel. Seat area shall be raised surface completely covered with weld so that the plug face contacts only nickel. Sprayed or screwed-in seats are not acceptable. Valve shaft seals for valves 4 inches and larger shall be of the type using a stuffing box and pull-down packing gland. Shaft seals shall be designed for replacement with the line pressurized at design pressure with the plug in both the open and closed position. For submerged service, or in valve manholes, valve vaults, or underground utility structures, valves shall have stainless steel bolts.

4. The design of the valve and stuffing box assembly shall be such that the packing can be adjusted or completely replaced without disturbing any part of the valve or operator assembly except the packing gland follower. Stuffing boxes shall have a depth sufficient to accept at least four rings of Buna-N vee-type packing. Valve seating adjustment shall be accomplished without removing the valve from the pipe line and with pressure in the line. For lever-operated valves, the plug position retention friction device shall consist of an adjustable phenolic cone that clamps on the plug shaft or a moly sheath. Metal-to-metal friction devices shall not be acceptable.
5. Valve working pressure ratings shall be 175 psi for valves through 12 inches and 150 psi for valves 14 inches through 24 inches. Valves shall provide drip-tight shutoff up to the full pressure rating.
6. All plug valves for buried service, all plug valves 8 inches in diameter or larger, all plug valves with direct pressure greater than 75 psi or reverse differential pressure greater than 25 psi, and all plug valves for any gas or digester gas service 4 inches in diameter or larger shall have worm gear actuators. All gearing shall be enclosed in a semi steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators shall indicate valve position. Buried or submerged valves shall be supplied with actuators suitable for direct burial or submergence, shall be mounted on a gasketed and totally enclosed actuator mounting bracket, and shall have a totally enclosed and gasketed cover. All other valves shall be furnished with lever actuators. Supply one lever for every four valves of like size furnished. All valves 3 inches and smaller shall have individual levers. Valves not in reach of the floor (7 feet to centerline or greater) shall have chain wheel worm gear actuators. Right angle actuators shall be furnished, if required, because of valve position. Supply sufficient galvanized or electroplated chain with chain wheel so loop through chain wheel is within 3 feet of floor. All underground valves shall be equipped with cast iron telescopic adjustable valve boxes and covers. Buried or submerged service valves shall be supplied with 316 stainless steel bolts and hardware for both valve and actuator.
7. Extension stems and other accessories shall be provided as shown on the Drawings and as required to allow easy access for operation of valves within reach from walkways or other access points. Extend operators to at least 24 inches above walkways. Extension stems for quarter-turn plug valves shall be fabricated from 2-inch pipe, and extensions stems for gear-operated valves shall be fabricated from steel or stainless steel rod. Extension stems, stem guides, and related hardware and accessories for submerged valves shall be stainless steel. Stems shall be provided with 2-inch operating nut or other mechanism as shown on the Drawings. Stem guides shall be provided as recommended by the manufacturer. Maximum unsupported length of stem shall be limited to an l/r ratio of 200.
8. Asphaltic varnish and coal tar coating are not allowed on interior valves. Exterior buried valves shall be fusion-bonded epoxy-coated or epoxy-coated as specified in Division 09. Interior and exterior exposed valves shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valves once assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all

valves, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Except as noted below, valve interior shall be shop-primed and finish painted with epoxy painting system or fusion-bonded epoxy system as specified above. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

C. Check Valves:

1. Except where noted, check valves in ductile iron lines carrying liquid shall be GA Industries 250-D, Apco Model 250 by DeZURIK, or equal, air cushion check valves. The swing check valves shall be constructed with a heavy cast iron or ductile iron body, a bronze or stainless steel seat ring, an extra heavy noncorrosive shaft for attachment of lever and necessary weights to close valve, and a complete noncorrosive air cushion chamber. The valve shall be tight-seating and shockless in operation. The seal ring shall be renewable and shall be securely held in place by a threaded joint. The air cushion chamber shall be attached to the side of the valve body externally and so constructed with a piston operating in a chamber that will effectively permit the valve to be operated without any slamming action. Shock absorption shall be by air, and the chamber shall be so arranged that the closing speed can be adjusted to meet the service requirements. The valve disc shall be of cast iron or ductile iron and shall be suspended from a noncorrosive shaft that shall pass through a stuffing box to be connected to the chamber on the outside of the valve.
2. Miscellaneous:
 - a. Check valves in other than ductile iron, cast iron, PVC, polyethylene, or compressed air lines shall be Class 150, Milwaukee Valve 510, Nibco T-433, or equal, screwed end, bronze, bronze disc, swing check for water and air.
 - b. Check valves in PVC lines shall be ball check type of PVC construction.
 - c. Check valves in polyethylene lines shall be of polypropylene construction.
 - d. Check valves in compressed air lines 3 inches or smaller shall be horizontal lift check valves, Class 150, Crane No. 27TF, or equal. Valves shall have threaded ends, PTFE disc, union cap, and bronze body and cap.
3. Asphaltic varnish and coal tar coating are not allowed on check valves. Exterior of cast iron or steel valve body shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valve once assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

- D. Plug Drain Valve: Plug drain valves shall be as manufactured by RW Gate Company, Troy Valve, or equal. Valve sizing and travel shall be as shown on the Contract Drawings. The mud valve shall be pipe flange mounted unless otherwise shown. Valves shall consist of non-rising threaded stems and wall bracket mounted 2-inch operating nuts or floorstand mounted handwheels as shown on the Drawings. The threaded portion of the stem shall have a minimum diameter of 1 1/2 inches and shall have machine rolled, full depth Acme

threads. Valves shall be constructed of 316 stainless steel throughout, including mud valve body, stem, extension stem, wall bracket, floorstand, anchors bolts and assembly hardware. Valve body shall be cast iron. The stem, stem nut, and seat shall be bronze. Painting and surface preparation shall be as specified for plug valves. A bronze thrust collar and bronze lift nut will be provided as part of the assembly. The seal shall be mounted on the movable cover and shall be minimum 3/8-inch thick, neoprene or EPDM.

- E. Motorized Valve Operators: The following valves shall be provided with motorized valve operators as listed in the schedule below. Electric actuators for motor-operated valves and electric actuators for motor-operated gates shall have the same manufacturer and shall be provided as specified in Section 40 05 57–Actuators for Process Valves and Gates.

Equipment Number	Valve Service	Valve Type	Valve Size, Inch	Open/ Close Time, Sec*	Rating	Control Service
MOV-43-01	WAS	Butterfly	6	20	Class I, Division 2	Modulating

* Valve and motorized operator open/close time shall be confirmed by manufacturer.

- F. Miscellaneous Valves, Strainers, Hose Bibs, and Valve Boxes:
- Shutoff valves in non-potable water lines smaller than 2 1/2 inches shall be Nibco T-585 (threaded), Nibco S-585 (solder joint), or equal, full port ball valves. Provide extended stems for valve operators installed with insulated pipe.
 - Shut-off valves in stainless steel process piping 2 inches and smaller designated for sample piping, pressure gauge piping, pump vents, or drains shall be Nibco T-585-R-66-LL, or equal, stainless steel full port, ball valves.
 - Shutoff valves in PVC piping shall be hand-operated 150 psi union-type PVC ball valves, Chemtrol TU Series Tru-bloc, Walworth Series 8927, or equal. Valves and all components including O-rings shall be compatible with chemicals in piping. PVC valves and union shall not be painted.
 - Y-strainers in potable, non-potable, piping shall have cast iron cast bronze bodies, stainless steel 20 mesh screens, Watts, LF777 or LFS777, or equal. Y-strainers in chemical lines shall be transparent PVC, Asahi, or equal, True Union strainer. Provide 20 mesh PVC mesh screens. Strainers used for hypochlorite service shall have Teflon O-rings.
 - Hose Bibs:
 - Hose bibs providing non-potable water shall be provided with a removable key handle.
 - Exterior hose valves shall be Woodford Model 65, Watts, or equal, freezeless wall hydrants with integral ASSE 1019 backflow preventer outlet, permanent valve seat, and brushed chrome exterior face with 3/4-inch outlet garden hose threads and 3/4-inch inlet. Provide loose key operator with each exterior hose bib. Provide round or square box recessed enclosure with locking door for the hose bib. CONTRACTOR shall coordinate wall thickness with recessed enclosure depth.
 - Interior hose valves shall be Woodford Model 24, Watts, or equal. Provide 3/4-inch garden hose thread, 3/4-inch inlet, and ASSE 1011 approved backflow preventer outlet. Interior hose valves shall be equipped with approved vacuum breaker, Watts 8A, Nidel Model 34H, or equal. Provide metal handle and chrome plate finish. Provide loose key with each faucet.

6. Valves in NPW piping used for fluid control as shown on the Drawings shall be Nibco, or equal, globe valves rated for 200 psi WOG. Valves shall be bronze with TFE disc.
7. Ball valves for digester gas sampling shall be 76-500 Series, stainless steel, threaded ends, spring return handle as manufactured by Apollo Valves, or equal. Provide stainless steel barbed sample fitting on valves and locate within 6 feet of finished floor.
8. Valve Boxes:
 - a. Valve boxes shall be provided for all buried valves.
 - b. Valve boxes shall be made of cast iron conforming to ASTM A48, Class 20. Valve boxes shall consist of a base section, tubular mid and top sections, both with cast threads by which one can be telescoped on the other, extension sections if required, and a circular drop cover. The castings shall be free from blowholes, porosity, hard spots, shrinkage defects or cracks, or other injurious defects and shall have a normal smooth casting finish. The castings shall be thoroughly coated with a 1 mil minimum thickness bituminous coating. Valve boxes shall be 5 1/4 inches in diameter. Valve boxes shall have a maximum length of 7 feet when extended without extension sections. Extensions shall be provided for deeper mains.
 - c. The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of valve boxes so that the bottom of the base is about 2 inches away from contact with the valve bonnet. The valve box shall not transmit shock or stress to the valve.
 - d. Valve box alignment devices: All valves shall be supplied with a gate valve adaptor as manufactured by Adaptor, Inc., or equal. All adaptors shall have a metal frame and be supplied with a 3/4-inch rubber gasket. All adaptors shall be sized to fit the brand of valve being supplied.

2.04 PIPING APPURTENANCES AND MISCELLANEOUS MATERIALS

- A. General: Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be subject to approval of CONSULTANT.
- B. Non-Potable Water Caution Signs: Place non-potable water signs permanently mounted at every hose bib, hydrant, or faucet on the non-potable water system. Sign shall include as a minimum the wording "CAUTION, NON-POTABLE WATER, DO NOT DRINK" or similar standard language. Signs shall be Brady Safety sign, or equal, minimum size 7 inches by 10 inches, constructed of fiberglass. Mount signs on building wall or structures with stainless steel screws or fasteners. At yard hydrant, provide post-mounted signs on steel U-channel posts.
- C. Rubber Expansion Joints: Rubber expansion joints shall be furnished and installed where required to eliminate vibration from equipment to piping. Except for aeration piping, expansion joints shall be the single filled-arch type as manufactured by the Mercer Rubber Company, Series 450 or 500; General Rubber Corporation, 1100 Series; or equal. Unless otherwise specified, expansion joints shall be provided complete with stainless steel control rods, rubber washers, stainless steel nuts, and jamb nuts, as required. Control rods shall be provided to prevent over-stress on coupling at a minimum of twice the system test pressure. The number and size of the control rods shall be sufficient for twice the test pressure, two rods minimum. CONTRACTOR shall provide tie ears to secure control rods to flanges where necessary. Expansion joints shall have integral duck and rubber flange with split backup rings and have a minimum rated working pressure of 150 psi and 20 inches Hg vacuum. Joints shall be provided with higher rated working pressures, if required to meet specified test pressures. Joints shall have a nominal laying length of 6 inches for joints sized up to

8 inches in diameter, 8 inches for joints sized up to 20 inches in diameter, and 10 inches for joints sized up to 36 inches in diameter. Tube and cover shall be of butyl rubber.

- D. Unrestrained Flanged Coupling Adapters: Flanged coupling adapters for drain or gravity flow piping shall be furnished and installed as shown on the Drawings. Flanged coupling adapters shall be of cast ductile iron construction, complete with Buna-N coupling gasket and O-ring flange gasket. Flanged coupling adapter for drain or gravity flow piping shall be Smith-Blair International 912, or equal.
- E. Restrained Flanged Coupling Adapters: Restrained flanged coupling adapters shall be furnished and installed as shown on the Drawings. Restrained flanged coupling adapters shall be of ductile iron construction, complete with EPDM sealing gasket, and gripping wedges and torque limiting actuating screws. Restrained flanged coupling adapters shall be Series 2100 MEGAFLANGE by EBAA Iron, or equal.
- F. Restrained Dismantling Flanged Coupling Adapters: Restrained dismantling flanged coupling adapters shall be furnished and installed as shown on the Drawings. Dismantling flanged coupling adapters shall be of ductile iron construction with flange connections compatible with ANSI Class 125 and 150 bolt patterns, complete with nitrile butadiene rubber (NBR) sealing gasket. Ductile iron or steel components shall be provided with fusion-bonded epoxy coating. All bolts, tie rods, and fastening hardware shall be Type 316 stainless steel. Restrained dismantling flanged coupling adapters shall be Style DJ400 by Romac Industries, Inc. or equal.
- G. Tension Ties: All tension ties and rod ties shall be provided to resist a minimum 150 psi pressure in the pipe line. CONTRACTOR shall provide tie ears to secure tension rods to flanges where necessary. Rods shall be provided with nuts and washers on both sides of tie ears. All nuts, washers, and rods shall be Type 304 stainless steel. Rods shall be Type 304 stainless steel at a minimum. Tie rods shall be equally spaced around pipe. The following table lists the minimum number and diameter in inches for the tie rods for various sizes of pipe.

Pipe Size (inches)	150 psi Pressure	
	Minimum Number	Minimum Size (inches)
4-10	4	5/8
12	4	5/8
14	4	3/4
16	4	3/4
18	4	7/8
20	4	1
24	4	1 1/8

- H. Mechanical Seals: Mechanical seals shall be 316 stainless steel Link Seal, Innerlynx by APS, or equal. Link seals shall be provided with 316 stainless steel bolts, nuts, and fasteners. Sleeve diameter shall be provided and mechanical seals installed as recommended by the manufacturer.

I. Pressure Gauge Assemblies:

1. Pressure gauge assemblies shall be provided where shown on the Drawings and as specified herein. Each pressure gauge assembly shall be provided complete with gauge, isolation ring (used to separate the process fluid from the gauge), isolation valves, piping, fittings, and appurtenances. Pressure gauge assembly shall be configured in a flow-through arrangement, as shown on the Drawings, with 1-inch nominal diameter stainless steel process piping connection to isolation ring and stainless steel isolation ball valves as specified elsewhere in this section.
2. All pressure gauge assemblies shall be completely assembled, vacuum filled, calibrated, and bench tested for accuracy prior to shipment to the site by an experienced and qualified service center. Service center shall have a minimum of 10 years' experience in assembly, testing, and supply of the specified pressure gauge products. Pressure gauge assembly service center shall provide qualifications and experience records with shop drawing submittal.
3. Isolation Ring:
 - a. Isolation ring shall be Onyx Valve Series PSS, Ashcroft Model 82, or equal.
 - b. Isolation ring shall be an in-line, flow-through design allowing for smooth, unimpeded flow of process media through the sensor with no dead space. Line pressure shall be sensed by a flexible annular liner and transmitted by deflection of the liner, via an internal sensing fill fluid, to an attached pressure sensing instrument. The isolation ring shall be provided with 1-inch female NPT process connections. Isolation ring shall be rated for a working pressure range of vacuum to 200 psi.
 - c. Instrument Connection: The attached pressure sensing instrument shall be connected to the body of the isolation ring with a module seal stinger fitting consisting of a rubber membrane and needle fitting with lock ring that allows removal and replacement of the instrument without loss of fill fluid and without removing the isolator ring from the process line. The needle fitting shall have both 1/4-inch NPT female and 1/2-inch NPT male threads. Instrument connection size shall be 1/2-inch NPT made by 316 stainless steel coupling to isolation ring. There shall be no pipe plugs that can be inadvertently removed causing a loss of the fill fluid.
 - d. Flexible Liner: The pressure-sensing liner shall be Buna-N, suitable for domestic and industrial wastewater, sludge, and slurries.
 - e. Flange and Body Material: The isolation ring shall be constructed of 316 or 316L stainless steel with 316 stainless steel hardware.
 - f. Fill Fluid:
 - (1) Isolation ring assembly shall be filled with a 10cSt silicone oil pressure transmitting fluid chemically compatible with all wetted materials and process media in its intended service.
 - (2) The isolation ring shall be vacuum filled by pulling a vacuum of between 0 and 50 mTorr on the assembly, then directly backfilling the assembly with the sensing fluid to prevent the entrainment of air inside the system.
 - g. Instrument Assembly:
 - (1) The instruments attached to the isolation ring shall have their accuracy checked after assembly to the ring and, when necessary, have any mechanical adjustments made prior to shipment to comply with its specified accuracy in accordance with the instrument manufacturer's recommendations.
 - (2) Isolation rings bearing multiple instruments or configured with fittings to attach the instruments shall be fitted using 316L Schedule 80 components arranged to minimize fill fluid volume and temperature error.

- (3) Fill fluid and liner material shall be clearly labeled with an engraved stainless steel tag or engraved fiberglass tag fastened to the isolation ring with stainless steel wire and hardware.
4. Gauge
 - a. Pressure gauges shall be Wika Instruments Model 233.34, Ashcroft Model 1279, or equal.
 - b. Each pressure gauge shall have the following features:
 - (1) 4 1/2-inch dial size.
 - (2) Black fiberglass-reinforced thermoplastic case with solid front, blowout back.
 - (3) Glycerin-filled.
 - (4) Acrylic window.
 - (5) External zero adjustment.
 - (6) 316 or 316L stainless steel wetted parts and movement.
 - (7) 1/2-inch NPT male connection.
 - (8) Accuracy: ASME B40.100 Grade 2A $\pm 0.5\%$ of scale range.
 - c. Pressure gauges shall be provided on the suction or discharge piping of equipment in the locations indicated and as shown on the Drawings with the scale, range, and units of measure for each gauge as listed in the table below:

Structure	Equipment	Qty (Total)	Suction/Discharge Side of Equipment	Scale Type	Range and Units
43	RASP-43-01 to -03	3	Suction	Positive (Dual)	0 to 15 psi (0 to 34 FT H ₂ O)
43	RASP-43-01 to -03	3	Discharge	Positive (Dual)	0 to 30 psi (0 to 70 FT H ₂ O)

- J. Service Saddle: Service saddles shall have a ductile iron body per ASTM A536 and have two carbon steel bales. Bales, washers and nuts shall be electro-galvanized with dichromate seal. Gasket shall be of Nitrile rubber and NSF61 listed. Saddle shall be Smith-Blair, Style 313, or equal.
- K. Tapping Sleeve: Tapping sleeve body and neck shall be made of heavy 18-8 Type 304 stainless steel. Flange, studs, nuts and washers shall be Type 304 stainless steel. Gasket shall be 1/4-inch thick, gridded and have a molded outlet ring to provide effective sealing. It shall be SSF 61-G Nitrile. All welded stainless steel surfaces shall be fully passivated. Sleeve shall be Smith-Blair Style 663, or equal.

PART 3—EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, start-up, and operator training.

3.02 INSTALLATION

- A. Interior or Exposed Piping:
 1. Provide pipe supports for all piping. Pipe support spacing and type shall, at a minimum, conform to manufacturer's recommendations unless more restrictive requirements are specified or shown on the Drawings. All interior or exposed pipelines shall be securely supported by adjustable saddles, brackets, or adjustable hangers supported directly by concrete, masonry work, or tile. Strap hangers, tin clips, or U-hooks will not be acceptable. Piping shall be supported, even though not shown on the Drawings, using base fittings and concrete pads to 6 inches above the floor, Anvil 264, B-line, or equal,

adjustable pipe saddle stand with floor flange to 6 feet above the floor, and supporting clamps or inserts more than 6 feet above the floor. In general, the maximum spacing of supports shall not exceed 10 feet on center. Except as specified for plumbing system, all PVC piping shall be supported using galvanized supports for flexible piping except as indicated. Type 316 stainless steel supports and fasteners shall be used in submerged locations, tanks, wet wells, sludge dewatering or thickening facilities, or as indicated. Insulation saddles shall be used at supports of insulated piping. CONTRACTOR shall furnish and place hangers, supports, wall pipes, and sleeves in the forms before concrete is poured where needed or shown on the Drawings.

2. All piping shall be adequately supported and braced to resist thrust at bends, expansion joints, and joints. Use base elbows, poured concrete, or rod ties. The weight of the piping shall be supported independently of connected equipment.
3. All supports and parts shall conform to the latest requirements of ASME B31 and shall have a structural safety factor of 5. Accurate weight balance calculation shall be made by CONTRACTOR to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection. CONTRACTOR shall be responsible for the installation of the supports. Pipe hangers shall be capable of supporting the pipe weight load in all conditions of operation. The hangers shall allow free expansion and contraction of the piping to prevent excessive stress in the piping. Where vertical movement up to 1/8 inch is anticipated, a precompressed variable spring support shall be used. Rigid hangers shall be provided with a means of vertical adjustment after erection. Where horizontal piping movements are greater than 1/2 inch, or where the hanger rod angularity from vertical is greater than 4 degrees from hot to cold position of the pipe, the hanger pipe and structural attachments shall be offset in a manner that the rod is vertical in the hot position. Hangers and supports shall be spaced in accordance with ASME B31 and as indicated in this specification. Pipe supports shall be placed before and after a valve, expansion joint, or equipment so stress will not be transferred to them.
4. CONTRACTOR shall provide calculations of pipe supports if requested by CONSULTANT.
5. All carbon steel parts shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation of all carbon steel parts shall be performed at such time during the assembly process as to preclude damage to the equipment once installed and assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.
6. The following maximum spacings shall be provided for supports:

MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING

Nominal Pipe or Tube Size	Ductile Iron (See Note 1) ft	PVC/CPVC Pipe (See Note 2) ft
2		4
2 1/2		4
3		4

Nominal Pipe or Tube Size	Ductile Iron (See Note 1) ft	PVC/CPVC Pipe (See Note 2) ft
4	10	4
5	10	4
6	10	9
8	10	9
10	10	10
12	10	10
14	10	10
16	10	10
18	10	10
20	10	
24	10	

Note 1: Provide at least one hanger per pipe length located as close to the flange or joint on barrel as possible.

Note 2: Spacing is based on Schedule 80 at 100°F. For Schedule 40 or higher temperatures, provide shorter span. Consult local plumbing code and manufacturer's recommendations as required. Minimum spacing requirements shall govern.

7. The length of hanger span and support spacing in the above table refers to straight lengths of pipe. When there are changes of direction in pipe, two supports shall be placed less than three-fourths the full span in the table. When practical, a hanger shall be located immediately adjacent to a change in direction of piping. Where there are concentrated loads between supports such as valves, spacing shall be based on load calculations rather than this table.
8. Provide saddles or shields under or around piping between hanger and supports for all insulated piping to prevent crushing of insulation. Provide stainless steel pipe shields under aeration stainless steel piping to prevent indentation of piping from the support or clamp.
9. Unless otherwise shown on the Drawings, anchored supports shall include a stainless steel U-bolt and nuts bolted to the wall bracket.
10. Exposed piping shall run straight, in neat parallel lines, and shall be located far enough from walls, ceilings, and floors to permit access for covering of pipe and painting work. Care shall be taken in laying out piping so that there is no interference with the proper location of piping for other purposes or other equipment and shall be run with regard to the requirements of each service.
11. Piping shall not interfere with headroom or clear floor space. Unless otherwise shown, piping shall run exposed in buildings, except in finished areas. Unless otherwise shown, small water piping in finished areas shall be concealed in interior walls, above suspended ceilings, or under floors where possible. Water piping shall not be installed in exterior walls, unless otherwise shown or noted on the Drawings. Joints shall not be used under floor slabs. Unless otherwise shown, piping under floor slabs shall clear floor slabs or footings by a minimum of 6 inches. Pipes under floors shall have a minimum of 6 inches of sand cover. Plates shall be provided on all uncovered pipes passing through floors, walls, and ceilings constructed of materials other than poured concrete. Plates shall be on exposed sides and shall be chrome-plated, spring and snap type.

12. Except for flanged piping, an ample number of standard weight ground joint unions and a shutoff valve shall be provided in all pipelines and at all equipment. CONTRACTOR shall provide 3/8-inch tapped and plugged connections in suction and discharge of all pumps for testing.
13. Valves shall be located on all branches of water supply lines where shown on the Drawings. Position valves to facilitate access and operation.
14. The appropriate number, size, and lengths of spool pieces and flange fillers needed for plumbing and leveling any existing piping shall be included in the price bid.
15. All glass-lined, PVC, and stainless steel aeration piping shall be protected from dust and debris deposits on the inside of the pipe during storage and installation. Protection shall be by plastic film or coated paper banded over the pipe ends to be removed just prior to installation. Any foreign matter shall be removed from the pipe interior at the time of installation.
16. Field cutting of glass-lined ductile iron piping shall be kept to a minimum and shall be done in strict accordance with special procedures recommended by the glass lining manufacturer to avoid damage to glass lining. Damaged glass lining shall be replaced or repaired. Glass lining shall be repaired in strict accordance with glass lining manufacturer's recommendations and shall be allowed only where acceptable to CONSULTANT.
17. Plug Valve Installation: On clear liquids and on lines carrying solids where neither side of the pipeline drains, the valve shall be positioned so that the seat end of the valve is downstream of the shutoff pressure. The highest pressure should always be on the back side of the plug, except for a valve installed in a vertical pipe. On sludge or slurry lines where one side of the line normally drains, it is preferential to install the seat end of the valve upstream so that the valve cavity drains empty. Where possible in horizontal pipelines, the valve shall be installed with the axis of the plug horizontal and the plug in the top of the valve when in the open position. In vertical pipelines carrying sludge or slurries, the seat end shall be at the top of the valve. Valve installation shall be in accordance with manufacturer's requirements.
18. The locations and elevations of existing piping are approximate. Any changes in the pipe location or elevation shall be reviewed by CONSULTANT.
19. CONTRACTOR shall submit shop drawings showing new pipe routing and existing pipe removal. CONTRACTOR shall be responsible for final pipe routing and shall route new piping as required to minimize conflicts. Piping shown on the Drawings is approximate only. Not all existing piping, conduit, equipment, etc., are shown on the Drawings. CONTRACTOR shall field-verify locations. CONTRACTOR shall reroute existing piping, conduit, etc., as indicated or as required to install new piping or equipment. CONTRACTOR shall remove and relocate existing pipe supports as required to install new piping. CONTRACTOR shall provide all piping, fittings, flange fillers, and other appurtenances as required to provide functional system at no additional cost to OWNER.
20. Caulking Ductile Iron Piping: Caulk to seal all gaps between flanges and all locations where a gap exists at flange hub/pipe intersection on ductile iron piping following installation and testing and prior to field finish painting. Trim back excess edge of rubber gasket between flanges as necessary to achieve a uniform and flush caulk joint, but no more than 1/8 inch from the outside edge of the flange. There shall be no excess caulk outside of the gaps or joints to be filled, and adjacent surfaces to be painted shall be clean and free of excess caulk. Caulking shall be done and fully cured as required prior to painting of piping. Coordinate work with Division 09.

B. Wall and Other Pipe Penetrations:

1. CONTRACTOR shall furnish and place hangers, supports, wall pipes, sleeves, and floor boxes in the forms before concrete is poured wherever needed or shown on the Drawings.
2. Where pipes pass through concrete members without wall fittings shown, CONTRACTOR shall provide sleeves in the forms for the piping, unless otherwise shown on the Drawings. The sleeve diameter shall not exceed the pipe o.d. plus 2 inches (or the pipe flange o.d. plus 1 inch, as applicable), unless otherwise shown on Drawings. If the concrete members are to be watertight, the annular space around the pipe shall be sealed with a mechanical seal. Sleeves shall be steel unless noted otherwise and shall include minimum 1-inch waterstop. Steel sleeves shall be prepared, primed, and painted in accordance with Division 09 prior to placement in between concrete forms. Steel sleeves shall receive touch-up paint prior to placing forms. In lieu of steel sleeves, HDPE Infinity Wall Sleeves or Gal-vo-plast Wall Sleeves by APS, or equal. Each sleeve shall include integral waterstop. CONTRACTOR shall install sleeves in accordance with manufacturer's recommendation and no sleeve distortion or deflection will be allowed. For copper pipe, provide an elastomeric sleeve on pipe where it passes through walls or slabs.
3. Where plain end wall pipes are shown or indicated on the Drawings, CONTRACTOR may substitute a flanged end wall pipe, if desired, for the purposes of pressure testing specified herein.
4. Where pipe passes through nonwatertight walls, the annular space shall be grouted full. Where pipes pass through nonwatertight floors, the sleeve shall extend 1 inch above the finished floor elevation. The annular space shall remain open, except the annular space between a rated space (example—Class I, Division 1, Group D hazardous location) and a nonrated space shall be sealed with a mechanical seal.
5. Where new pipes go through existing watertight concrete members, CONTRACTOR shall core a hole through the member, unless otherwise shown on the Drawings. The annular space between the concrete and pipe shall be sealed with a mechanical seal. Where new pipes go through existing nonwatertight concrete or masonry members, holes shall be cored and annular space between the concrete and the pipe shall be grouted full (walls or floors at rated spaces) or remain open (floors at nonrated spaces). Prior to any coring, CONTRACTOR shall locate reinforcing steel in the member and shall consult with CONSULTANT to determine optimal location for the core. Plug abandoned pipes and wall pipes, after pipe and fittings removal flush to the concrete surface, with nonshrink grout, to achieve a watertight seal.
6. Nonshrink grout shall be as specified in Division 03.
7. No chases or recesses shall be made in poured concrete for pipe installation, and no pipe shall run in poured concrete unless called for in the Drawings or specifications or permitted by CONSULTANT. The cutting or core drilling of concrete for pipe shall be avoided wherever possible, and in no case where such cutting or core drilling is necessary shall reinforcing rods be cut or disturbed without notifying CONSULTANT. All openings for pipe work shall be neatly patched in a workmanlike manner.

3.03 FIELD QUALITY CONTROL

- A. CONTRACTOR shall include the cost of all testing and cleaning in the price Bid.
- B. Work shall be tested as specified in this section. Unless indicated by CONSULTANT in writing before testing begins, tests shall be witnessed by CONSULTANT and others as necessary. Test results shall be recorded, and reports or appropriate certificates shall be submitted to CONSULTANT in triplicate.

- C. New piping shall be tested. Piping, interior or exposed, shall be subject to test before being covered with insulation or paint or before caulking of any gaps at flanges of ductile iron piping. Piping and appurtenances shall be watertight or airtight and free from visible leaks.
- D. Piping shall be flushed or blown out after installation and prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents for testing.
- E. Gauges used for testing shall have increments as follows:
 - 1. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
 - 2. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
 - 3. Tests requiring a pressure of greater than 100 psi shall use a testing gauge having increments of 2 psi or less.
- F. Pressure Tests: The test pressure in all lines shall be held for one hour during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests. All piping conveying a combination of fluids, such as SCM/WAS, shall be tested at the higher test pressure.

Fluid Abbreviation or Name	Minimum Test Pressure in psi	Test Medium	Leakage Allowance Designation ⁽¹⁾
ML, PI, PRE, SCM, SE, RAS (Gravity Flow)	10	Water	"A"
WAS, RAS (Pump Discharge)	50	Water	"A"
NPW, PW	150	Water	"A"

⁽¹⁾ Leakage allowance Designation "A" shall mean zero leakage.

3.04 DEMOLITION

- A. All interior piping removals, including appurtenances and abandonment, shall be by CONTRACTOR. The locations and elevations of existing piping are approximate. Any change in pipe location or elevation shall be reviewed by CONSULTANT.
- B. CONTRACTOR shall remove or abandon all existing piping and appurtenances as noted. Unless otherwise shown or specified, piping and appurtenances to be removed shall become the property of CONTRACTOR and shall be removed from the site for salvage or disposal.
- C. Valve boxes and exposed valves and operators on piping to be abandoned shall be removed. All concrete surfaces to remain shall be patched as required to provide a smooth surface. Repiping and connections to new piping shall be as specified for new piping.

- D. It is the responsibility of CONTRACTOR to remove the following, including piping and appurtenances, as specified and patch all holes resulting therefrom unless specified or shown otherwise. The intent of these specifications is to require that the removal of materials, patching of all existing holes, and repiping be done in a workmanlike manner. All costs shall be included in the Lump Sum Bid.

3.05 CLEANING

- A. All equipment and materials shall be clean before installation.
- B. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.
- C. All surplus material, tools, and equipment shall be removed, and the premises shall be left free of everything of the kind.

END OF SECTION

SECTION 40 05 53

IDENTIFICATION FOR PROCESS INTERCONNECTIONS PIPING AND EQUIPMENT

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Perform all work required to furnish and install equipment, valve, pipe, and wire identification with supplementary items necessary for proper installation as specified herein, or shown on the Drawings. CONTRACTOR shall identify including, but not limited to, all equipment, valves, piping, ductwork, dampers, pumps, and wires.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

1.03 REFERENCES

- A. All material, installation, and workmanship shall comply with the applicable requirement and standards addressed within the following references: ASME A13.1–Scheme for the Identification of Piping Systems.

PART 2–PRODUCTS

2.01 NAMEPLATES

- A. Nameplate material shall be multi-color, two-layer, nonconductive engraving plastic suitable for permanent installations in indoor and outdoor locations. The material shall be UV-resistant and suitable for installation in direct sunlight.
- B. Type “A” Nameplates:
 - 1. Use: All equipment specified in Divisions 42 and 46
 - 2. Size: 4-inch by 6-inch minimum.
 - 3. Background Color: Black.
 - 4. Character Color: White.
 - 5. Character Size: 1 1/4 inches.
 - 6. Engraving: Equipment label.
 - 7. Mounting Location: As requested by CONSULTANT. All fasteners shall be stainless steel.
- C. Type “B” Nameplates:
 - 1. Use: Control panels.
 - 2. Size: As necessary.
 - 3. Background Color: Black.
 - 4. Character Color: White.
 - 5. Character Size: 3/16 inch.

6. Engraving: Operating function.
 7. Mounting Location: As requested by CONSULTANT.
- D. Type "C" Nameplates:
1. Use: Description of control panel function.
 2. Size: As necessary.
 3. Background Color: Black.
 4. Character Color: White.
 5. Character Size: 3/16 inch.
 6. Engraving: Operating function.
 7. Mounting Location: As requested by CONSULTANT.
- E. Type "D" Nameplates:
1. Use: Operator instructions.
 2. Size: As necessary.
 3. Background Color: Yellow.
 4. Character Color: Black.
 5. Character Size: 3/16 inch.
 6. Engraving and Mounting Location: As requested by CONSULTANT.
- F. Type "E" Nameplates:
1. Use: All equipment not specifically mentioned above.
 2. Size: As necessary.
 3. Background Color: Black.
 4. Character Color: White.
 5. Character Size: 3/16 inch.
 6. Engraving and Mounting Location: As requested by CONSULTANT.

2.02 LABELING TAGS

- A. Labeling Tags:
1. Use: Field-mounted devices (Limit switches, etc.).
 2. Size: 1-inch by 3-inch.
 3. Material: 1/32-inch-thick stainless steel.
 4. Character Size: 1/4 inch.
 5. Engraving: As requested by CONSULTANT.
- B. Valve Tags:
1. All new valves shall be tagged. All slide gates shall also be tagged. CONTRACTOR shall provide on valves, engraved 2 1/2-inch by 2 1/2-inch plastic laminated tags, Seton "Setonply Series M4550-H," or equal. Nomenclature for tagging (letters and numbers) will be provided by CONSULTANT. Colors will be selected by OWNER. CONTRACTOR shall affix tags to valves with Brady 38091, or equal, stainless steel wire and Brady 38090, or equal, zinc wire clamps.
 2. Valve tags shall be fastened next to valve box cover on valve manholes with stainless steel fasteners. Each stop plate and slide gate and each stop plate and slide gate grooves shall both be labeled with tags using stainless steel fasteners.

2.03 WIRE MARKERS

- A. Wire markers shall be permanently attached wraparound adhesive, sleeve- or heat-shrink-type labels. Wire numbering preprinted on the conductor, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable.

- B. Wire markers shall be specifically printed for this project using a wire marker printer. Handwritten markers are not acceptable.

2.04 PIPE MARKERS

- A. Manufacturers: Marking Services, Inc., Seton Name Plate Company, W.H. Brady Company, or equal.
- B. Pipe markers shall conform to ANSI A13.1. Arrow markers must have same ANSI background colors as their companion pipe markers or be incorporated into the pipe identification marker.
- C. Plastic Pipe Markers: Factory-fabricated, flexible, semirigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Pipe markers and arrow markers also shall be provided for all piping systems.
- E. Use Seton Setmark type SNA or Brady Snap-on type identification for all piping systems, up through 6 inches. For piping systems larger than 6 inches, use Seton or Brady strap-on markers, or similar, by Marking Services, Inc. Self-adhesive labels are not acceptable. Provide lettering in accordance with table below.

PIPE MARK SIZE CHART

Outside Pipe Diameter (Including Covering)	Minimum Length of Label Field Color (Inch)	Minimum Height of Letters (Inch)
3/4 inch to 1 1/4 inch	8	1/2
1 1/2 inch to 2 inch	8	3/4
2 1/2 inch to 6 inch	12	1 1/4
8 inch to 10 inch	24	2 1/2
Over 10 inch	32	3 1/2

PART 3-EXECUTION

3.01 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state, and local requirements and referenced standards and conform to code and ordinances of authorities having jurisdiction.
- B. Degrease and clean surfaces to receive nameplates.
- C. Install nameplates parallel to equipment lines.
- D. Affix nameplates with stainless steel screws or sticky-back adhesive.
- E. Affix labeling tags with permanent bonding cement or locking wire ties. Provide 3/8-inch hole to accommodate wire tie.
- F. Prepare and install neatly typed directions in all panels, including existing panels, where work is done under this Contract.

- G. Four-inch-round, 4-inch-square, and 4 11/16-inch junction boxes concealed above ceilings may be identified with neat lettering on the cover with a permanent-type black marking pen.

3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, control panels, thermostats, junction boxes, and at load connection. Identify with branch circuit or feeder number for power circuits and with control wire number as indicated on schematic and interconnection diagrams for control wiring. Wire markers shall be permanently attached wraparound adhesive or heat-shrink-type markers. Wire numbering preprinted on the conductor, individual wraparound numbers, and flag-type labels are not acceptable.
- B. Conductors in pull boxes, motor control centers, control panels, cabinets, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system.

3.03 PIPE MARKERS

- A. Install pipe markers in accordance with manufacturer's instructions.
- B. Install in clear view and align with axis of piping.
- C. All pipes shall be labeled with a minimum of two labels in each room, crawl space, or compartment. Locate identification at maximum 20-foot centers on straight runs, including risers and drops adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Labels shall be abbreviated as noted under fluid abbreviations on Drawings.
- D. All piping containing or transporting hazardous or corrosive chemicals shall be identified with labels every 10 feet and with at least two labels in each room, closet, or pipe chase.
- E. Labels shall identify fluid being conveyed and include flow direction arrow. Provide a double-ended arrow marker when flow can be in either or both directions.
- F. CONTRACTOR shall include a schedule in its submittal identifying the various pipe designations, abbreviations, and labeling scheme. Colors, text, and piping abbreviations are to be selected by OWNER, with the following piping marker scheme used where applicable.

Pipe Contents	Label Colors (Background/Text)
Wastewater Lines	
Sewage (except sanitary drain, waste, and vent piping)	Green/White
Sludge	Green/White
Water Lines	
Raw	Green/White

END OF SECTION

SECTION 40 05 57

ACTUATORS FOR PROCESS VALVES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation electric actuators for process valves. The actuators and appurtenances for the process valves shall be furnished by the process valve supplier. All actuators shall be by the same manufacturer.
- B. Related Sections and Divisions:
 - 1. Applicable provisions of Division 01 shall govern work in this section.
 - 2. Section 40 05 00—Piping and Appurtenances.
- C. CONTRACTOR shall coordinate with Section 40 05 00—Piping and Appurtenances.

1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with the provisions of Section 01 33 00—Submittals. The following information and data shall be included as part of the shop drawing submittal:
 - 1. Detailed catalog information, descriptive literature, and specifications of hardware. All items being provided must be specifically noted on this literature.
 - 2. Detailed equipment drawings with dimensions.
 - 3. Motor nameplate data.
 - 4. Manufacturer's wiring diagrams showing all external connection points.
 - 5. Any exception to these Specifications, including explanation for nonconformance.
- B. Refer to test requirements in Part 3—Execution for additional submittal requirements.

1.03 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization or Substantial Completion of the project.

PART 2—PRODUCTS

2.01 MANUFACTURERS

- A. Actuators for process valves shall be Rotork IQ3 Series of Rochester, New York; Limitorque MX Series of Lynchburg, Virginia; or AUMA SA Series of Cannonsburg, Pennsylvania; or equal. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.

- B. Specifications for actuators were prepared based on Rotork IQ3 series. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes, including engineering changes, to accommodate the other Base Bid equipment including but not limited to structural, mechanical, and electrical work.

2.02 ELECTRIC ACTUATORS

- A. Electric actuators shall be sized and provided by the valve manufacturer.
- B. General
 - 1. Power to the electric actuators shall be 460-volt, three-phase, 60 Hz, unless otherwise noted. Electric actuators shall be sized by the valve manufacturer for a minimum of 1.5 times the manufacturer's torque requirements with the supply voltage 10% below nominal. The minimum pressure for determining torque requirements for electric actuators shall be based on pipe service test pressure or 25 psi, whichever is greater.
 - 2. Actuator motor shall run with the correct rotation for the required direction of valve irrespective of the connection sequence of the incoming power.
 - 3. Actuator motor shall be designed for high-torque applications.
 - 4. Electric actuator shall be removable from the valve without taking the valve out of service.
 - 5. Electric actuator shall be designed for mounting and running in any position.
 - 6. Electric actuator shall be suitable for use in -30°C to 70°C (-22°F to 158°F) ambient temperatures and 100% relative humidity.
 - 7. Electric actuator shall be capable of sustaining 60 starts per hour during normal service and 1,200 starts per hour under reduced load conditions.
 - 8. Setup and configuration of the torque settings and position limits and configuration of the indication contacts shall be completed without the removal of any actuator covers or the use of integral switches or buttons on the actuator.
 - 9. In the event of a power loss or failure, the position contacts must continue to be able to supply remote position feedback and maintain interlock capabilities. If batteries are required to maintain contact functionality, the actuator vendor shall provide a supply sufficient for 30 continuous days of un-powered operation.
 - 10. A backup power source must be provided in the actuator to provide correct remote limit switch indication should the actuator be moved manually when the power supply is interrupted.
 - 11. The position of the actuator and valve must be updated contemporaneously, even when the power supply is not present.
- C. Construction:
 - 1. Electric actuator shall include the motor, starter, control power transformer, local controls for electric operation, and all associated appurtenances as specified herein or otherwise required for operation in the rated conditions.
 - 2. Motor insulation shall be Class F and rated for a Class B temperature rise.
 - 3. Stall, overtemperature, single-phase, and overtorque protection shall be included for the motor. The motor shall be equipped with internal thermostats to protect against motor overtemperature. Thermostats shall automatically reset upon cooldown. Torque must be determined from a direct measurement of force at the output of the actuator and not based on motor speed, current, or other electrical parameters. A torque bypass shall be provided to prevent an overtorque shutdown when seating or unseating valve.
 - 4. Drive gearing shall be self-locking to prevent the valve from back-driving the actuator.
 - 5. Enclosure shall be explosionproof in Class I, Division 1 or Division 2, Groups C and D locations.

6. Electrical components shall be completely factory-wired and there shall be integral terminal strips for field-wiring connections. Terminal strips shall be sealed in a separate compartment from the inner electrical components of the actuator.
 7. The motor and all other internal electrical elements of the actuator must be protected from ingress of moisture and dust when the terminal cover is removed for site cabling. The terminal compartment must maintain the same ingress protection rating with the terminal cover removed. The actuator enclosure shall allow for temporary site storage without the need for electrical supply connection. All external fasteners shall be suitable for corrosive exterior environments.
 8. Modulating Service actuators shall be rated for a continuous duty cycle (minimum of 1,200 starts per hour).
 9. The motor duty rating shall be sufficient for one complete open to close to open (or reverse) cycle without exceeding its temperature rating.
 10. The motor duty rating shall be sufficient for one complete open to close to open (or reverse) cycle without exceeding its temperature rating.
- D. Manual Operation: A handwheel shall be provided for manual operation of each motor-operated valve with arrows to indicate "open" and "close" rotation. The handwheel shall be engaged when the motor is de-clutched by a lever or similar means. Friction-type de-clutch mechanisms are not acceptable. The handwheel shall not rotate during motor operation. When operating in manual mode, the actuator shall remain in this mode until the motor is energized, at which time the actuator shall automatically return to electric operation. It shall be impossible for manual and electric operation to occur simultaneously.
- E. Electric Operation:
1. Electric operation shall be provided from local controls on the electric actuator enclosure. The operator shall have the ability to select "Open," "Stop", and "Close" for local operation. The operator shall also have the ability to select "Local" and "Remote" modes of control for the electric actuator. In the "Local" mode the electric actuator shall be controlled from the "Open," "Stop", and "Close" selection described above and "Remote" mode shall be disabled. In the "Remote" mode the electric actuator shall be controlled from the MCP.
 2. Valve open/close time shall be as specified in Section 40 05 00–Piping and Appurtenances.
 3. Auxiliary contacts shall be provided for remote indication of "In Remote" and "Failed" statuses at the MCP. All contacts shall be rated for 120 VAC operation.
 4. Modulating Service: Electric actuator shall accept a 4-20 mA signal for "Position Control" and provide a 4-20 mA signal for "Position Feedback" status to/from the MCP when operating in the "Remote" mode.
- F. Gearing:
1. Actuator gearing must be totally enclosed in an oil-filled gearcase suitable for operation at any angle.
 2. All drive gearing and components shall be of metal construction and incorporate a lost-motion hammer blow feature.
 3. For rising spindle gates, the output shaft shall be hollow to accept a rising stem and incorporate thrust bearings of the ball or roller type at the base of the actuator. The design shall permit the opening of the gearcase for inspection or disassembly without releasing the stem thrust or taking the gates out of service.
 4. For 90° operating type valves, drive gearing shall be self-locking to prevent the valve back-driving the actuator.

- G. Drive Interface: Actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. Drive bushing shall be positioned in the base of the actuator. Thrust bearings shall be sealed for life and the base shall be capable of withstanding five times the rated thrust of the actuator.

2.03 CONTROLS

- A. Electrical controls and instrumentation for this equipment are specified under Section 26 09 00—Controls and Instrumentation of these specifications.

2.04 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

2.05 FINISHES

- A. It is the intent of these specifications that equipment, support and accessories be furnished factory shop-primed and finish-painted. Equipment and appurtenances shall be prepared in accordance with commercial grade SSPC specifications No. 6. Priming and finish painting shall be as recommended by manufacturer and shall be suitable for outdoor operation. Touch-up paint shall be provided by manufacturer.

PART 3—EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, startup, and operator training. Comply with additional requirements as specified below.
- B. A minimum of one trip and one day on site shall be provided for startup and training services.

3.02 ELECTRIC ACTUATOR TESTING

- A. Factory Test:
 - 1. Each electric actuator shall be fully performance-tested in the manufacturer's facility to determine compliance with the rated conditions. Certified test data shall be submitted for approval prior to shipment and shall include the following:
 - a. Serial number.
 - b. Test data.
 - c. Manufacturing site address.
 - d. OWNER's name, project name, and order number associated with the project.
 - 2. The factory test shall be similar to typical valve operation. The following parameters shall be recorded and clearly stated in the test data:
 - a. Torque at maximum torque setting in open and close directions.
 - b. Current at maximum torque setting in open and close directions.
 - c. Flash test statement.
 - d. Test power supply voltage.

- B. Installed Test: Manufacturer's representative shall certify that electric actuators have been properly installed. During equipment startup, manufacturer's representative shall confirm that each electric actuator is operating properly as specified. A report shall be submitted verifying the test. Electric actuator shall be modified if specified conditions are not met.

END OF SECTION

SECTION 40 05 59.23

SLIDE GATES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation two slide gates (SLG-40-01 and SLG-40-02) as listed below and indicated. Slide gates shall be complete with gate, guides, framing, operator, and other components as required to make a complete system.
- B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Application: Slide gates shall be suitable for use in wastewater streams that, in addition, may contain iron salts, polymers, chlorine solution, or sulfur dioxide solutions.

1.03 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization or Substantial Completion of the project.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Fabricated stainless steel slide gates shall be Whipps, Inc. of Athol, Massachusetts, RW Gate of Troy, New York, Fontaine-Aquanox of Quebec, Canada, or equal.

2.02 GATE CONSTRUCTION

- A. The slide gates shown on the Drawings and listed in the specifications shall conform to the latest edition of the AWWA Standard for Slide Gates, AWWA C561, and to the following detailed specifications.
- B. Disc: The gate disc shall consist of a flat plate reinforced with structural or formed members welded to the plate. The disc shall be designed to limit the deflection of the gate to 1/360 of its span or 1/16 inch, whichever is less, under design head. The working design stresses shall not exceed the lesser of 40% of the yield strength or 25% of the ultimate strength of the material. All disc components shall have a minimum material thickness of 1/4 inch. Provide ultra-high molecular weight polymer bearing bars on each side of gate.

- C. Frame: The gate frame shall consist of guides, invert member, and operator yoke welded or bolted together to form a rigid one-piece frame. The guides shall conform to AWWA C561 requirements and shall have a minimum material thickness of 1/4 inch. The guide slot shall engage the disc plate a minimum of 1 inch. The invert member shall be an angle, channel, or formed shape welded to the bottom of the guide to form a flush surface and to meet with the disc seal. For self-contained gates, the yoke members shall be designed to limit the deflection to 1/360 of its span. The working stresses shall not exceed the lesser of 40% of the yield strength or 25% of the ultimate strength of the material and shall be arranged to permit removing the disc from the frame.
- D. Seals: Self-adjusting UHMW seals shall be attached to the frame if necessary so that leakage shall not exceed 0.05 gpm per foot of seal perimeter of the maximum head in the seating and unseating head condition.
- E. Stems: Stems shall be Type 316 stainless steel and shall have a minimum diameter of 1 1/2 inches. Stem threads shall be machine-rolled, full-depth Acme type. Stems shall be designed to transmit in compression a minimum of two times the rated output of the hoist at 40 pounds effort on the crank or handwheel. The L/r ratio of the unsupported stem shall not exceed 200. Stem guides, where required to limit the unsupported stem length, shall be bronze or UHMW bushed. All gates having widths greater than two times their height shall be provided with two lifting devices connected by a tandem shaft for simultaneous operation.
- F. Stem Covers: Rising stem gates shall be provided with clear butyrate or Lexan stem covers to provide indication of gate position, permit inspection of the stem threads, and to protect the stem from contamination. The stem cover shall be constructed of clear rigid butyrate or Lexan. Vent holes shall be provided to prevent condensation.
- G. Provide a horizontal member at 21 inches above the operating floor where handrailing is interrupted by the slide gate.
- H. All gates shall be shipped and delivered to the project site fully assembled unless CONTRACTOR requests other arrangements.
- I. All gates shall be provided with UHMW seats on the upstream and downstream sides of the disc to prevent metal-to-metal contact between the disc and the frame.

2.03 MATERIALS

- A. Slide components shall be Type 316 stainless steel unless otherwise indicated. All welds and weld burn shall be passivated per ASTM A380 at the factory to provide a clean, uniform finish. If sandblasting is used, the entire slide and entire frame shall be sandblasted to provide a uniform finish. Self-adjusting UHMWPE seat/seals shall conform to ASTM D4020.

2.04 MANUAL OPERATORS

- A. Unless otherwise specified, operation of the gate shall be by an antifriction handwheel bench stand or by crank operation through right angle bevel gears as shown on the Drawings. Maximum effort shall not exceed 40 pounds on handwheel or crank to raise gate under full operating head. The lift mechanism shall be capable of withstanding, without damage, a handwheel or crank effort of 200 pounds. Bench stand shall be minimum of 36 inches above operating floor. Where possible, the bench stand shall be 42 inches above the operating floor where the gate interrupts handrailing. If the bench stand must be higher to allow

operation of the gate, provide a horizontal member across the yoke at 42 inches above the operating floor. The member shall meet OSHA strength requirements for guardrail.

- B. The hoist nut shall be manganese bronze conforming to ASTM B584 C86500. The hoist nut shall be supported on roller bearings. The hoist shall be outfitted with a stainless steel pinion shaft and the pinion shaft shall be supported by roller or ball bearings. A 2-inch-square nut shall be provided on the pinion shaft to allow operation by a portable electric operator. A lubrication fitting shall be provided for lubrication of the hoist bearings without disassembly of the hoist. Suitable seals shall be provided to prevent entry of foreign matter. The direction of handwheel or crank rotation to open the gate shall be clearly and permanently marked on the hoist. Where the actuators will be interconnected, it shall be by a flexible coupling and stainless steel shaft with stainless steel hardware.

2.05 FINISHES

- A. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished factory shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09. Unless otherwise specified, mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process to preclude damage to the equipment once assembled. Cleaned surfaces shall then be factory shop-primed. Factory shop prime with one coat of Tnemec N69 or N140, Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Color of primer should be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. Motors and speed reducers shall be factory shop-primed and finish-painted using the manufacturer's standard paint system for the specified application. Touch-up paint shall be provided by manufacturer.
- B. Provide mill finish on stainless steel. Welds shall be sandblasted to remove weld burn and scale in the factory. All heat tint and slag from the welding process shall be passivated in accordance with ASTM A380. If bead blasting is used, the entire slide and frame shall be bead-blasted.

2.06 ANCHOR BOLTS

- A. CONTRACTOR shall provide anchor bolts necessary for equipment furnished. Anchor bolts shall be Type 316 stainless steel and shall be of ample strength for intended service. Provide anchor bolts in accordance with Section 05 56 00—Anchor Bolts and Post-Installed Anchors.

PART 3—EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 1 for equipment installation, quality control, testing, supervision, startup, and operator training. Comply with additional requirements as specified below.

- B. A minimum of one trip and two days on site shall be provided for startup and training services.

END OF SECTION

SECTION 43 23 21

CENTRIFUGAL SLUDGE PUMPS

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation three return activated sludge (RAS) pumps (RASP-43-01, RASP-43-02, and RASP-43-03). The pumps and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Design Requirements: Three pumps (RASP-43-01, RASP-43-02, and RASP-43-03) shall be used for pumping RAS. The RAS pumps shall be installed at the new RAS/WAS Pumping Station (Structure 43). RAS temperature will be approximately 40°F to 90°F. RAS concentration is expected to be between 0.5% and 2.0% solids.
- B. Performance Requirements:
1. The pumps shall meet the following performance requirements with the motor drives provided under this contract and driven by VFD as specified herein (800 rpm to 1,565 rpm):

Pump	Maximum TDH			Normal TDH			Minimum TDH		
	Flow (gpm)	TDH (ft)	Efficiency (%)	Flow (gpm)	TDH (ft)	Efficiency (%)	Flow (gpm)	TDH (ft)	Efficiency (%)
RASP-43-01,-02, -03	2,400	25.1	50	1,600	11.2	66.2	800	4.1	65

2. The pump model specified in Paragraph 2.01.A shall meet the following performance requirements at a maximum speed of 1,800 rpm.
 - a. 400 gpm at 88 feet TDH.
 - b. 1,000 gpm at 63 feet TDH.
 - c. 1,600 gpm at 45 feet TDH.
3. Pump efficiency measured at the shaft input shall not be less than indicated in the above tables at full speed when pumping at the maximum capacity and total dynamic head in feet specified.
4. None of the hydraulic heads specified include any allowance for pump internal velocity head, and all specified heads shall be adjusted for the velocity heads applicable to the pumps. Internal pump velocity head shall not be considered effective head delivered by the pump and shall not be included in the pump test head or performance curve and efficiency calculations. In calculating system heads, suction head was calculated based on elevation difference plus friction losses to the pump suction flange. Discharge head was calculated based on elevation differences plus friction losses from the pump discharge flange to point of discharge.
5. Pump NPSHR shall not exceed 30 feet at any listed operation point of the pump.
6. Pump shall not have sediment clogging potential at any operating condition listed above.

7. Maximum and minimum head conditions provided in the tables in Paragraphs 1.02.B.1 and 2 are given as a guide to the shape of the head discharge curve. Pumps shall have a discharge curve of the same shape or steeper within the guidelines previously specified.

1.03 SUBMITTALS

- A. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- B. Certified pump factory test report as specified under Paragraph 3.03.B shall be submitted prior to shipment.

1.04 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization or Substantial Completion of the project.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. RAS pumps shall be helical screw centrifugal pumps, Wemco Model SFE5-L as manufactured by Trillium Flow Technologies of Fresno, California, or equal. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.
- B. Drawings and Specifications were prepared based on Wemco. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes, including CONSULTANT's changes, to accommodate the other Base Bid equipment including, but not limited to, structural, mechanical, and electrical work.
- C. CONTRACTOR may provide Alternative Bids for equipment from other manufacturers. CONTRACTOR shall comply with all provisions regarding substitute items and shall include in the Bid and be responsible for the cost of any changes to accommodate substitute equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay costs of engineering services for review of substitutes and for revisions of drawings and/or specifications by CONSULTANT to accommodate substitutes.

2.02 GENERAL

- A. The complete units, when assembled and operating, shall be free of cavitation and noise. Vibration shall not be in excess of Hydraulic Institute Standards over the entire range of operation specified and be verified by supplier after startup. Pump impeller selection must compensate for slip losses or other speed variations due to final motor or control selection to deliver flows at head conditions specified herein. Pump supplier shall be responsible for verifying that its pump will operate properly utilizing the suction and discharge pipe sizes,

valves, and fitting as shown on the Drawings and with the control equipment specified in Section 26 09 00–Control Panels and Instrumentation, of these specifications.

2.03 PUMPS

- A. Pumps shall be horizontal, end suction, and shall be as follows:

Pump	Wemco Model No.	Discharge and Suction Size (inches)	Impeller	Nominal Speed (rpm)
RASP-43-01	SFE8-T	8 by 8	Screw-Centrifugal	1,800
RASP-43-02	SFE8-T	8 by 8	Screw-Centrifugal	1,800
RASP-43-03	SFE8-T	8 by 8	Screw-Centrifugal	1,800

2.04 PUMP CONSTRUCTION

- A. Pumps shall be screw centrifugal sludge pumps.
- B. Pump volute shall be close grained cast iron and back pullout for the rotating assembly. Cleanouts shall be provided. The suction cover shall be provided with an internal spiral groove to prevent binding of fibrous material between it and the impeller. The casing shall be designed to allow for back pullout of the power frame for maintenance without removing suction or discharge piping. Suction and discharge connections shall be 125 pound ANSI flanged.
- C. Impeller and suction liner or cone shall be 450 Brinell Hi-chrome iron, ASTM 532-CL3, Type A and fitted with full back pump out vanes or spiral grooves. Suction liner shall be independently replaceable and externally adjustable by means of three regulating screws. Screws shall advance, retreat, and lock position of the suction liner. Adjustment shall be accomplished with simple hand tools and shall not require the disconnection of the pump from the piping.
- D. Shaft assembly shall be high strength alloy steel. Provide suitable bearings capable of taking all mechanical and hydraulic loads. Bearings shall be grease-lubricated single-row radial and double-row thrust bearings rated for a minimum B-10 life of 100,000 hours at Best Efficiency Point and minimum L-10 life of 50,000 hours at the rated conditions.
- E. Bearing frame shall be close grained cast iron.
- F. Pump base shall be a minimum of 3/8-inch fabricated steel with an open channel base. Motor base, coupling, and guard shall be arranged so that the pump rotating assembly is removable without disturbing motor or connecting piping.
- G. The hydraulic design of the impeller shall combine the action of a positive displacement screw with the action of a single-vane centrifugal impeller to provide a single, non-bifurcated flowstream with only gradual changes in flow direction.
1. The leading edge of the impeller vane shall blend into the impeller body in such a way that any rag or other fibrous material caught on the leading edge and folded over both sides of the vane will be unfolded and released as the textile follows the flowstream through the pump.
 2. The impeller flange or impeller shall contain a spiral groove on the rear face so that any solids in the pumped media are discharged from the space between the backplate and the rear of the impeller.

- H. To maintain optimum running clearances along the entire length of the impeller to maintain design hydraulic efficiencies, the geometry of the impeller and suction liner shall be conical so any axial adjustment of the impeller will cause the clearance between the impeller and suction piece to change uniformly along the entire length of the impeller.

2.05 PRESSURE GAUGES

- A. Suction and discharge pressure gauge assemblies shall be provided in accordance with Section 40 05 00—Piping and Appurtenances and as shown on the Drawings.

2.06 FLUSHLESS SEAL SYSTEM

- A. Shaft sealing shall be by independently mounted, tandem mechanical seals contained in an oil chamber that is formed as an intrinsic part of the bearing frame and allows the seals to be completely submerged in and lubricated by the oil bath. Externally mounted oil reservoirs are not acceptable.
 - 1. The mechanical seal nearest the bearing shall use carbon/ceramic faces and shall isolate the seal cooling oil from the bearing frame. When mounted in a vertical configuration, this shall allow the pump to operate continuously submerged within 4 inches of the upper bearing cap.
 - 2. The mechanical seal nearest the impeller shall be stainless steel or rubber bellows-type construction firmly attached to the rotating face and clamped to the shaft to prevent contaminants from contacting the stainless steel spring that loads the seal face. Seal faces shall be a solid tungsten-carbide rotating face running against a solid silicon-carbide stationary face. Seals with both faces of similar materials, or seals with bonded, soldered, or converted face surfaces, are not equal or acceptable.
 - 3. The mechanical seal nearest the impeller shall be contained in a seal chamber formed by the impeller flange and a recess cast into the motor frame. To prevent debris from entering the chamber and to prolong the mechanical seal life, a flush port shall be provided so that optional external water flush can be supplied directly into the seal chamber.
 - 4. The mechanical seal nearest the impeller shall be isolated from contaminants in the pumped media by a labyrinth-fit between the backside of the impeller and the backplate as well as by pump-out grooves cast into the impeller back shroud and into the backplate to minimize debris reaching the shaft seal.

2.07 PUMP DRIVE

- A. Direct-Coupled:
 - 1. Pump manufacturer shall provide a common pump and motor base constructed of a minimum 3/8-inch-thick fabricated steel, suitably reinforced to support the full weight of pump and motor.
 - 2. Pump supplier shall furnish and install a flexible spacer coupling between the pump shaft and motor shaft.
 - 3. An approved fiberglass or thermoplastic coupling guard shall be provided to safely enclose the coupling. If metal guards are furnished, they shall be of all 316 stainless steel construction with suitable lifting eyes and handles.

2.08 MOTORS

- A. Motors shall conform to all applicable requirements of NEMA, ANSI, IEEE, and NEC standards and shall be UL listed for the service specified.
- B. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.
1. Physical Construction:
 - a. Copper leads and windings with ball or roller bearings in end brackets of steel or cast iron or aluminum brackets with steel bearing sleeves. Motor leads shall have the same insulation class as the windings.
 - b. Rotor bars shall be aluminum.
 - c. Motor shaft shall be high-strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. The maximum allowable no-load shaft runout shall be 0.002 inch.
 - d. Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be prelubricated and field-regreasable. Openings for addition of grease shall have grease fittings provided.
 2. Mounting: As recommended by the manufacturer.
 3. Enclosure: TEFC.
 4. Efficiency: Premium efficient as noted in schedule below.
 5. Service Factor: 1.0 on VFD power, 1.15 on sine wave power.
 6. Power requirements: 60 Hz, three-phase, 230/460-volt, factory-wired for 460-volt connection, $\pm 10\%$ voltage variation.
 7. Load type: Variable torque.
 8. NEMA Design: B.
 9. Insulation: Class F and rated for a Class B temperature rise.
 10. Nominal operating speed: See Motor Schedule.
 11. Nameplate: Stainless steel engraved attached to motor frame or enclosure with stainless steel rivets.
 12. Conduit/Junction Box: Cast iron, diagonally split, fully rotatable, gasketed between cover and box, and between box and frame. Motor lead opening in the frame shall also be gasketed. A clamp-type terminal shall be provided inside each motor conduit box for grounding.
 13. Accessories:
 - a. Oversized motor junction box.
 - b. Lifting eyes.
 - c. Thermostats applied to motor windings, capable of shutdown and manual reset by external controls (by Division 26).
 14. VFD requirements: Motor operating on VFDs shall be inverter-duty rated, meet the requirements of NEMA MG1, Part 31, and be capable of a minimum speed turndown of 10:1. Motors shall also include shaft grounding rings as manufactured by AEGIS, or equal.
- C. Motor Schedule: If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

Pump Motor	Horsepower	Nominal Speed	Efficiency	VFD
RASP-43-01	10 hp	1,800 rpm	91.7%	Yes
RASP-43-02	10 hp	1,800 rpm	91.7%	Yes
RASP-43-03	10 hp	1,800 rpm	91.7%	Yes

- D. Motor shall not be loaded greater than 85% of its nameplate rating at any of the design operating conditions listed in Paragraph 1.02B.

2.09 VARIABLE SPEED PUMP CONTROLS

- A. Variable speed drives are specified in Division 26 of these specifications for the pumps. Care shall be taken in sizing the drive so that adequate starting torque is available for the pumps. This information shall include, but not be limited to, motor full load amps and locked rotor amps and shall be provided to the variable speed supplier specified in Division 26.
- B. Pump controls are specified in Division 26, Section 26 09 90—Controls and Instrumentation of these specifications. Pump manufacturer shall review these controls and coordinate with Division 26.
- C. Equipment manufacturer shall furnish information regarding the minimum motor speed allowed in order to protect the motor and driven equipment to the variable speed drive supplier specified in Division 26. Minimum speed requirements shall be based on actual installed conditions and shall be furnished at or prior to equipment start-up. Calculations showing how minimum speed requirements were determined shall be furnished to CONSULTANT for review.

2.10 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. CONTRACTOR shall provide spare parts to OWNER for all equipment components with an expected life of 1 year or less.

2.11 FINISHES

- A. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished factory shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09. Unless otherwise specified, mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process to preclude damage to the equipment once assembled. Cleaned surfaces shall then be factory shop-primed. Factory shop prime with one coat of Tnemec N69 or 20 HS or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Color of primer should be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. Motors and speed reducers shall be factory shop-primed and finish-painted using the manufacturer's standard paint system for the specified application. Touch-up paint shall be provided by manufacturer.

2.12 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.

PART 3—EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, startup, and operator training. Comply with additional requirements as specified below.
- B. A minimum of two trips and one day per trip on site shall be provided for startup and training services.

3.02 VARIABLE SPEED CONTROL COORDINATION

- A. The equipment manufacturer shall coordinate with the variable speed drive supplier at the time of equipment startup to address minimum speed requirements to protect both motor and equipment and to meet specified design and performance requirements. Minimum speed settings (in hertz) shall be provided to OWNER. Equipment operation over the entire control range shall be completed to demonstrate successful operation and to meet specified design and performance requirements.

3.03 TESTING

- A. A factory test shall be performed on one pump of each size supplied of those furnished under this Contract. The factory test shall include at least three points on the pump curve to verify the required flow at the design TDH specified. The results of the factory test shall be submitted to CONSULTANT prior to pump shipment. Pump performance shall comply with Hydraulic Institute Standard 2B acceptance grade.
- B. During equipment start-up, manufacturer's representative shall confirm each pump is operating on the design curve at design speed. Report shall be submitted verifying test. Pump shall be modified if specified conditions are not met.

END OF SECTION

SECTION 46 43 22

FINAL CLARIFIER COLLECTORS

PART 1—GENERAL

1.01 SUMMARY

A. Work Included:

1. This section includes furnishing, installing, and placing into successful operation two final clarifier collector mechanisms (FCD-40-01 and FCD-40-02) in 85-foot-diameter clarifiers. FCD-40-01 and FCD-40-02 shall be installed in rehabilitated existing Final Clarifier Nos. 1 and 2, as shown on the Drawings. All equipment shall be furnished by the same manufacturer.
2. Clarifier mechanism shall be the center feed, suction-header type. The clarifier mechanism shall include a drive mechanism complete with reducer, motor, and overload device; sludge removal header and manifold; influent flocculation feed well and supports; energy dissipating inlet; access bridge and center platform including grating, railings, and toeboards; center influent pier; center drive cage and truss arm; surface skimmer with scum trough and skimmer blade ramp; surface skimmer for influent flocculation feed well; anti-rotational scum baffle; and associated attachment bolts and anchor bolts. All clarifier mechanisms and appurtenances, except where noted otherwise below, shall be constructed of hot-dipped galvanized steel, for both submerged and non-submerged members.
3. The clarifier shall be center (siphon) feed and peripheral overflow. The clarifier mechanism shall consist of a center pier supporting a center drive mechanism. The sludge collector drive mechanism shall support and rotate the center drive cage to which are attached the energy-dissipating inlet assembly (static flocculator), influent flocculation feed well, manifold, header, and truss arm with skimming equipment. The bridge and center platform shall span the radius of the clarifier tank and shall be supported from the outer tank wall and center pier. The header shall be located parallel to the tank bottom and shall have a series of inlet orifices so that in a single revolution the header uniformly removes sludge from the tank bottom. The header shall continuously remove the required proportional settled sludge volume to effect a uniform withdrawal over the entire radius of the tank. The header shall be hydraulically designed to remove larger volumes of sludge at greater distances from the tank center, while also taking into consideration the slope of the tank bottom. The slowly revolving mechanism shall collect the sludge from the tank bottom and carry it through the header to the center manifold outlet, the removal being accomplished by pumping. Each mechanism shall be designed for clockwise rotation as shown on the Drawings.
4. Each mechanism shall be designed so there shall be no field welding required, except for the welding of the U-bolts supporting the scum skimmer. The mechanism may be used as the screed for grouting of the tank bottom, provided work is completed in accordance with manufacturer's recommendations.

- ###### B. Related Sections and Divisions:
- Applicable provisions of Division 01 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. The new collectors shall be designed for installation in 85-foot-diameter octagonal concrete basins having a side water depth of about feet 0 inches.
2. Minimum center influent pier size shall be 24 inches outside diameter.
3. Design flow requirements, each clarifier; with two clarifiers in service:

	Minimum (mgd)	Design Average Daily (mgd)	Design Maximum (mgd)
Effluent Overflow	1.0	4.0	13.2
Return Flow (RAS)	1.0	4.0	4.0
Mixed Liquor Flow	2.0	8.0	17.2

4. The maximum mixed liquor flow headloss through the final clarifier collector equipment (from center pier through the flocculation feed well) shall be 0.25 feet at Design Average Daily flow and 0.50 feet at Design Maximum flow.
5. Clarifier collector equipment shall be designed with provisions to eliminate corrosive reactions due to dissimilar metals such as electrolysis or galvanic corrosion. Dielectric barriers or special connections between dissimilar metals shall be provided where necessary.

1.03 SUBMITTALS

- A. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.

B. Header Hydraulic Testing:

1. As a condition of approval, the manufacturer shall provide CONSULTANT with acceptable performance verification data that the proposed header design does remove the proportional settled sludge volume to provide hydraulic balance in the tank and uniform sludge withdrawal for the entire tank bottom. Shop drawings will not be reviewed until this verification has been provided.
2. A complete copy of the data and reports shall be submitted. A letter shall be submitted by the manufacturer showing how the field or laboratory data collected applies to the design and orifice sizing and location of the header for this project.
3. Manufacturer shall supply calculations showing the following information for the proposed header specific for this project:
 - a. Tank diameter.
 - b. Maximum and minimum sludge flow in mgd.
 - c. Header Velocities under all specified flows in fps.
 - d. Number of orifices.
 - e. Orifice spacing.
 - f. Orifice diameters across the header.
 - g. Headloss across orifice.
 - h. Headloss across header at various sections (between each orifice spacing).
 - i. Orifice flow in gpm.
 - j. Header flow in gpm at various sections (between each orifice spacing).
 - k. Tabulation of all headlosses across header.
 - l. Fluid viscosity.

- C. Design Parameters:
1. Tank Diameter: 85 feet.
 2. Withdrawal Sludge Concentration: 5,000 to 20,000 mg/L.
 3. Withdrawal Sludge Flow Rates: 1.0 mgd to 4.0 mgd.
 4. Maximum Header Velocity: 3.5 fps at maximum withdrawal sludge flow rates.
 5. Minimum Header Velocity: 0.5 fps at minimum withdrawal sludge flow rates.
 6. Total Headloss at Maximum Withdrawal Sludge Flow Rates in Header: 1.33 feet (maximum).
 7. This verification data can be provided based either on an existing final clarifier under the following field conditions, or under laboratory conditions.
- D. For verification based on data collected in a laboratory conditions, the following information shall be submitted for equipment manufactured by Ovivo USA:
1. Ovivo Water Technologies has developed a hydraulic computer model for the design of clarifiers equipped with "C3D" suction ducts. That program was first developed in 1974 based on theoretical fluid mechanics formulas.
 2. In 1985, Ovivo Water Technologies conducted a laboratory test on a full size header designed for a 43.5-foot diameter basin at their R&D Facility in Salt Lake City, Utah. This test was used to improve the accuracy of the computer model by using the laboratory data to calibrate some of the cumulative headloss coefficients. These headlosses are the friction losses, momentum losses due to the convergence of flow in the duct at the orifice locations, and pressure recovery that occurs in the duct between the orifice locations. This test also confirmed that the computer model would accurately predict the parameters required to design a suction duct that would provide uniform withdrawal across the width of the basin and also predict the total headloss through the duct.
 3. In 1992, a test was conducted by an independent laboratory to validate the current Ovivo Water Technologies type "C3D" hydraulic design model. The test was conducted at the Utah State University Water Research Laboratory under the supervision of Dr. Roland Jeppson, Professor of Civil and Environmental Engineering. The test was conducted in a laboratory on a suction header specifically designed for the 142.5-foot diameter type "C3D" clarifiers for the West Point–Seattle, Washington Wastewater Treatment Plant. The results of this test provided a verification of the flow distribution and headloss characteristics of the Ovivo Water Technologies duct design and allowed Ovivo Water Technologies to further refine the headloss coefficients as well as other parameters used in the model.
 4. Therefore, it can be concluded that Ovivo Water Technologies' latest version of the hydraulic computer design model for the type "C3D" suction header accurately predict the hydraulic characteristics and design parameters of the duct as demonstrated by these laboratory tests.
 5. The manufacturer shall provide a letter of certification stating that Ovivo Water Technologies' latest version of the hydraulic computer design model for the type "C3D" suction header:
 - a. Has been applied successfully in the design of numerous "C3D" mechanisms.
 - b. Is equally applicable to the Copperas Cove, Texas, Clarifier Rehabilitation Project.
 - c. Has been utilized for the design of the 85-foot diameter clarifier with type "C3D" suction headers.
 - d. Provides predictions of headlosses and uniform sludge withdrawals that will occur under the Copperas Cove, Texas, Clarifier Rehabilitation Project field conditions, including the specified mixed liquor concentration and withdrawal flow rates.

1.04 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization or Substantial Completion of the project.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. Final Clarifier collectors, including drive mechanisms, shall be Ovivo USA, LLC, of Salt Lake City, Utah, Envirodyne Systems, Inc., of Camp Hill, Pennsylvania, or equal. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.
- B. Drawings and Specifications were prepared based on Suction Header Clarifier Mechanisms by OVIVO USA, LLC. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes, including CONSULTANT's changes, to accommodate the other Base Bid equipment including, but not limited to, structural, mechanical, and electrical work.
- C. CONTRACTOR may provide Alternative Bids for equipment from other manufacturers. CONTRACTOR shall comply with all provisions regarding substitute items and shall include in the Bid and be responsible for the cost of any changes to accommodate substitute equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay costs of CONSULTANT's services for review of substitutes and for revisions of drawings and/or specifications by CONSULTANT to accommodate substitutes.

2.02 DRIVE MECHANISM

- A. The drive mechanism shall come completely factory-assembled.
- B. Motors shall conform to all applicable requirements of NEMA, ANSI, IEEE, and NEC standards and shall be UL recognized.
- C. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.
 - 1. Physical Construction:
 - a. Copper leads and windings with ball or roller bearing in end brackets of steel or cast iron or aluminum brackets with steel bearing sleeves. Motor leads shall have the same insulation class as the windings.
 - b. Rotor bars shall be aluminum.
 - c. Motor shaft shall be high-strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. The maximum allowable no-load shaft runout shall be 0.002 inch.

- d. Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be prelubricated and field-regreasable. Openings for addition of grease shall have grease fittings provided.
2. Mounting: As recommended by manufacturer.
3. Enclosure: TEFC.
4. Efficiency: Premium efficiency as noted in schedule below.
5. Service Factor: 1.15.
6. Power Requirements: 60 Hz, three-phase, 230/460-volt, factory-wired for 460-volt connection, $\pm 10\%$ voltage variation.
7. Load type: Constant torque.
8. NEMA Design: B.
9. Insulation: Class F.
10. Nominal Operating Speed: Single speed. Refer to Motor Schedule below.
11. Nameplate: Stainless steel engraved attached to motor frame or enclosure with stainless steel rivets.
12. Conduit/Junction Box: Cast iron, diagonally split, fully rotatable, gasketed between cover and box, and between box and frame. Motor lead opening in the frame shall also be gasketed. A clamp-type terminal shall be provided inside each motor conduit box for grounding.
13. Accessories:
 - a. Oversized motor junction box.
 - b. Lifting eyes.
14. Motor Schedule: If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

Equipment	Horsepower (hp)	Nominal Speed (rpm)	Minimum Nominal Efficiency (%)	VFD
FCD-40-01	0.75	1,800	85.5	No
FCD-40-02	0.75	1,800	85.5	No

- D. The center assembly shall consist of the drive unit with main bearing, suitable lubrication fittings, support points for the drive unit with main bearing and attachment points for the rotating center cage. The drive unit shall consist of a primary speed reducer that is driven by the electric motor, a No. 80 self-lubricated roller chain, an intermediate gear set consisting of a worm and worm gear, and a low speed gear set consisting of a pinion and internal spur gear. The worm gear assembly shall be driven by a roller chain and sprockets enclosed in a fabricated stainless steel guard.
- E. The gear box shall have an AGMA Class II rating. Planetary gear input arrangements directly connected to the pinion will not be allowed.
- F. All components of the drive mechanism shall be designed in accordance with AGMA Standard 6034-B92 (February 1992) "Practice for Enclosed Cylindrical Worm Gear Speed Reducers and Gearmotors", and Standard 2001-C95 (January 1995) "Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth"; for 24-hour continuous, uniform load duty and 20-year design gear life at the specified output speed. The AGMA rated torque of the drive shall be the lowest value computed for worm gear set, spur gear and pinion for strength and durability. Select conservative values for bending strength and pitting resistance life factors Z_n and Y_n based on a minimum of

420,000 cycles of the main gear. The drive AGMA torque rating shall be as specified above with a minimum 1.25 service factor. All bearings shall be designed for a minimum B-10 life of 200,000 hours.

- G. At twice the run torque rating of the drive mechanism, the material stress shall not exceed the material yield strength.
- H. The minimum drive mechanism torque ratings for the clarifier mechanism shall be:
 - 1. Continuous Torque Rating: 33,000 ft.-lbs.
 - 2. Alarm Torque (AGMA): 70,000 ft.-lbs.
 - 3. Motor Shutoff: 84,000 ft.-lbs.
 - 4. Shear Pin Shutoff: 46,200 ft.-lbs.
 - 5. Peak Torque Rating: 148,000 ft.-lbs.
- I. The clarifier mechanism shall be designed to operate at a continuous speed of approximately 0.03 to 0.04 rpm to limit the collector tip speed to 8 to 10 ft/min.
- J. The main gear and worm assembly shall be enclosed in an ASTM A48 cast iron housing and provided with adequate seals to protect the interior of the housing. Fabricated steel housings are not considered equal. Housings shall be machined with precision tolerance bearing pilots (shoulder diameters) a minimum of 3/8 inch deep to register and restrain all bearings. This feature provides rigid alignment of mating gear components. Housings shall be designed so that gears and bearings are oil bath lubricated. For spur gear teeth that are not fully submerged in oil, the tooth mesh shall be designed to force lubricant to the upper portion of the tooth face. Housings shall be provided with a deep oil reservoir extending a minimum of 5 inches below the main/pinion gear and bearing. This is necessary for the accumulation of moisture/condensate away from bearings and gears. Housings shall also be fitted with oil level sight gauges, oil fill and valved drain connections, and valved condensate drain connections from the low points of the oil reservoir.
- K. The main gear housing shall be bolted to the top of the stationary influent column and shall be capable of transmitting the mechanical design strength. The rotating center cage to which the scum skimmer and supports are attached shall be bolted to the main gear.
- L. The main gear shall be AISI 4150 alloy steel or high strength ductile iron of ASTM A536 grade 80-55-06, designed per AGMA 2001-D04, and shall be supported by and rotated upon the main bearing. The spur gear shall be driven by an internal pinion. The pinion shall be machined from AISI Type 4150 alloy steel, designed per AGMA 2001-D04, quenched and tempered to 350 to 400 BHN hardness.
- M. The main gear bearing shall be a precision-type bearing with an internal forged stainless steel spur gear designed such that the gear, bearing balls, and raceways can be removed for service or replaced without removing the access bridge, gear housing, or disconnecting the drive cage and anything attached to the drive assembly. The precision bearing design shall be so that the B-10 life is a minimum of 1,000,000 hours. The precision main bearing shall have a 40-inch ball race diameter and 1.25 inch diameter balls. The bearing balls shall run completely submerged in an oil bath protected by dust seals. The bearing balls shall rotate in a full circle four-point contact raceway capable of large thrust and overturning moment loading.
- N. The complete drive shall be assembled in the clarifier manufacturer shop and tested to verify the drive is running properly and to calibrate the drive control. A complete test report

shall be sent to CONSULTANT verifying that the drive meets the quality assurance of manufacturer.

- O. The pinion shall be constructed of steel, heat-treated and precision cut to provide adequate tooth mesh for the values used in the calculations. The pinion must rotate in a lower taper roller bearing assembly and similar upper bearing encasement machined into the worm gear housing. The lower bearing pocket shall not be the collection point for condensation. Pinion shafts shall be one piece extending through the worm gear without intermediate couplings.
- P. The secondary reducer unit shall be constructed using ASTM A48 cast iron housing with a minimum pitch diameter worm gear of 21 inches. The worm shall be made of AISI 4140/42H heat-treated steel ground and polished, driving a centrifugally cast manganese bronze worm gear. A double-enveloping worm gear is also acceptable.
- Q. The drive unit shall be equipped with an electro-mechanical overtorque control device actuated by thrust from the worm shaft. The pointer shall provide a visual reading of the relative main gear output torque on a 0 to 100 percent graduated scale. The 100 percent reading shall be equal to 100 percent drive duty rating specified below. The electromechanical overtorque control shall include two microswitches each with a dry contact rated for 125 VAC at 15-amps. Microswitches shall be operator-adjustable to actuate at 0% to 140% clarifier torque rating. The control device shall activate an alarm switch for warning of impending overload, a motor cutout switch for overload protection and a back-up safety motor cutout switch for back up overload protection. In lieu of a back-up safety motor cutout switch, a slip clutch assembly will be acceptable upon review by CONSULTANT. The respective switches in the overload control device shall be factory calibrated and set to the following settings:
 - 1. Alarm; 40% of scale. (WSH-40-01 and WSH-40-02).
 - 2. Motor cutout; 85% of scale. (WSHH-40-01 and WSHH-40-02).
- R. The alarm and motor cut-out switches (2 total) in the control device shall be factory calibrated and set to the required torque.
- S. A shear pin device set for 140% of the continuous operating capacity shall be provided.
- T. All drive control components and microswitches shall be mounted in an aluminum NEMA 4X enclosure with a gasketed, sealed removable cover. The pointer shall be covered with a plexi-glass enclosure and shall be above the walkway surface for visibility from the walkway. Amperage sensing devices are not acceptable for overtorque protection due to their inability to react quickly enough to prevent damage to the drive. Overtorque devices with exposed linkage connections will not be accepted due to possible corrosion problems. Overtorque microswitches shall be wired intrinsically safe via Specification Section 26 09 00—Controls and Instrumentation System Supplier-provided intrinsic safety barriers. Coordinate electromechanical overtorque control device installation with Section 26 09 00—Controls and Instrumentation System Supplier.
- U. All drive units (primary, intermediate, and final) shall be provided with readily accessible oil level sight gauges, and oil and condensate drain pipes with petcock for monitoring and draining oil and condensate as recommended by the manufacturer. All oil drains shall be located so that an oil pan of sufficient size to contain the full volume of oil in the drive can be easily placed below the drain from the bridge deck for changing oil or draining condensate by use of the drain petcock.

2.03 ENERGY DISSIPATING INLET (EDI)

- A. The clarifier shall be equipped with an EDI constructed of minimum 3/16-inch steel plate located inside the flocculation feedwell.
- B. The dispersion well shall be designed to dissipate the energy of the incoming flow by way of multiple baffled ports equally spaced around the EDI. The ports shall impart a tangential flow into the flocculating feedwell.
- C. The dispersion well shall be a minimum 9-feet 0-inch diameter with minimum 3-foot side height and minimum 2-feet 6-inch submerged or wetted depth with outlet ports of number and size as recommended by clarifier equipment manufacturer. EDI outlet ports shall be equally spaced around the periphery and designed for a maximum inlet velocity of 1.5 feet per second.
- D. The EDI shall include a bottom plate fit to within 1 inch of the center column to prevent short-circuiting. The bottom plate shall also be provided with properly sized drain holes.

2.04 INFLUENT FLOCCULATION WELL

- A. Clarifiers shall be provided with influent flocculation wells. The influent flocculation well, fabricated of minimum 3/16-inch steel plate sections with bolted connections, and 1/4-inch structural steel trim angles at top and bottom for shape and rigidity, shall rotate with and be supported from the center drive cage, and shall not be supported from the center platform. The well shall be of adequate size and design to diffuse the flow into the tank at a uniform flow-through velocity.
 - 1. The well shall be minimum 22-feet 0-inch diameter with minimum 5-feet 0-inch side depth.
- B. Ports shall be cut in the influent flocculation well to permit escape of the entrapped scum. Scum discharge ports shall not have baffles or other features that obstruct surface skimmer blades or wipers or impede the release and removal of scum.

2.05 STRUCTURAL DESIGN CRITERIA

- A. Pier and center cage shall be designed for a minimum of 200% of AGMA continuous torque (alarm torque). Each arm shall be designed for a minimum of 100% of AGMA continuous torque (alarm torque).
- B. All welded connections shall be fully sealed welds.

2.06 CENTER PIER

- A. A 28-inch diameter cylindrical steel center pier shall support the drive, collector mechanism, access bridge, and center service platform. The top of the pier shall have a drive mechanism mounting plate which shall be set plumb with the centerline. The drive mechanism shall be positioned, shimmed, leveled, and grouted in place with a non-shrink grout. The center pier shall be fabricated of 1/4-inch-thick minimum, steel plate and shall be anchored to the concrete base of the clarifier tank with a minimum of eight 1-inch-diameter stainless steel anchor bolts. The center pier shall serve as an influent pipe and shall have a series of large ports at its upper end to direct the flow into the EDI and

influent flocculation feed well at a velocity not to exceed 2.2 fps through each influent port at maximum flow. Influent velocity shall be reduced by providing a total inlet port area a minimum of 135 percent of the center column cross sectional area. Bottom of ports shall be a minimum of 2 feet 0 inches above bottom of influent flocculation well and shall be designed with additional bracing as required by structural design criteria.

- B. Equipment manufacturer shall furnish a stainless steel template with integral grout shield to accurately locate the center pier anchor bolts and allow for grouting beneath the pier and manifold seal plate after final plumbing. The integral grout shield shall block the gap between the top of concrete structural slab and the inside diameter of the base of the center pier. The grout shield shall serve as a barrier to prevent non-shrink grout placed beneath the base of the center pier from entering or projecting into the center pier or the influent pipe. No portion of the template or grout shield shall project into the inside diameter of the pier or pipe. The grout shield described above may be provided separately by CONTRACTOR, but shall conform to the design parameters described above. Details of grout shield shall be submitted with shop drawings for review and shall be approved by clarifier equipment manufacturer prior to submittal to CONSULTANT.

2.07 HEADER

- A. The header of rectangular-shaped full tapered section shall uniformly vary in size from a maximum near the tank center to a minimum at the outer end to provide uniform sludge drawoff velocities throughout and shall be fabricated entirely of minimum 1/4-inch-thick, hot-dipped galvanized steel plate. The header shall be cleaned and fully passivated after fabrication. Sludge withdrawal by means of individual riser pipes or stepped manifold construction will not be acceptable.
- B. The longitudinal cross-sectional axis of the header shall be mounted at an angle of 45 degrees with the tank bottom to provide a peaked top. The leading edge of the header shall extend downward 2 inches to provide fluidizing vanes as an integral part of the header and to direct the sludge into the area of influence of the orifices. The distance between the bottom of orifice and the tank floor shall be minimized and shall not exceed 4 1/2 inches. Attached to this vane shall be a neoprene squeegee with a stainless steel backing plate and fastening hardware. The squeegee shall have slotted holes for 1-inch vertical adjustment. At the inner end of the header, a flange with rubber gasket seal shall be provided for bolting to the center outlet manifold. The header shall have a scraper fabricated of 1/4-inch, thick hot-dipped galvanized steel plate with a neoprene blade and stainless steel fastening hardware to clean the tank bottom between the manifold and header, and direct the sludge to the first orifice of the header.
- C. At regular intervals, not to exceed 30 inches, inlet orifices, varying in size from a minimum diameter near the tank center to a maximum at the outer end, shall be accurately located in the header. Minimum diameter of orifice shall be 2.0-inch diameter. The design of each orifice shall be proportionate to the volume of sludge withdrawn and the design of the orifices and header shall be such as to provide hydraulic balance in the tank and uniform sludge withdrawal from the entire tank bottom at all flows. The design shall consider the slope of the tank bottom and tendency for sludge to accumulate near the center of the tank.
- D. Header supports shall consist of Type 304 stainless steel tie-bars with stainless steel turnbuckles and lock nuts that shall hold the header in alignment in both horizontal and

vertical planes. A structural steel tie-bar arm shall be provided for the attachment of the stainless steel tie-bars to structural steel members.

2.08 CENTER CAGE AND MANIFOLD

- A. A fabricated steel center cage shall be bolted to the final reduction gear of the collector drive and shall rotate about the center pier and support the EDI (static flocculator), influent flocculation feed well, manifold, header, truss arm, and skimmer assembly. The center cage shall be of an all-welded construction with structural steel members having a minimum thickness of 1/4 inch. The center cage shall be a minimum of 4-feet 0-inch square.
 - 1. Option No. 1: The manifold shall transport return sludge from the header into the withdrawal pipe under the tank floor. The manifold shall be constructed of 1/4-inch minimum thickness, steel plate, and fitted with two sealing rings attached to the manifold with stainless steel hardware. The upper seal ring shall ride against the center pier. The bottom seal ring shall ride on a fabricated stainless steel bottom plate securely anchored to the concrete floor with stainless steel hardware and grouted in place after proper aligning. The equipment manufacturer shall furnish a template to accurately locate the anchor bolts.
 - 2. Option No. 2: The self-cleaning manifold shall transport return sludge from the header into the withdrawal pipe under the tank floor. The manifold shall be constructed of 1/4-inch minimum thickness, steel plate, and fitted with two sealing rings attached to the manifold with stainless steel hardware. The inner seal ring shall ride flat and horizontal against a UMHW wear strip affixed to the center pier. The bottom seal ring shall ride flat and horizontal on a UMHW wear strip elevated a minimum of 8 inches above the concrete floor with stainless steel hardware and grouted in place after proper aligning. The equipment manufacturer shall furnish a template to accurately locate the anchor bolts. A 10-year seal warranty shall be provided.
- B. Opposite the header, a truss arm shall be provided, supported from the center cage and manifold, and used for the surface skimmer support. The arms shall be of truss construction and shall be of all-welded steel construction with members having a minimum thickness of 1/4 inch. Truss shall be pinned at the base for vertical adjustment and connected to the center cage through strut and adjustable steel clevis assembly with stainless steel fastening hardware. Tie-rod and turnbuckle designs that do not provide lateral support will not be acceptable.

2.09 SURFACE SKIMMER, SCUM TROUGH AND ANTIROTATIONAL SCUM BAFFLE

- A. Provide one surface skimmer in each clarifier consisting of a deflector blade, hinged wiper assembly, submerged shelf, scum beach and trough assembly. All skimmer assembly components and hardware shall be constructed of hot-dipped galvanized steel. All springs, pivot points, and threaded fasteners shall be constructed of 304 stainless steel. The surface skimmer equipment shall consist of a deflector blade supported from structural "A"-frame supports mounted on top of the truss arm at 15-foot maximum spacing. A hinged wiper assembly shall be mounted on the outer end of the deflector blade. The hinged wiper assembly shall be so constructed as to form a pocket for trapping scum. The hinged arrangement shall provide continual contact and proper alignment between wiper blade, scum baffle and beach as the blade travels up the beach. The wiper blade shall have a wearing strip on its outer end that contacts the scum baffle and Neoprene strip on its lower and inner edge, which contacts the scum beach and trough. The wiper blade shall ride up the beach in such a manner that the arrangement of the wiper and beach concentrates the

scum trapped in the skimmer arm pocket to minimize the amount of flushing water required. Skimmers which rely on the scum baffle for support will not be acceptable.

- B. Support brackets and manual lockout mechanism shall be provided with a means for locking the skimmer's hinged wiper assembly up and out of the liquid. Lockout mechanism shall raise the hinged skimmer assembly above the water surface without removal.
- C. The scum trough, beach, and submerged shelf shall be fabricated from minimum 1/4-inch-thick hot-dipped galvanized steel plate, adequately supported from the tank wall. The scum trough and submerged shelf shall be sized and configured as recommended by the equipment manufacturer. The scum trough, beach, and submerged shelf shall be fully-fabricated as a one-piece, welded assembly. The scum trough shall be 6 feet wide with an overall length of 4 feet 0 inches along the scum baffle consisting of beach plate, inner radius baffle, hopper, and discharge pipe. The beach plate shall slope at a nominal incline of 1.75 inches per foot to a point 5 inches below the maximum water elevation. The submerged shelf shall continue from the beach plate on a horizontal run for an additional 4 feet along the scum baffle. An outer and inner radius baffle extending 9 inches below and 6 inches above maximum water level shall run continuously from the trough to the end of the submerged shelf. The outer scum baffle shall be provided with connections to the clarifier scum baffle plates at each end. The trough shall be 12 inches wide with a uniformly sloped bottom toward the trough drain outlet. A 6-inch-diameter, factory-welded, standard pipe flange shall be provided on the trough drain outlet for connection to the scum discharge piping. All supports and hardware shall be stainless steel.
- D. The scum trough shall incorporate an automatic scum flushing valve mounted to the trough. The mechanical flushing device shall be made of hot-dipped galvanized steel and shall be activated by the main tank skimmer arm. The flushing device shall pivot on a fabricated hinge that uses a 3/4-inch-diameter minimum stainless steel pin/bolt. The flushing device shall provide a counterweight action which, in conjunction with a replaceable neoprene seal, shall provide a positive valve closure and watertight seal. The flushing device shall be held open to allow 0 to 20 gallons of flushing water per trip. Flushing volume shall be adjustable.
- E. The scum trough shall include integral rider straps as required to provide a smooth transition of the hinged scum wiper assembly as it travels from the top of the scum trough back to its normal skimming position at the water surface. The scum trough, skimmer, and wiper assembly shall be configured and designed for smooth operation at all points throughout the skimmer travel and shall be free of splashing, vibration, or turbulence.
- F. The influent flocculation feed well shall be provided with a scum skimmer and anti-rotational baffle arranged to evacuate scum from inside the flocculation well to the outside of the well through the scum discharge port(s). The rotating skimmer blade shall be supported at a center cage corner and extend, at an angle of approximately 45 degrees or as recommended by manufacturer, from the EDI to the scum port in the feed well wall. The scum blade shall be a minimum 3-inch by 5-inch hot-dipped galvanized steel angle and shall be designed to form a wedge with the anti-rotational baffle to force the scum out of the scum ports in the flocculation well wall.
- G. A stationary anti-rotational scum baffle shall be provided designed to trap scum by forming a wedge with the rotating skimmer blade, forcing the scum outward to the scum trough entrance. The anti-rotational baffle shall consist of structural steel support members and a baffle skirt made of 3/16-inch-thick Neoprene Duro 60 two-ply reinforced belting extending

a minimum of 4 inches below the water level. The belting shall be attached to the steel supports with stainless steel fasteners and a 1/4-inch-thick stainless steel backing bar. The anti-rotational baffle shall run from the outermost edge of the center cage and EDI to the scum port at the inside wall of the flocculation well to force scum out of the center flocculation well scum port, and shall extend from the outer edge of the flocculation well to the entry point of the scum trough submerged shelf. The structural steel support system of the anti-rotational baffle shall be supported by the center platform and bridge.

2.10 BRIDGE

- A. An all-welded structural steel access bridge consisting of two wide flange beams shall extend from the tank wall to the center service platform. The bridge shall be supported on the tank wall on its access end and on the spur gear housing at the center of the tank. The bridge shall consist of a minimum 3-foot-wide walkway with aluminum grating. The bridge shall be designed to support, in addition to the dead load, a live load of 150 pounds per square foot with a deflection not exceeding 1/360 of the span.
- B. Center platform with aluminum grating shall be sized and configured to allow access for maintenance on clarifier components as required. Minimum platform size shall be 5 feet square.
- C. Along sides of the center platform and bridge walkway, a railing system consisting of not less than 1 1/2-inch Schedule 40 aluminum double-rail pipes and Schedule 80 posts shall be constructed according to the typical details shown on the drawings. A 3/16-inch-thick by 4-inch-high toe plate shall be bolted to the railing posts on both sides of the bridge walkway and all sides of the center service platform.
- D. Continuous neoprene spacers or dielectric tape shall be provided between all aluminum grating and structural steel bearing surfaces. Aluminum railing (including toe boards) as specified in Division 05 and grating as specified in Division 05, complete with stainless steel fasteners and continuous neoprene spacers or dielectric tape, shall be furnished by CONTRACTOR, but shall be detailed by the equipment supplier.

2.11 WEIR, TROUGHS, BAFFLES, AND MISCELLANEOUS

- A. Effluent weirs, troughs, and scum baffles complete with anchors and brackets, shall be furnished by CONTRACTOR as specified in Division 05. Details of the weirs, baffles, and covers to show locations and elevations required by the equipment, including scum beach and trough connection, shall be provided by the clarifier manufacturer to CONTRACTOR as specified in Division 05. The weirs and baffles shall be as shown on the Drawings. CONTRACTOR shall coordinate between clarifier equipment, weir, and baffle manufacturers.
- B. All parts of the mechanism shall be amply proportioned for all stresses that may occur during fabrication, erection, and intermittent or continuous operation. Workmanship shall be of high grade in all respects.
- C. Any condition of unbalance in the sludge collector arms created by supporting the surface skimmer mechanism or other appurtenances shall be compensated for by the addition of counterweights to the lighter member. The steel plate counterweights shall be provided by the equipment manufacturer and shall not exceed 50 pounds each.

- D. FRP density current baffles shall be installed around the tank wall as shown on the contract drawings. Construction of the baffles shall consist of 4 feet square $\frac{1}{4}$ inch plate FRP panels attached to Hot Dipped Galvanized steel supports or FRP supports with the use of 304 stainless steel self tapping Tek screws. The panels shall be located as shown on the drawings and shall slope at 45 degrees towards the tank center. The top of the panels shall not be sealed against the tank wall to prevent build up of floating solids and gas accumulation. All fiberglass components shall be of isophthalic resin with UV inhibitors.

2.12 FINISHES

- A. It is the intent of this specification that all equipment, supports and appurtenances shall be furnished factory shop-primed, clean, and ready to accept finish painting by CONTRACTOR, with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09. Unless otherwise specified, structural elements and mechanical equipment items shall be furnished with all surfaces (except galvanized, rubber, plastic, or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be factory shop-primed. Factory shop-prime with one coat of Tnemec N69 or N140, or Sherwin Williams Duraplate 235, or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Color of primer shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. All gear boxes, motors and controls shall be painted in accordance with Division 09, except polished shafts which shall be heavily coated with grease. Chains shall be coated with slush oil.
- B. Galvanizing:
1. All items, except piping designated to be galvanized, shall be hot-dipped galvanized in accordance with ASTM Specification A123 and A153. Piping shall be hot-dipped galvanized in accordance with ASTM A53. Furnish a Certificate of Compliance stating that the galvanizing complies with ASTM Specifications and Standards and all other applicable requirements specified herein.
 2. Fabrication of items to be galvanized shall be in accordance with ASTM A143, A384, and A385. Structural steel shall be fabricated generally in accordance with Class 1 guidelines as shown in Recommended Details for Galvanized Structures as published by the American Hot Dip Galvanizer's Association, Inc.
 3. Galvanized items shall be handled, transported, and stored to prevent damage or staining to the coating. Maintain adequate ventilation and continuous drainage.
 4. Silicon content for steel to be hot-dipped galvanized shall be in the range of 0 to 0.04%.
 5. Steel work shall be precleaned utilizing a caustic bath, acid pickle and flux, or shall be blast cleaned and fluxed. In either case, all surface contaminants and coatings shall be removed.
 6. All welding shall be performed in accordance with the American Welding Society publication D19.0-72, Welding Zinc Coated Steel. All uncoated weld areas shall be touched up.

2.13 ANCHOR BOLTS AND FASTENERS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be Type 316 stainless steel and shall be of ample size and strength for the intended service. Provide

anchor bolts in accordance with Division 05. All anchor bolts shall be set by CONTRACTOR in accordance with the manufacturer's instructions.

- B. All fastening bolts, nuts, washers, and fastening hardware shall be Type 316 stainless steel.

2.14 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. CONTRACTOR shall provide spare parts to OWNER for all equipment components with an expected life of 1 year or less.

PART 3-EXECUTION

3.01 GENERAL

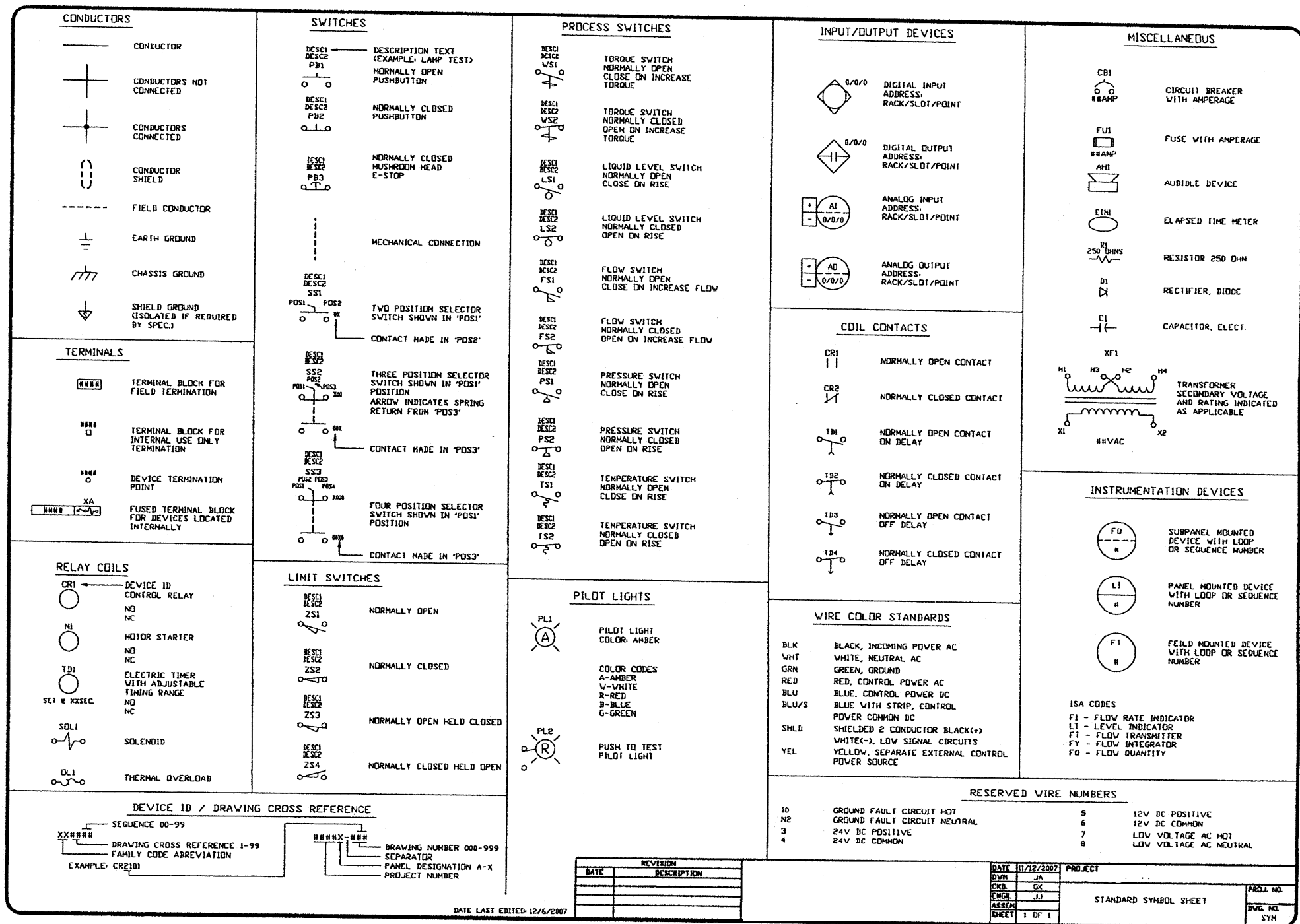
- A. Refer to requirements specified in Division 01 for equipment installation, testing, quality control, supervision, start-up, and operator training. Comply with additional requirements as specified below.
- B. A minimum of two trips and three days on site shall be provided for checkout, testing, start-up, and training services.

3.02 FIELD TESTING

- A. The clarifier collector mechanisms shall be field tested after erection and in the presence of CONSULTANT to confirm and verify the structural and mechanical compliance to the torque requirements specified by loading each collector mechanism with 100% and 120% of rated AGMA continuous torque specified (alarm torque). Also, this field test shall substantiate operation of warning and drive shutdown circuitry.
- B. Complete test procedures shall be submitted to CONSULTANT for review prior to testing; however, testing shall be accomplished with the machine in operation. Loads shall be applied to the mechanisms' structural arms through cables or be applied by means of a hydraulic cylinder. Gauges shall be used to assess the torque.
- C. The manufacturer's service representative shall verify that the alarm, motor cut-out, and back up safety motor cut-out switches are properly set and are in proper operation to protect the clarifier mechanism as specified.
- D. All labor, materials, and test apparatus necessary for conducting the above tests shall be furnished by this CONTRACTOR and included in the Lump Sum Bid.
- E. No static tests shall be acceptable; tests shall be conducted with the drive running.

END OF SECTION

SAMPLE DRAWINGS

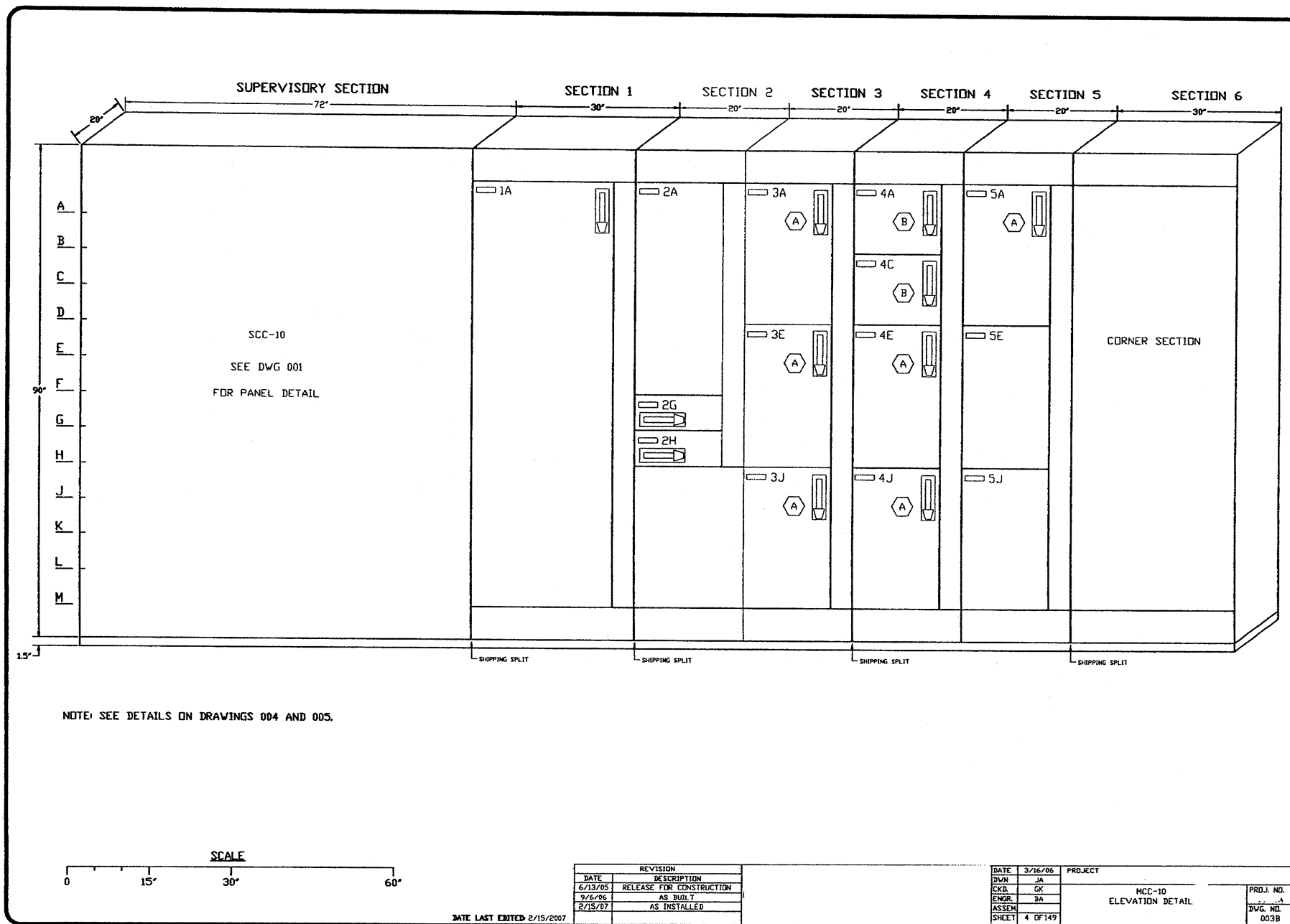


Sample Symbol sheet

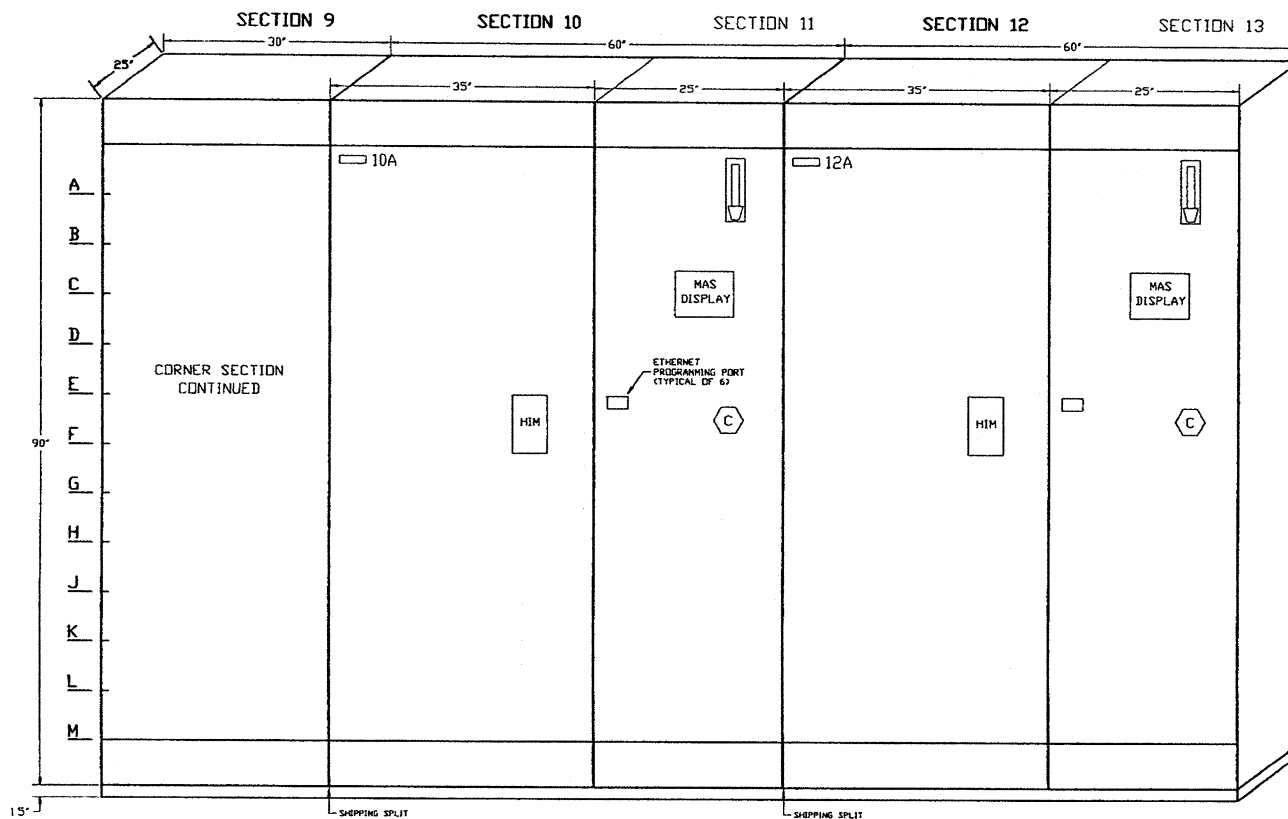
Standard Abbreviations

<u>Abbreviation</u>	<u>Description</u>	<u>Abbreviation</u>	<u>Description</u>
A	Air Compressed	OV	Overvoltage
AC	Air Condition	PB	Pushbutton
AD	Auto Dialer	PC	Pull Cord
AH	Alarm Horn	PC	Personal Computer
AL	Alarm Light	PFC	Power Factor Capacitor
AM	Amp Meter/Ammeter	PL	Pilot Light
ANN	Annunciator	PLC	Programmable Logic Controller
AR	Alternating Relay	PM	Power or Phase Monitor
AWG	American Wire Gauge	PN	Pneumatic
BA	Battery	PR	Pressure Regulator
BLU	Blue	PS	Pressure Switch
BRN	Brown	PS	Power Supply
CA	Cable	PSH	Pressure Switch High
CB	Circuit Breaker	PSL	Pressure Switch Low
CR	Control Relay	REC	Receptacle
CT	Current Transformer	SP	Surge Protector
DB	Distribution Block	SS	Selector Switch
DI	Diode	STP	Shielded Twisted Pair
DS	Disconnect Switch	SV	Solenoid Valve
EC	Electronic Control Device	TD	Time Delay Relay
ETM	Elapsed Time Meter	TG	Toggle Switch
EN	Enclosure	TS	Temperature Switch
FO	Fiber Optic	TSP	Twisted Shielded Pair
FS	Flow Switch	TT	Temperature Transmitter
FU	Fuse	UPS	Uninterruptible Power Supply
GFI	Ground Fault Interrupter	UTP	Unshielded Twisted Pair
GND	Ground	VA	Voltampere
GRN	Green	VFD	Variable
HTR	Heater	VM	Voltmeter
LA	Lightning Arrestor	WHT	White
LP	Lighting Panel	WS	Weight Switch
LR	Latching Relay	WT	Weight Transmitter
LS	Level Switch	XFMR	Transformer
MS	Motor Starter Contactor	SI	Signal Isolator
M	Motor	SS	Speed Switch
NP	Nameplate	ZS	Position Switch
OIT	Operator Interface Terminal		
OL or O/L	Overload		
ORG	Orange		

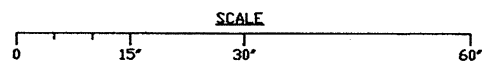
Sample List of
Abbreviations



Sample Exterior
Layout Drawing



NOTE: SEE DETAILS ON DRAWINGS 004 AND 005.
SECTIONS 10 THROUGH 13 ARE MOUNTED BACK-TO-BACK
WITH SECTIONS 14 THROUGH 17.



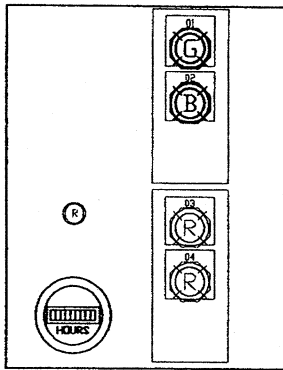
DATE LAST EDITED 2/15/2007

REVISION	
DATE	DESCRIPTION
6/13/05	RELEASE FOR CONSTRUCTION
9/6/06	AS BUILT
2/15/07	AS INSTALLED

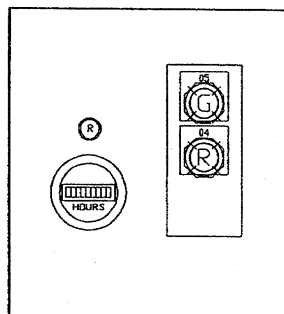
DATE	3/16/06	PROJECT	
DWN	JA		
CKD	GK	MCC-10	PROJ. NO.
ENGR	BA	ELEVATION DETAIL	
ASSEN			DWG. NO.
SHEET	6 OF 149		003D

Sample Exterior
Layout Drawing

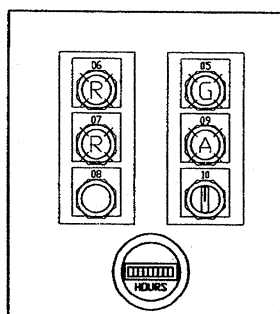
A DETAIL



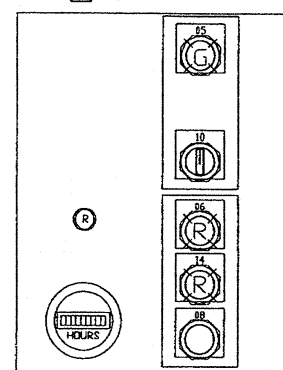
B DETAIL



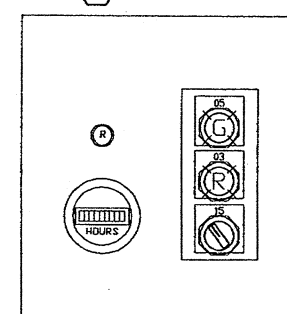
C DETAIL



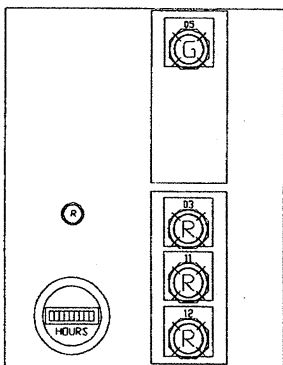
G DETAIL



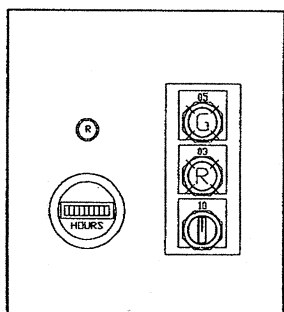
H DETAIL



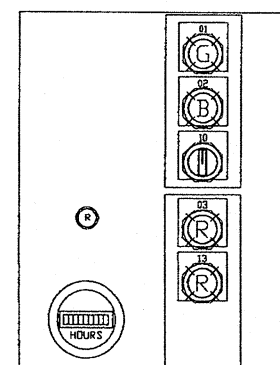
D DETAIL



E DETAIL

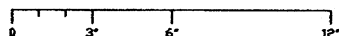


F DETAIL



LEGEND PLATE SCHEDULE					
TAG	DESC1	DESC2	DESC3	SIZE	REMARKS
01	FORWARD			1-13/16" SQ	
02	REVERSE			1-13/16" SQ	
03	OVERLOAD			1-13/16" SQ	
04	OVERCURRENT			1-13/16" SQ	
05	RUN			1-13/16" SQ	
06	VFD FAULT			1-13/16" SQ	
07	MOTOR/BEARING	HIGH TEMP		1-13/16" SQ	
08	RESET			1-13/16" SQ	
09	JBOX/MOTOR	MOISTURE		1-13/16" SQ	
10	HAND AUTO	OFF		1-13/16" SQ	
11	ZERO SPEED	ALARM		1-13/16" SQ	
12	ESTOP	ACTIVATED		1-13/16" SQ	
13	INSPECTION	DOOR OPEN		1-13/16" SQ	
14	MOTOR	DIVERTEMP		1-13/16" SQ	
15	OFF	ON		1-13/16" SQ	

SCALE



DATE LAST EDITED 2/15/2007

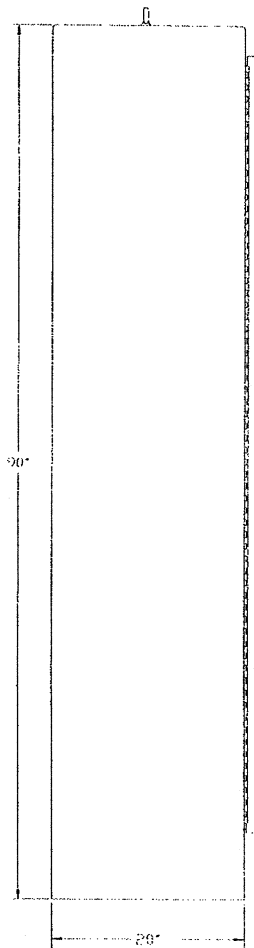
REVISION	
DATE	DESCRIPTION
6/13/05	RELEASE FOR CONSTRUCTION
9/6/06	AS BUILT
2/15/07	AS INSTALLED

DATE	3/16/06	PROJECT
DWN	JA	
CKD	OK	
ENGR	BA	
ASSEM		
SHEET	11 OF 149	

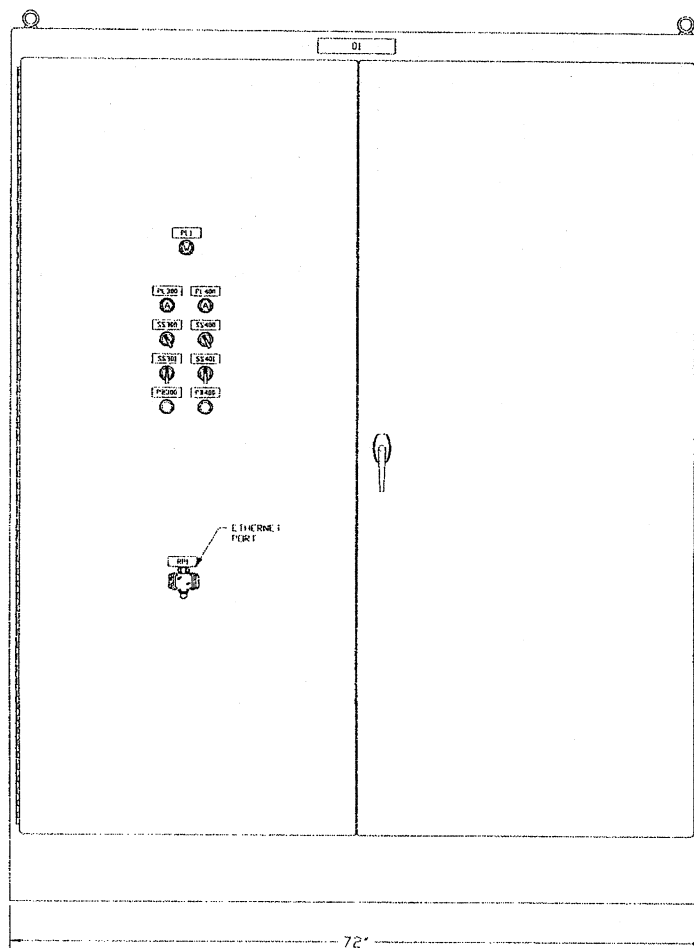
MCC-10
BUCKET DETAILS

PROJ. NO.
DWG. NO.
004

Sample Exterior
Layout Drawing



SIDE VIEW



FRONT VIEW



DATE LAST EDITED: 2/15/2007

REVISION	
DATE	DESCRIPTION
6/13/05	RELEASE FOR CONSTRUCTION
9/6/06	AS BUILT
2/15/07	AS INSTALLED

NAMEPLATE SCHEDULE					
TAG	DESC1	DESC2	DESC3	SIZE	REMARKS
01	SCC-10			15x8	
PB300	RESET			1X3	
PB400	RESET			1X3	
PL1	POWER ON UPS			1X3	
PL300	INFLUENT	WET WELL NO1	BACKUP FLOATS ACTIVE	1X3	
PL400	INFLUENT	WET WELL NO2	BACKUP FLOATS ACTIVE	1X3	
SS300	BACKUP FLOATS	DN - AUTO		1X3	
SS301	LEAD PUMP	03 - AUTO - 05		1X3	
SS400	BACKUP FLOATS	DN - AUTO		1X3	
SS401	LEAD PUMP	04 - AUTO - 06		1X3	
RPI	ETHERNET	PROGRAMMING PORT		1X3	

NAMEPLATES ARE BLACK WITH WHITE LETTERS

NOTES

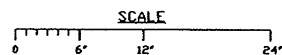
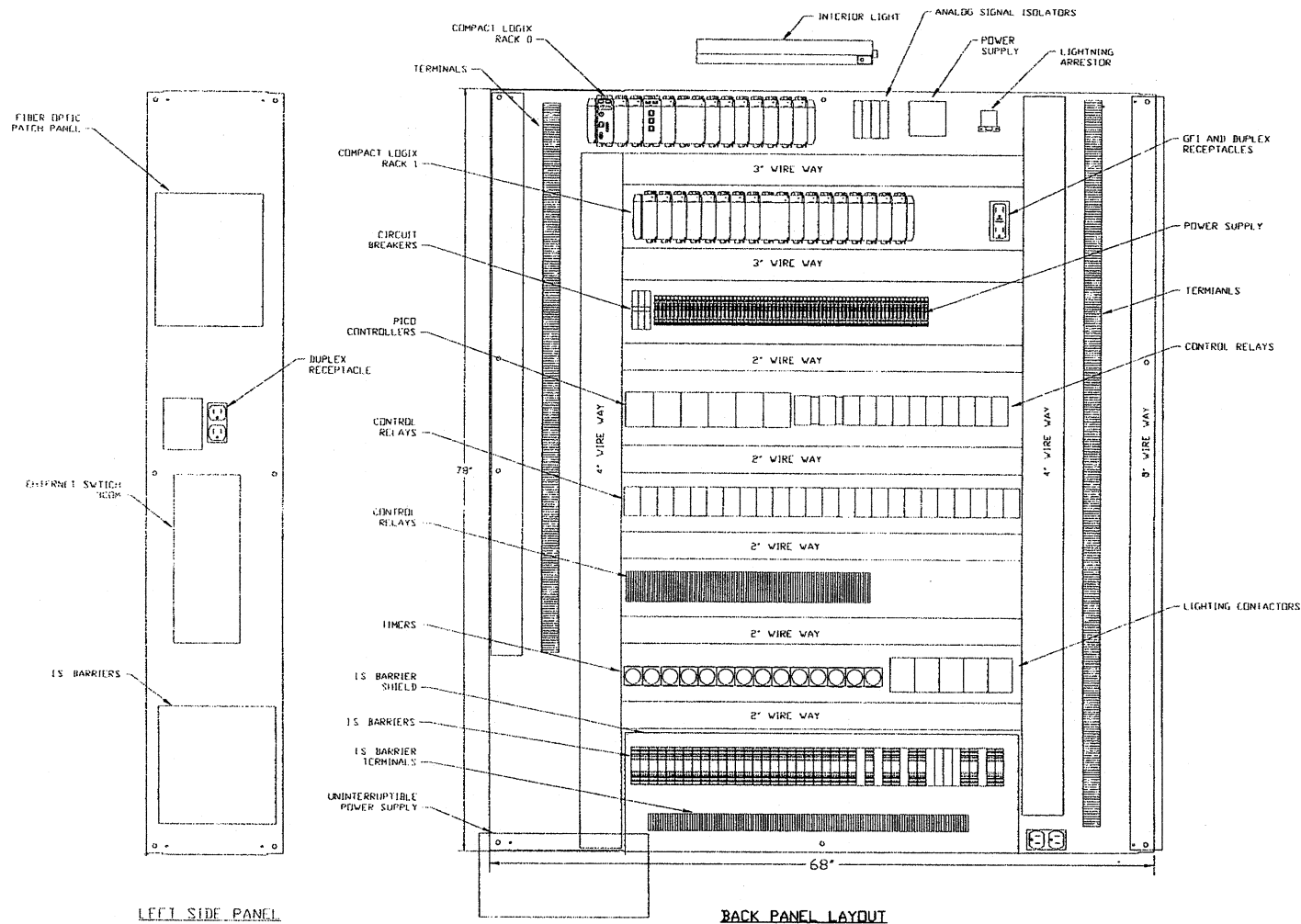
- ENCLOSURE IS A NEMA TYPE 12 FREESTANDING HOFFMAN A-9072201 SD WITH INNER PANEL HOFFMAN A-90P72T1
- FINISH IS ANSI 61 GRAY
- UL # BF-3171536

DATE	3/16/06	PROJECT
DWN	JA	
CKD	CK	
ENGR	BA	
ASSEM		
SHEET	1 OF 149	

SCC-10
ENCLOSURE DETAIL

PROJ. NO.
DWG. NO.
001

Sample Exterior Layout Drawing

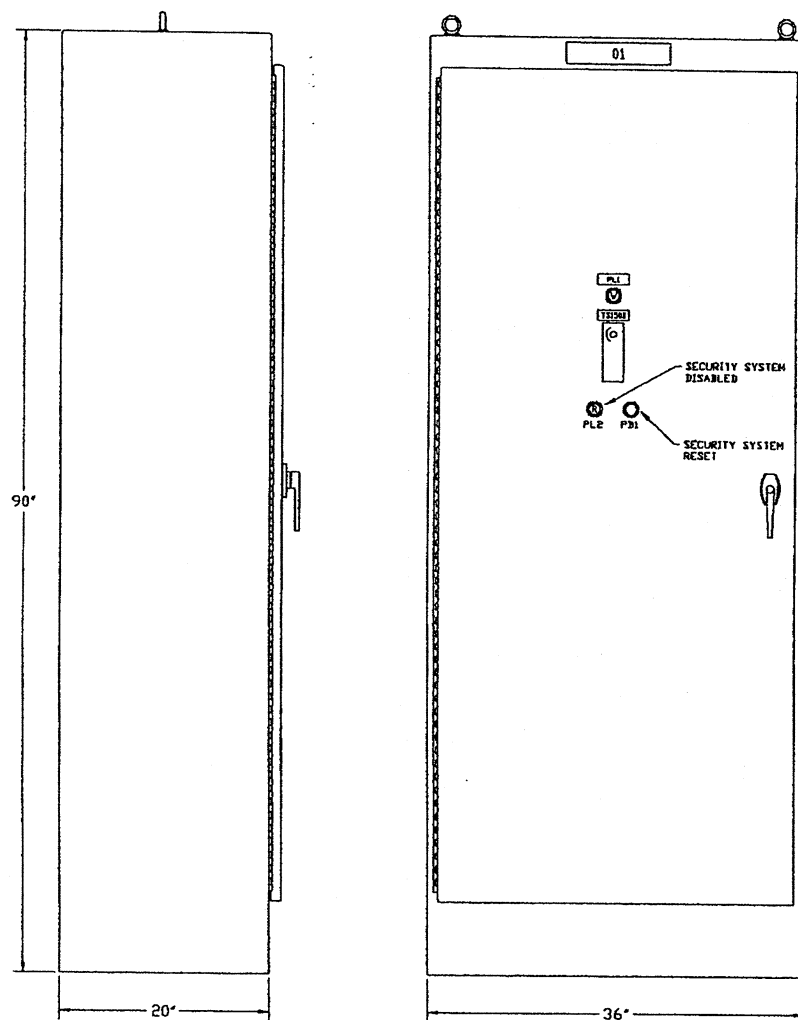


DATE LAST EDITED 2/15/2007

REVISION	
DATE	DESCRIPTION
6/13/85	RELEASE FOR CONSTRUCTION
7/6/86	AS BUILT
2/15/87	AS INSTALLED

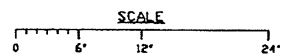
DATE	3/16/86	PROJECT
DWN	JA	SCC-10 BACK PANEL LAYOUT
EXD	GK	
ENGR	BA	
ASSEM		
SHEET	2 OF 149	PRJ. NO.
		DWG. NO.
		002

Sample Interior Layout Drawing



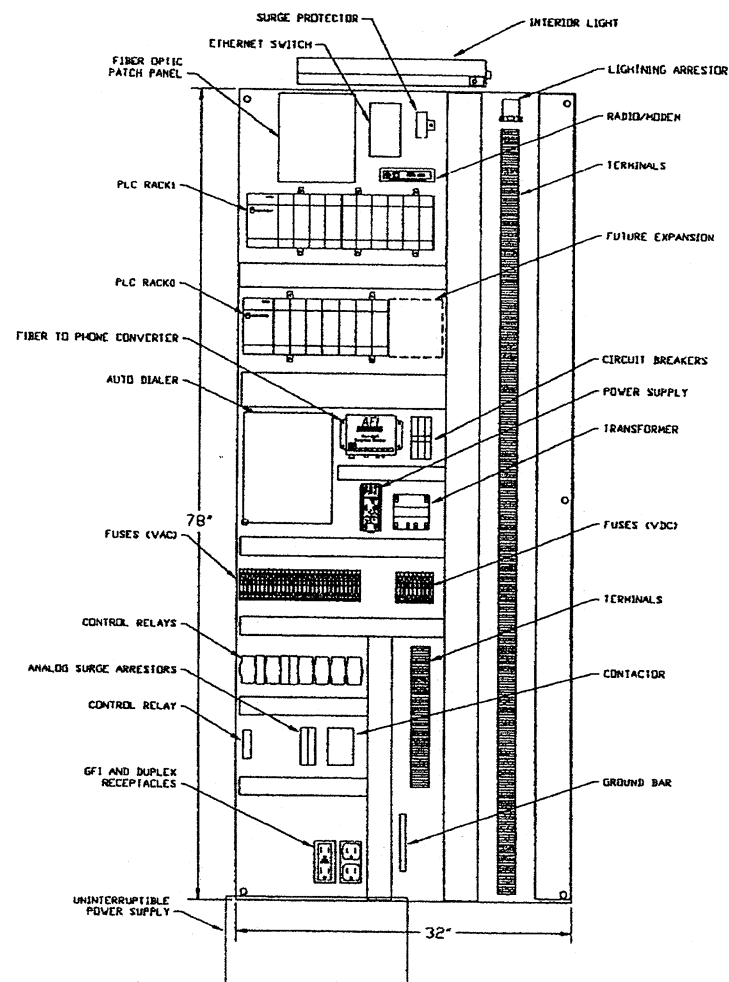
NOTES:

- ENCLOSURE IS A NEMA TYPE 12 FREESTANDING HOFFMAN A903620FS, WITH INNER PANEL HOFFMAN A90P36FL.
- FINISH IS ANSI 61 GRAY.
- UL 508A



SUBMITTAL USE ONLY
NOT FOR
CONSTRUCTION
DATE LAST EDITED: 12/6/2007

REVISION	
DATE	DESCRIPTION



PANEL LAYOUT

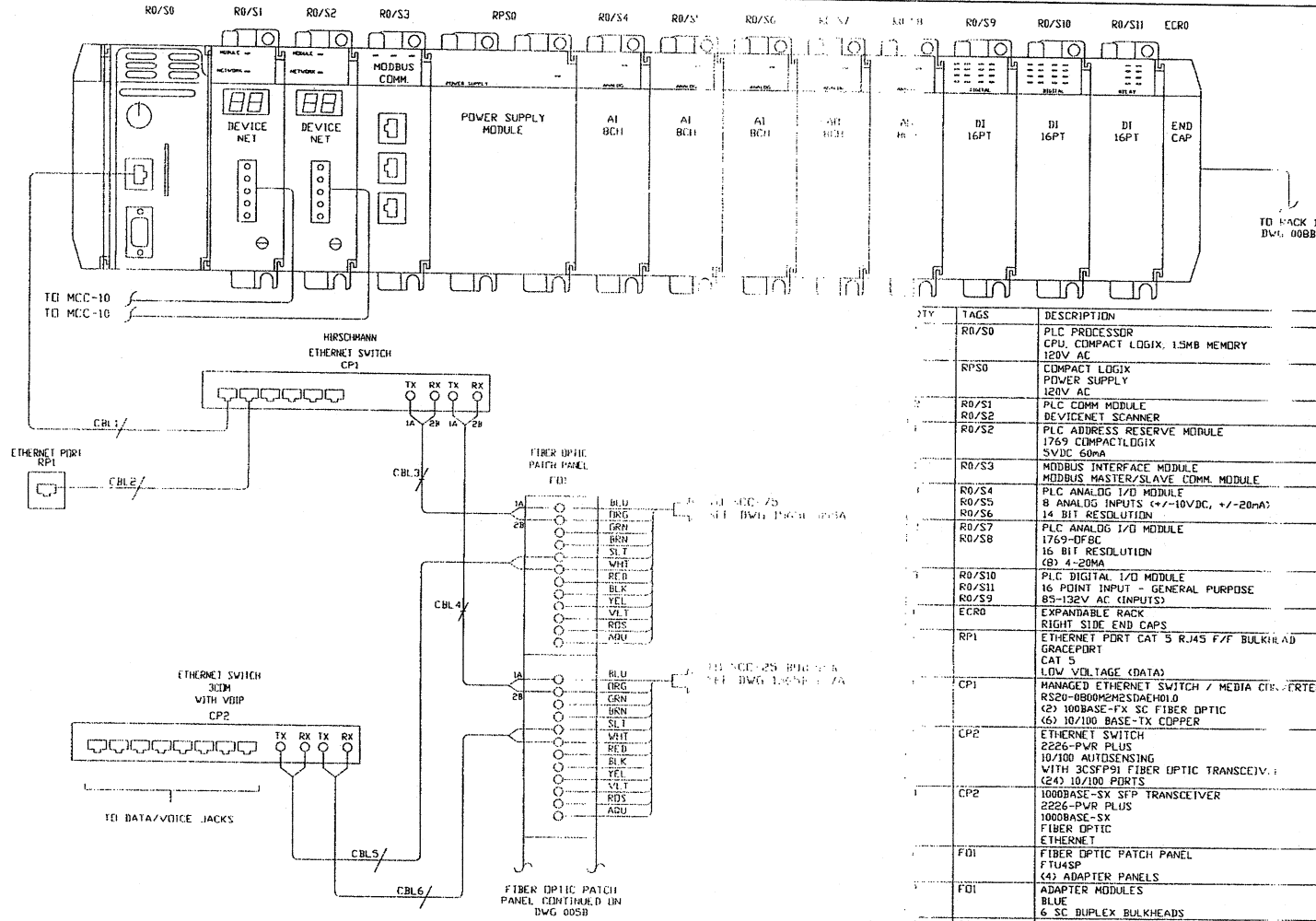
NAMEPLATE SCHEDULE					
TAG	LINE 1	LINE 2	LINE 3	SIZE	REMARKS
01	SCC-MAIN			2x10	
PL1	POWER ON UPS			1x3	
TS1580	LOW BUILDING TEMPERATURE			1x3	

NAMEPLATES ARE BLACK WITH WHITE LETTERS

DATE		PROJECT	
11/12/2007	JA	SCC-MAIN	PRJL NO.
DWN	GK	ENCLOSURE DETAIL	DWG. NO.
ENGR	JJ		001
ASSEM			
SHEET	1 OF 34		

Sample Exterior and Interior Layout
Drawing

COMPACT LOGIX I/O SCHEDULE



QTY	TAGS	DESCRIPTION	MFG	CATALOG
1	R0/S0	PLC PROCESSOR CPU, COMPACT LOGIX, 15MB MEMORY 120V AC	ALLEN BRADLEY	1769-L35E
1	RPS0	COMPACT LOGIX POWER SUPPLY 120V AC	ALLEN BRADLEY	1769-PA4
1	R0/S1	PLC COMM MODULE DEVICENET SCANNER	ALLEN BRADLEY	1769-SDN
1	R0/S2	PLC ADDRESS RESERVE MODULE 1769 COMPACTLOGIX 5VDC 60MA	ALLEN BRADLEY	1769-ARM
1	R0/S3	MODBUS INTERFACE MODULE MODBUS MASTER/SLAVE COMM. MODULE	PROSOFT	MV169-MCM
1	R0/S4	PLC ANALOG I/O MODULE 8 ANALOG INPUTS (+/-10VDC, +/-20mA)	ALLEN BRADLEY	1769-IFB
1	R0/S5	PLC ANALOG I/O MODULE 1769-OFBC 16 BIT RESOLUTION (2) 4-20MA	ALLEN BRADLEY	1769-OFBC
1	R0/S6	PLC ANALOG I/O MODULE 16 BIT RESOLUTION (2) 4-20MA	ALLEN BRADLEY	1769-IFB
1	R0/S7	PLC ANALOG I/O MODULE 16 BIT RESOLUTION (2) 4-20MA	ALLEN BRADLEY	1769-IFB
1	R0/S8	PLC ANALOG I/O MODULE 16 BIT RESOLUTION (2) 4-20MA	ALLEN BRADLEY	1769-IFB
1	R0/S9	PLC DIGITAL I/O MODULE 16 POINT INPUT - GENERAL PURPOSE 85-120V AC (INPUTS)	ALLEN BRADLEY	1769-IA16
1	R0/S10	PLC DIGITAL I/O MODULE 16 POINT INPUT - GENERAL PURPOSE 85-120V AC (INPUTS)	ALLEN BRADLEY	1769-IA16
1	R0/S11	EXPANDABLE RACK RIGHT SIDE END CAPS	ALLEN BRADLEY	1769-CRRI
1	ECR0	ETHERNET PORT CAT 5 RJ45 F/F BULKHEAD GRACEPORT CAT 5 10/100 VOLTAGE (DATA)	GRACE ENG PRODUCTS	P-R2-B3
1	RP1	ETHERNET PORT CAT 5 RJ45 F/F BULKHEAD GRACEPORT CAT 5 10/100 VOLTAGE (DATA)	GRACE ENG PRODUCTS	P-R2-B3
1	CP1	MANAGED ETHERNET SWITCH / MEDIA CONVERTER RS20-0800M2MSDAEH010 (2) 100BASE-TX SC FIBER OPTIC (4) 10/100 BASE-TX COPPER	HIRSCHMANN	943 434-003
1	CP2	ETHERNET SWITCH 2226-PWR PLUS 10/100 AUTOSENSING WITH 3CSFP91 FIBER OPTIC TRANSCEIVER (2) 10/100 PORTS	3COM	3C16490-US
1	CP2	1000BASE-SX SFP TRANSCEIVER 2226-PWR PLUS 1000BASE-SX FIBER OPTIC ETHERNET	3COM	3CSFP91
1	F01	FIBER OPTIC PATCH PANEL FTU4SP (4) ADAPTER PANELS	HUBBELL	FTU4SP
1	F01	ADAPTER MODULES BLUE 6 SC DUPLEX BULKHEADS	HUBBELL	FSPSCN6
1	CBL1	UTP PATCH CABLE PCXSEB03 CAT 5E RJ45	HUBBELL	PCXSEB03
1	CBL3	FIBER OPTIC PATCH CABLE 1 METER (1 PAIR) (2) FIBERS SC-MM 62.5	HUBBELL	DFPCSCSC1MM
1	CBL4	FIBER OPTIC PATCH CABLE 1 METER (1 PAIR) (2) FIBERS SC-MM 62.5	HUBBELL	DFPCSCSC1MM
1	CBL5	FIBER OPTIC PATCH CABLE 2 METER (1 PAIR) (2) FIBERS SC-LC MM 62.5	HUBBELL	DFPCLSCC2MM
1	CBL6	FIBER OPTIC PATCH CABLE 2 METER (1 PAIR) (2) FIBERS SC-LC MM 62.5	HUBBELL	DFPCLSCC2MM

DATE	REVISION
11/16/2007	RELEASE FOR DISTRIBUTION
11/16/2007	REVISION 1
11/16/2007	REVISION 2

DATE LAST EDITED 11/16/2007

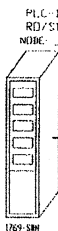
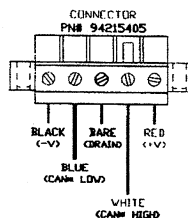
DATE	BY	PROJECT
11/16/2007	DVN	SCC-10
11/16/2007	CKD	PLC I/O SCHEDULE
11/16/2007	ENGR	PRJ NO.
11/16/2007	ASSEM	DWG NO.
11/16/2007	SHEET	008A

Sample Interconnection Diagram

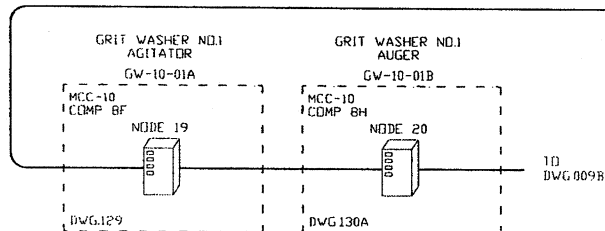
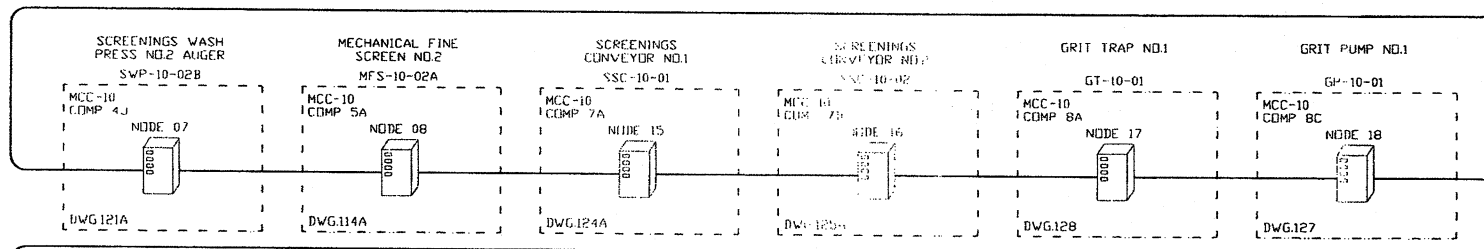
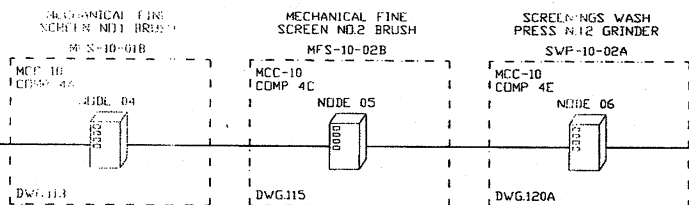
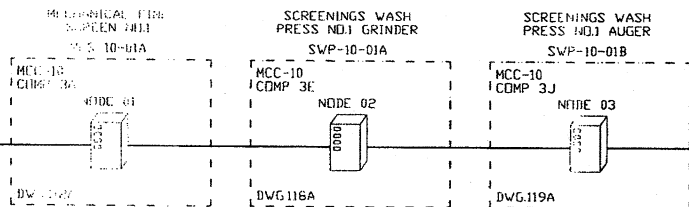
DEVICENET CONNECTOR DETAIL

NOTES:

1. CAN+ = CONTROLLER AREA NETWORK



SEE DEVICENET
CONNECTION DETAIL



* 120 OHM TERMINATING
RESISTOR REQUIRED

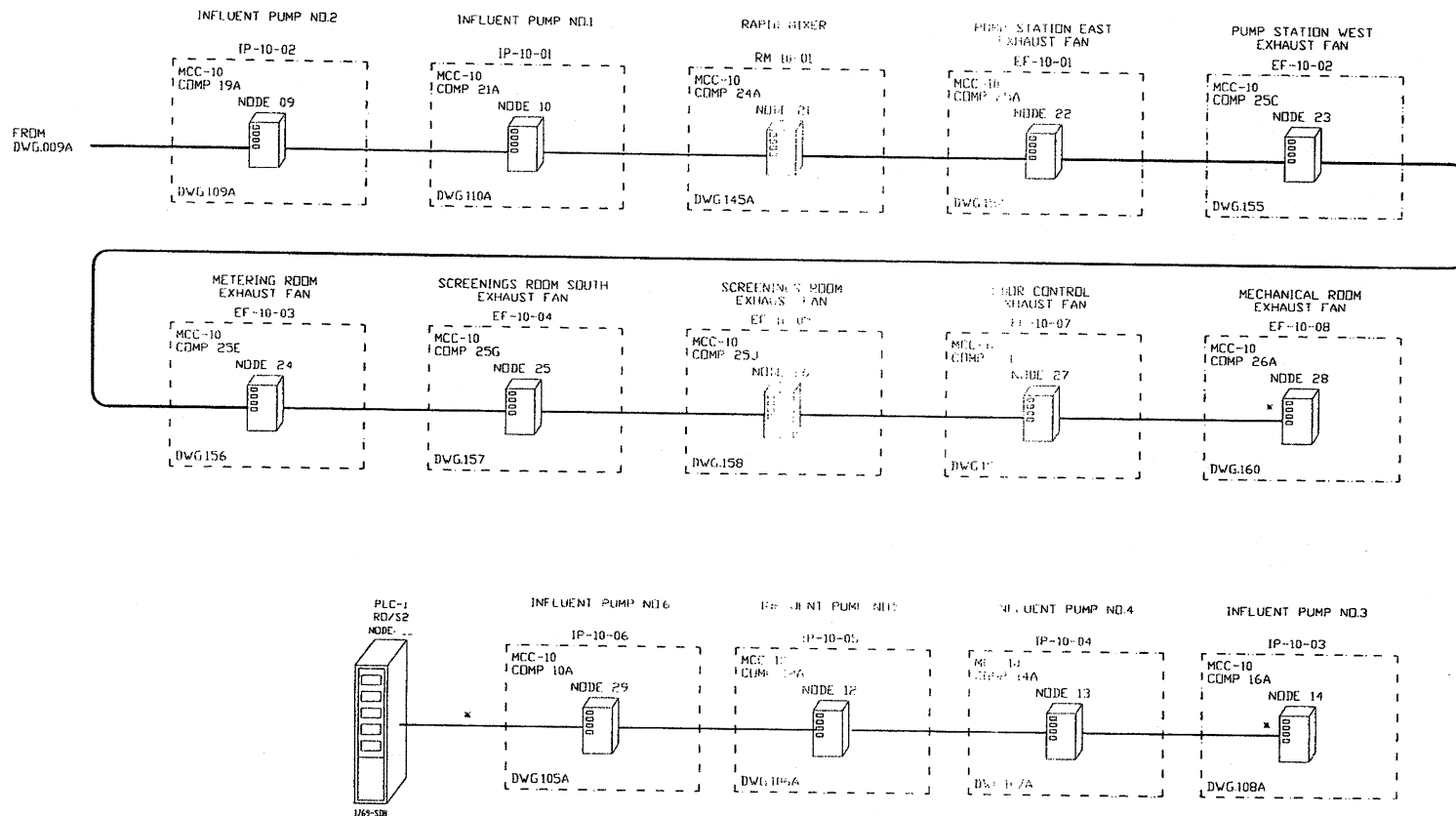
DATE LAST EDITED 7/16/2008

REVISION	
DATE	DESCRIPTION
7/17/08	RELEASE FOR CONSTRUCTION
7/22/08	AS BUILT
8/15/07	AS INSTALLED

DATE	3/16/06	PROJECT
DWN	JA	
CRD	OK	
ENGR	BA	
ASSEM		
SHEET	19 OF 149	

MCC-10 DEVICENET NODE ADDRESSING	PRD.J NO. DWG. NO. 009A

Sample Network Diagram



■ 120 OHM TERMINATING RESISTOR REQUIRED

DATE LAST EDITED 7/16/2008

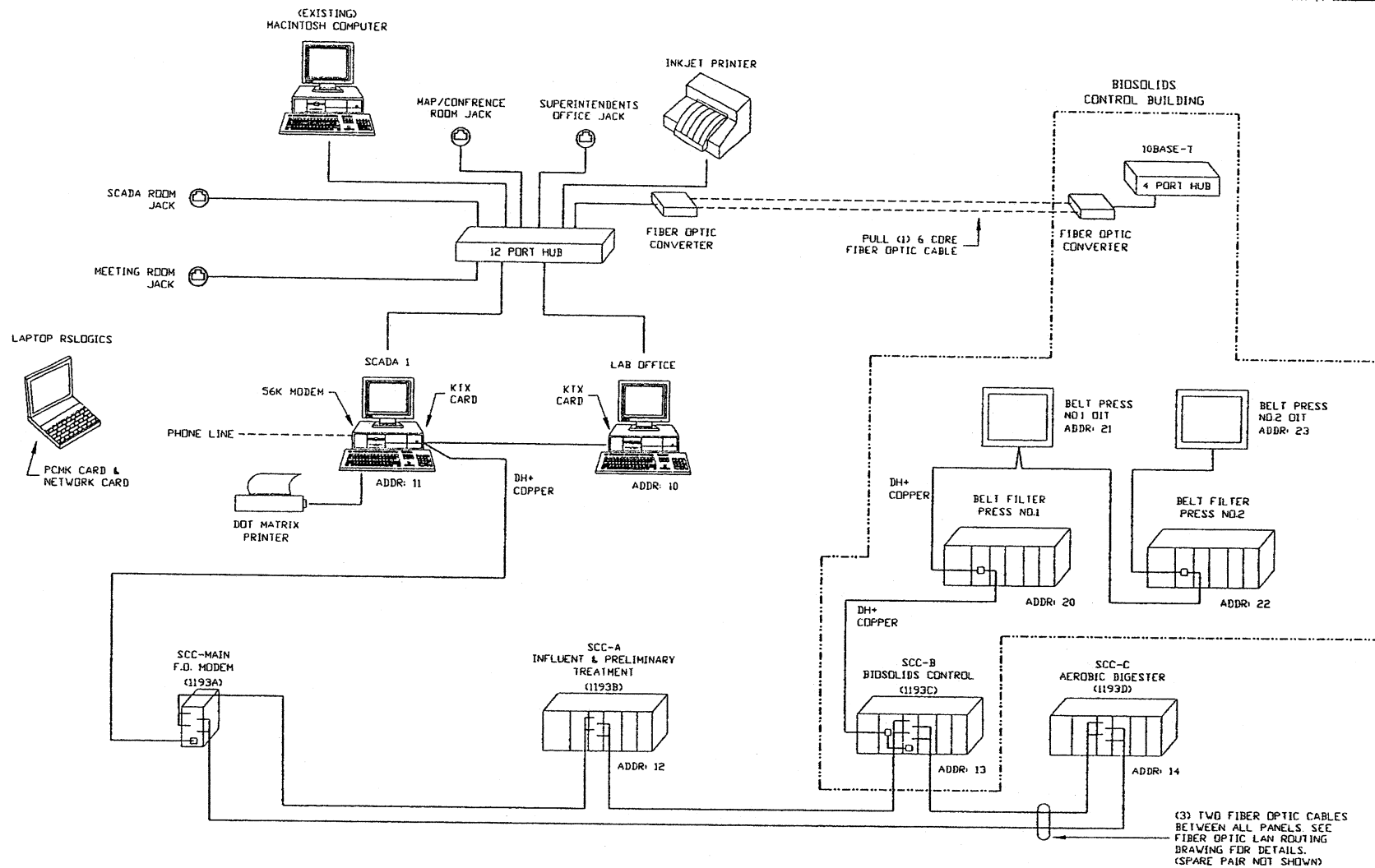
REVISION	
DATE	DESCRIPTION
02/28/03	RELEASE FOR CONSTRUCTION
03/10/03	AS NOTED
07/17/07	AS INSTALLED

DATE	3/16/06	PROJECT
DWN	JA	
CKD	JK	
ENGR	JA	
ASSEN		
SHEET	20 OF 149	

MCC-10
DEVICENET
NODE ADDRESSING

PROJ. NO.
DWG. NO.
009B

Sample Network Diagram



DATE LAST EDITED 02/09/01

REVISION	
DATE	DESCRIPTION

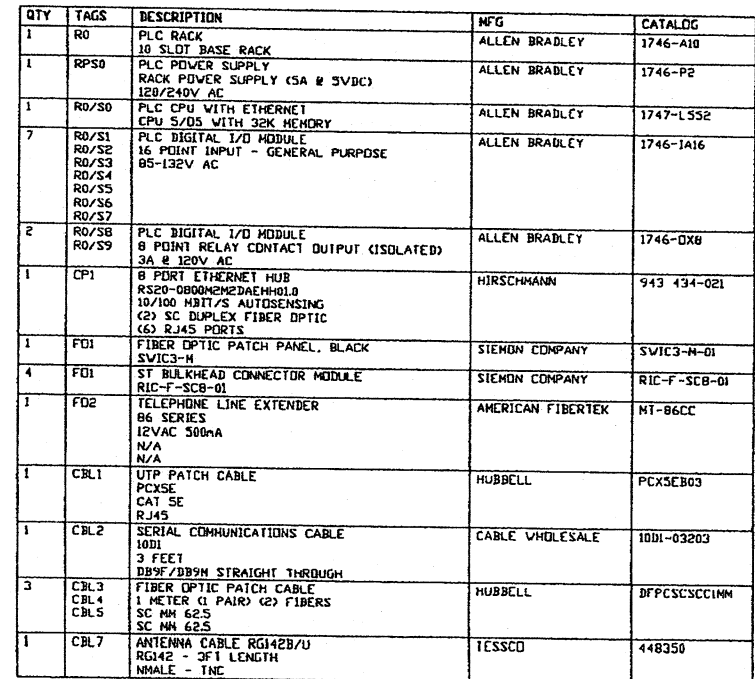
DATE	3/12/01	PROJECT
BY	JA	
CHKD	GR	
ENGR	PS	
ASSEM		
SHEET	OF	

SCADA SYSTEM LAYOUT

PROJ. NO.
DWG. NO.
001

Sample Network Diagram

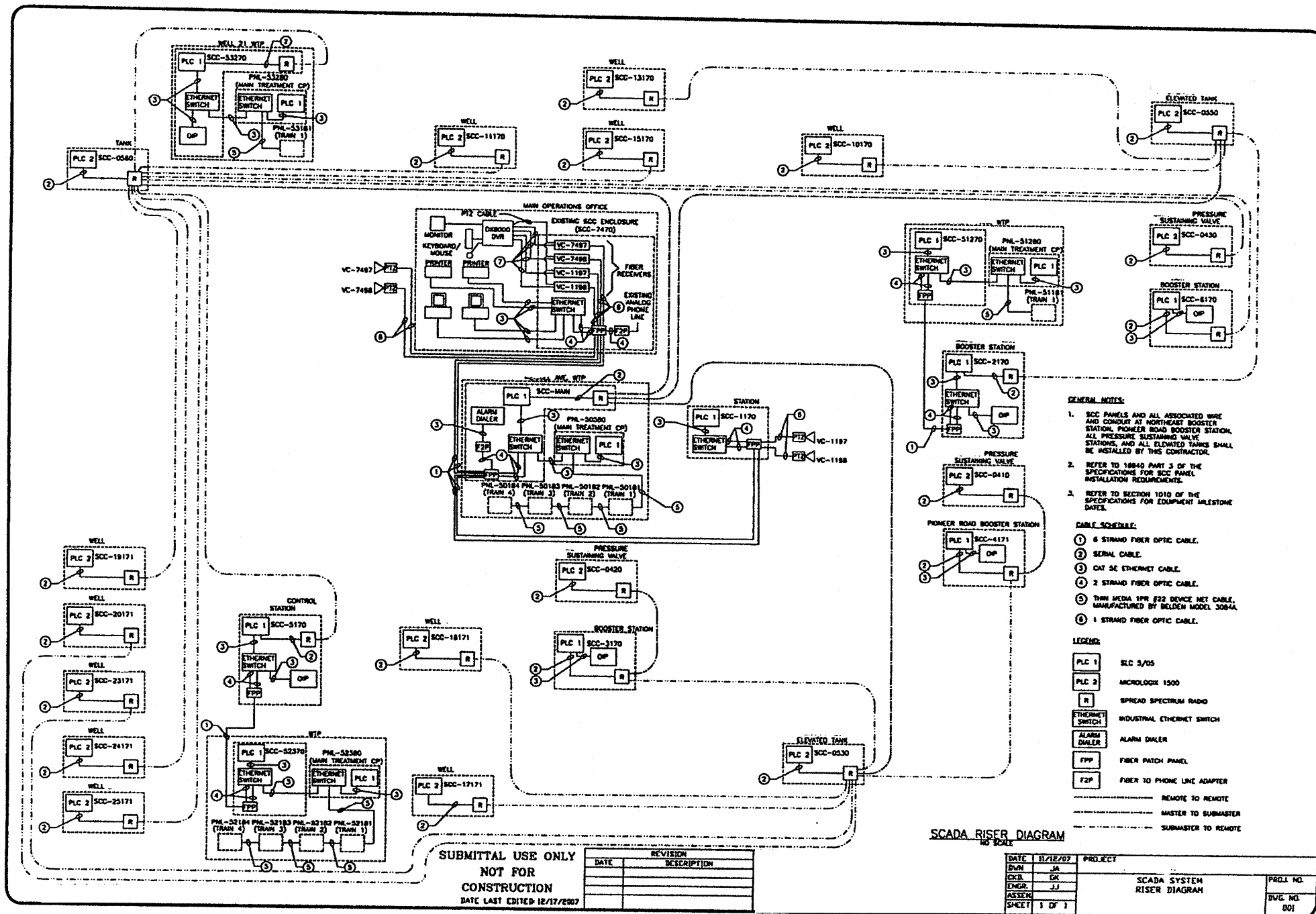
R0/S0	R0/S1	R0/S2	R0/S3	R0/S4	R0/S5	R0/S6	R0/S7	R0/S8	R0/S9



REVISION	
DATE	DESCRIPTION

DATE	01/12/2007	PROJECT	
DWN	JA		
CMB	GK		
ENGR	JJ	SCC-MAIN	PROJ. NO.
ASSEM		PLC I/O SCHEDULE	DWG. NO.
SHEET	3 OF 34		003A

Sample Interconnection Diagram

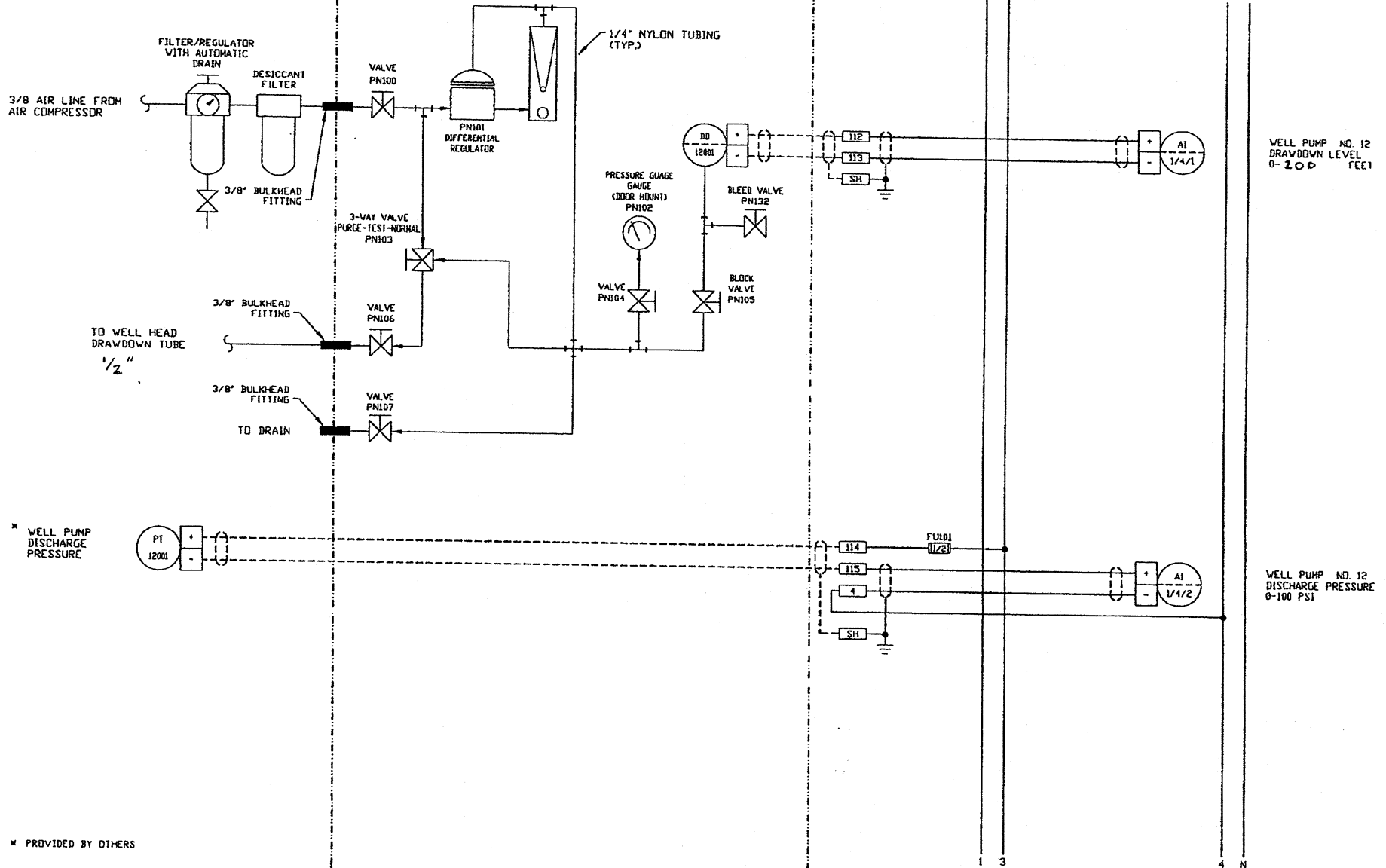


Sample Interconnection Diagram

FIELD OR AS NOTED

DRAWDOWN TRANSDUCER PANEL (1674A1-002)

SCC-MAIN



SUBMITTAL USE ONLY
NOT FOR
CONSTRUCTION
DATE LAST EDITED: 12/10/2007

REVISION	
DATE	DESCRIPTION

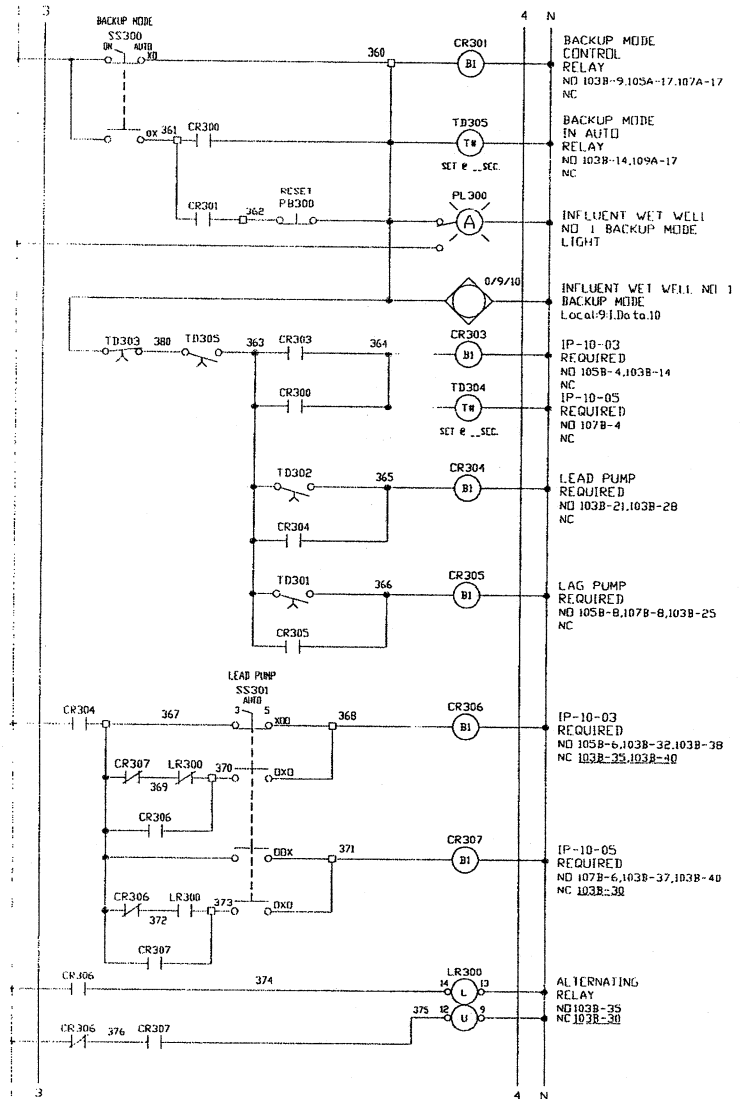
DATE	11/12/2007	PROJECT
BY	JA	
CHK	GR	
ENGR	JJ	
ASST		
SHEET	9 OF 24	

SCC-MAIN WELL PUMP NO. 12	PROJ. NO. DWG. NO. 101B

Sample Elementary schematic

FIELD OR AS NOTED

SCC-10



REVISION	
DATE	DESCRIPTION
7/13/05	RELEASE FOR CONSTRUCTION
7/6/06	AS BUILT
7/1/07	AS INSTALLED

DATE LAST EDITED 2/15/2007

DATE	3/16/06	PROJECT	PROJ. NO.
DWN	JA	SCC-10	
ENGR.	JK	INFLUENT WET WELL NO 1	DWG. NO.
ASST.			103B
SHEET	7-9		

Sample Elementary
Schematic

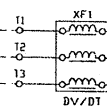
FIELD OR AS NOTED

MCC-10 COMP. 16A/17A

SCC-10

DEVICENET
NODE 14

480V 3PH 60Hz BUS

INFLUENT
PUMP NO 3
IP-10-03
480VAC
260FLA

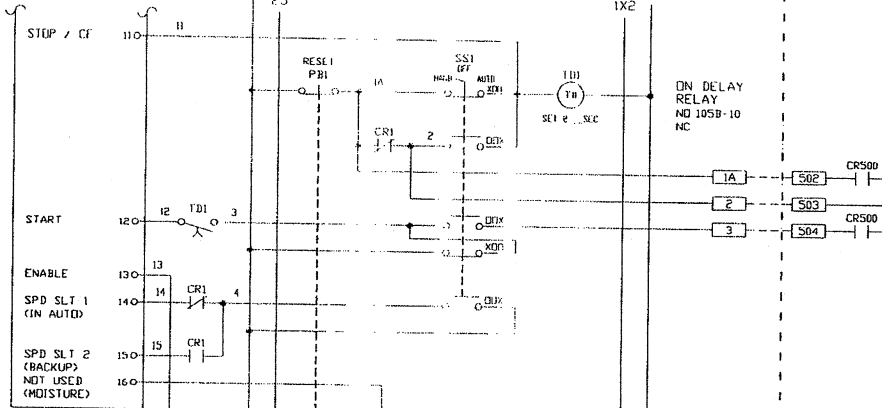
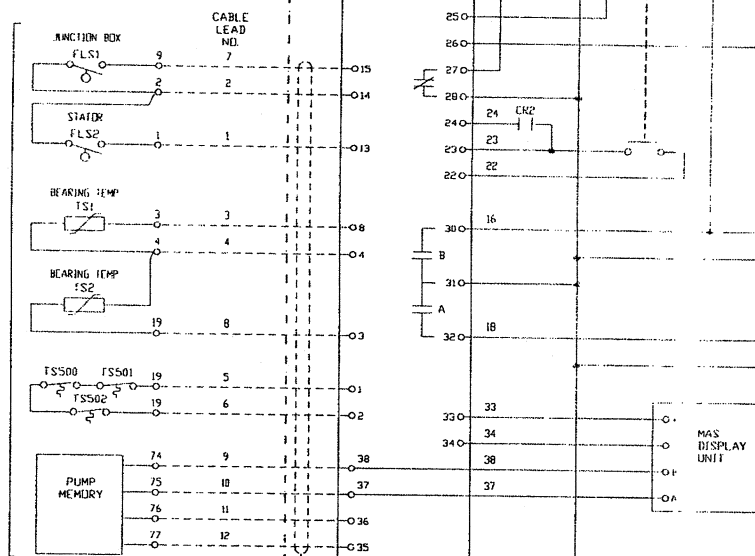
DV/D1

VFD1
ALLEN BRADLEY
POWERFLEX 700H110M
RUCOR
MOUNTED

FIELD OR AS NOTED

MCC-10 (10M) 15A/17A

SCC-10

CONTINUED
FROM PREVIOUS PAGE* FLYGT HAS
INIMOTOR/J-BOX
MOISTUREMOTOR/BEARING
TEMPERATURE

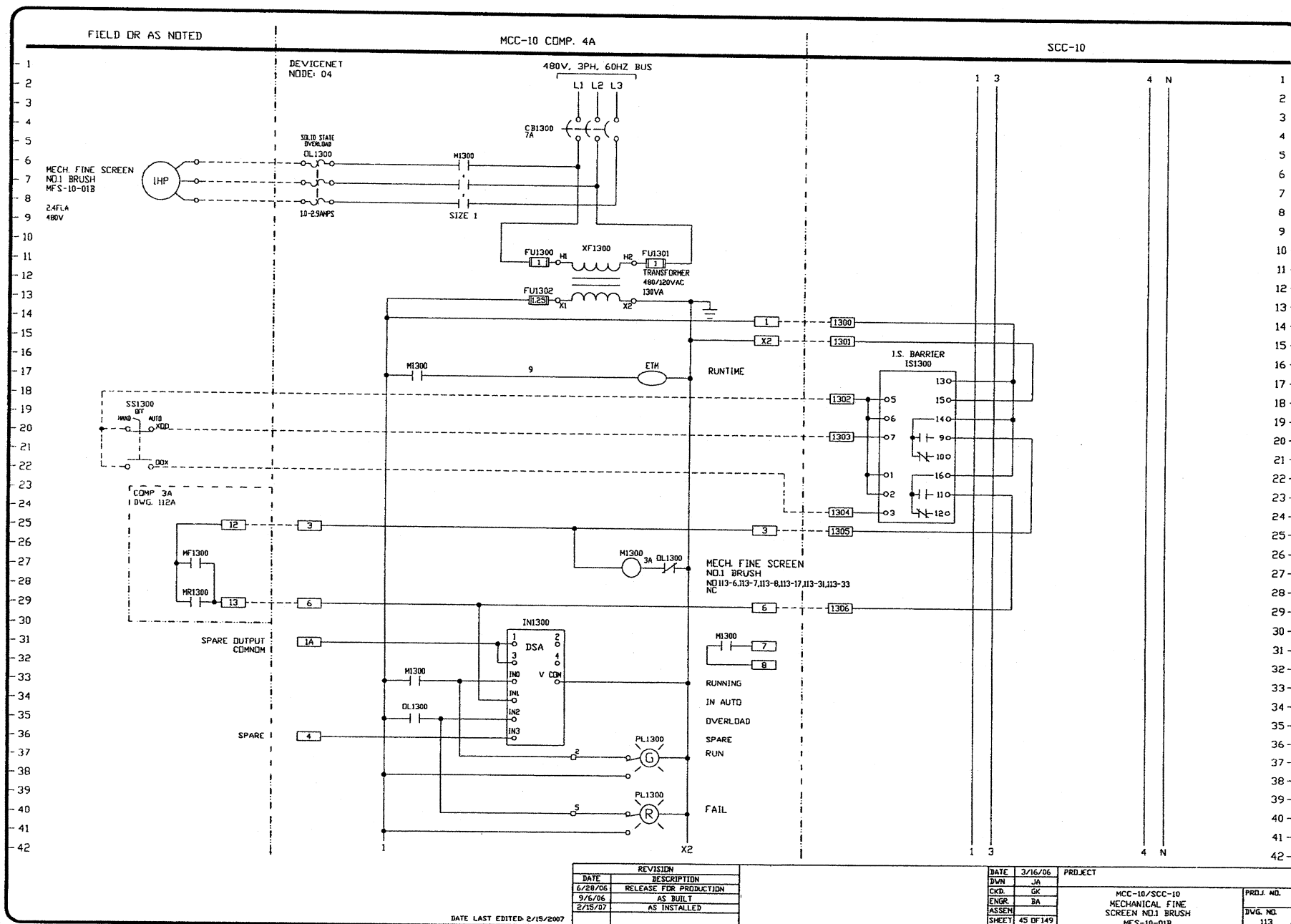
* PROVIDED BY OTHERS

DATE	REVISION
1/26/06	RELEASE FOR PRODUCTION
1/26/06	AS BUILT
1/15/07	AS INSTALLED

DATE LAST EDITED: 2/15/2007

DATE	3/16/06	PROJECT
DWN	JA	
CHK	GK	
ENGR	BA	
ASSEM		
SHEET	30 OF 149	

MCC-10/SCC-10
INFLUENT PUMP NO.1
IP-10-01PMT NO.
DVG NO.
105BSample Elementary
Schematic

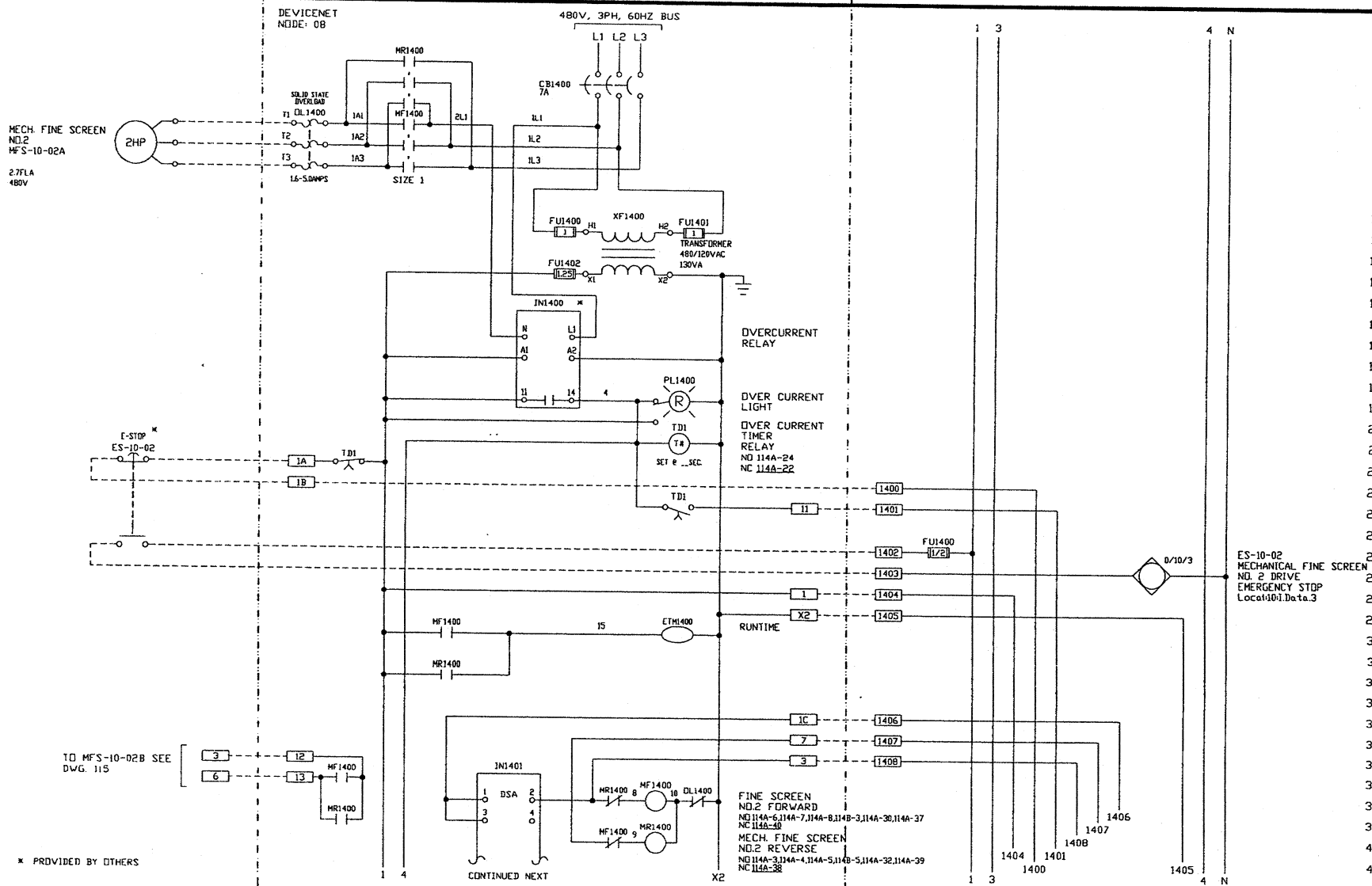


Sample Elementary
Schematic

FIELD OR AS NOTED

MCC-10 COMP. 5A

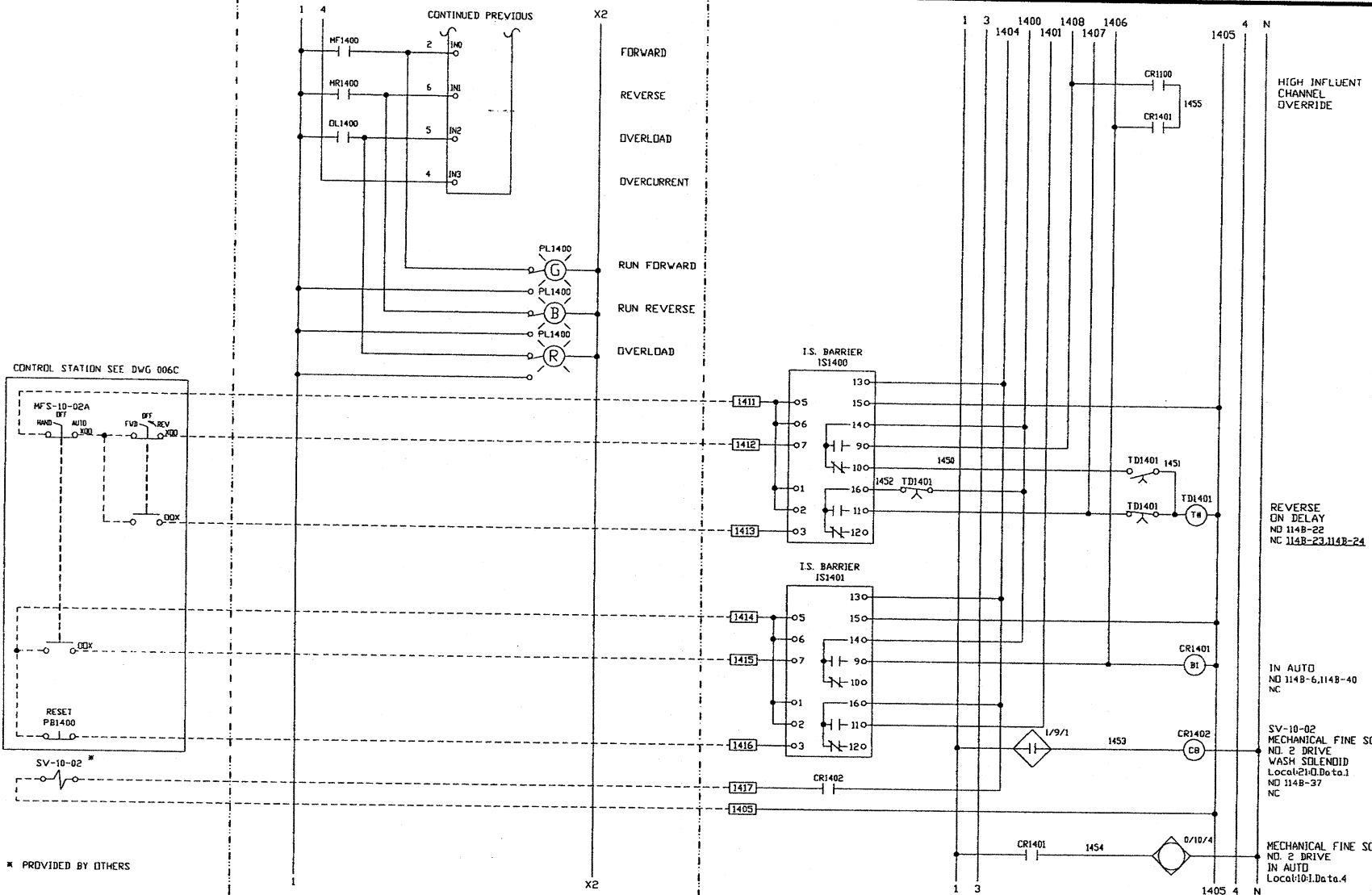
SCC-10



FIELD OR AS NOTED

MCC-10 COMP. 5A

SCC-10



DATE LAST EDITED: 2/15/2007

REVISION	
DATE	DESCRIPTION
6/28/06	RELEASE FOR PRODUCTION
9/6/06	AS BUILT
2/15/07	AS INSTALLED

DATE	3/16/06	PROJECT
DVN	JA	
CHK	GR	
ENGR	BA	
ASSEM		
SHEET	47 OF 149	

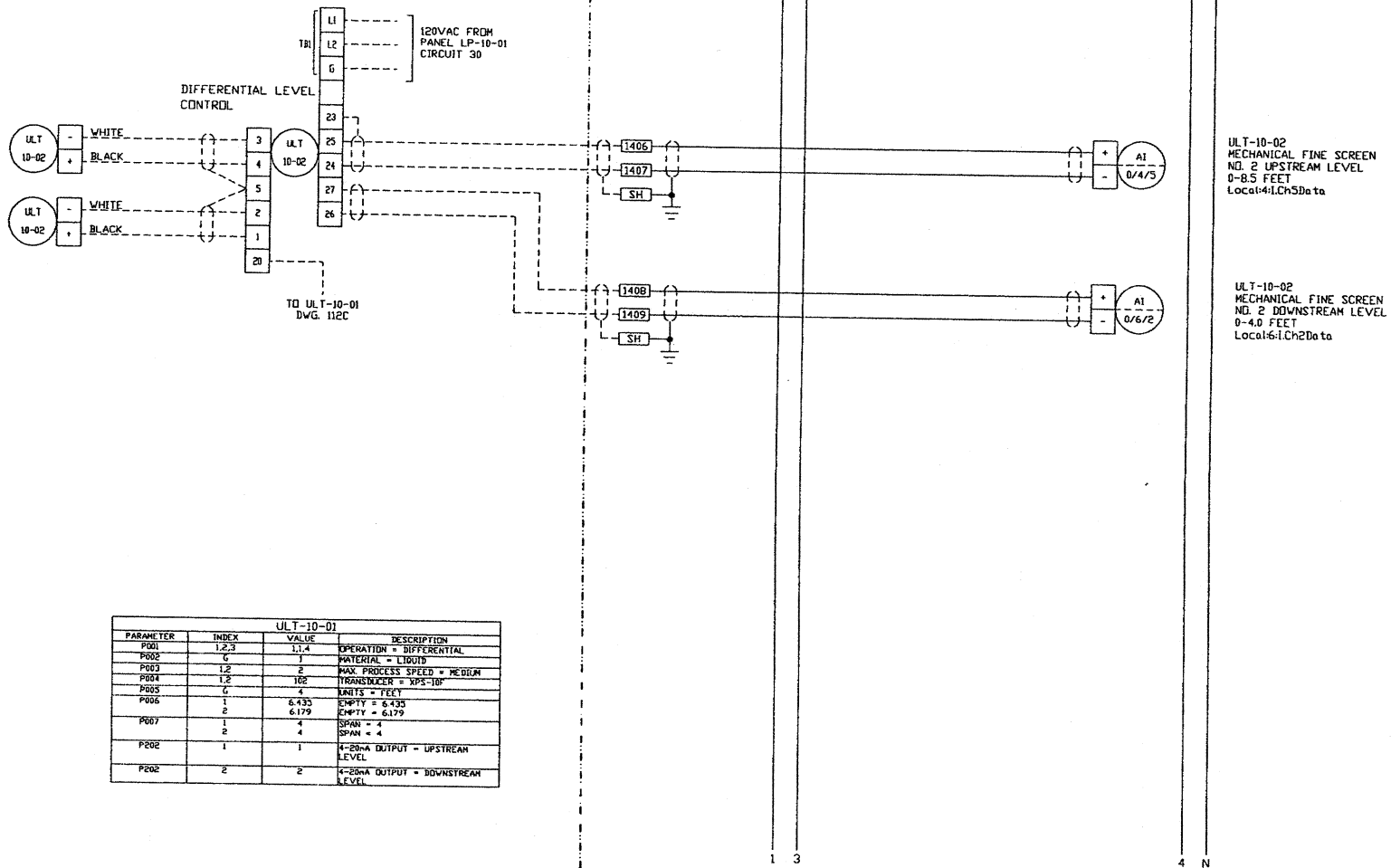
MCC-10/SCC-10
MECHANICAL FINE SCREEN NO.2
HFS-10-02A

PPD.J. NO.
DVS. NO.
114B

Sample Elementary
Schematic

FIELD OR AS NOTED

SCC-10

UPSTREAM
LEVEL TRANSDUCERDOWNSTREAM
LEVEL TRANSDUCER

ULT-10-01			
PARAMETER	INDEX	VALUE	DESCRIPTION
P001	1,2,3	1,1,4	OPERATION = DIFFERENTIAL
P002	6	1	MATERIAL = LIQUID
P003	1,2	2	MAX PROCESS SPEED = MEDIUM
P004	1,2	102	TRANSDUCER = XPS-10"
P005	6	4	UNITS = FEET
P006	1	6.435	EMPTY = 6.435
	2	6.179	EMPTY = 6.179
P007	1	4	SPAN = 4
	2	4	SPAN = 4
P202	1	1	4-20mA OUTPUT = UPSTREAM LEVEL
P202	2	2	4-20mA OUTPUT = DOWNSTREAM LEVEL

DATE LAST EDITED: 7/16/2008

REVISION	
DATE	DESCRIPTION
6/28/06	RELEASE FOR PRODUCTION
9/6/06	AS BUILT
2/15/07	AS INSTALLED

DATE	3/16/06
DWN	JA
CHKD	DK
ENGR	BA
ASSEM	
SHEET	48 OF 149

PROJECT	
SCC-10	
MECHANICAL FINE SCREEN NO.2	
MFS-10-02A	

PROJ NO.	DWG NO.
	114C

Sample Elementary
Schematic

GEOTECHNICAL ENGINEERING REPORT

Northwest WWTP In-Line Pump Additions

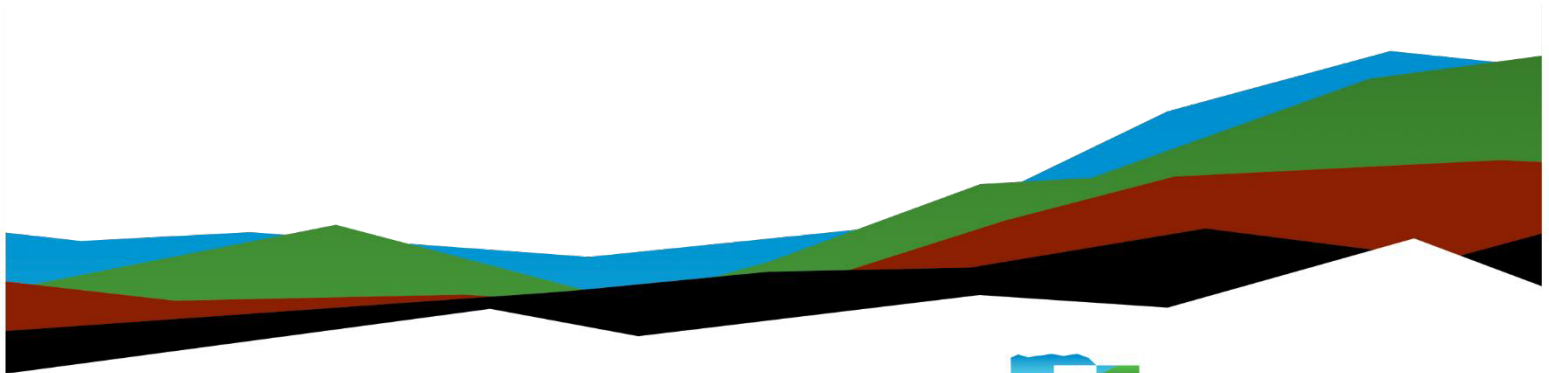
Geotechnical Engineering Report

Copperas Cove, Texas

August 15, 2025 | Terracon Project No. AC255045

Prepared for:

Strand Associates Inc.
1906 Niebuhr Street
Brenham, Texas 77833



Nationwide
[Terracon.com](https://www.terracon.com)

- Facilities
- Environmental
- Geotechnical
- Materials



800 Paloma Drive, Suite 160
Round Rock, TX 78665
P (512) 628-8600
Terracon.com

August 15, 2025

Strand Associates Inc.
1906 Niebuhr Street
Brenham, Texas 77833

Attn: Mark Rudolph, P.E.
P: 979-836-7937
E: Mark.Rudolph@strand.com

Re: Geotechnical Engineering Report
Northwest WWTP In-Line Pump Additions
1601 North First Street
Copperas Cove, Texas
Terracon Project No. AC255045

Dear Mr. Rudolph:

We have completed the scope of Geotechnical Engineering services for the above referenced publicly funded project in general accordance with Terracon Proposal No. PAC255045, Revision 1 dated May 7, 2025. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork, foundations, and floor slabs for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.
TBPELS Firm Registration TX-F3272

A handwritten signature in blue ink that reads 'Larson M. Snyder'.

Larson M. Snyder, P.E.
Senior Project Manager

A handwritten signature in black ink that reads 'Edward E. Jaimes'.

Edward E. Jaimes, P.E.
Geotechnical Department Manager



08/15/2025

Table of Contents

Introduction..... 1

Project Description..... 1

Site Conditions 2

Geotechnical Characterization 3

 Groundwater 4

Seismic Site Class..... 4

Geotechnical Overview 5

Earthwork 6

 Demolition 6

 Site Preparation..... 6

 Excavation..... 6

 Subgrade Preparation 7

 Temporary Groundwater Control 8

 Fill Material Types 8

 Fill Placement and Compaction Requirements 9

 Utility Trench Backfill 10

 Grading and Drainage..... 11

 Earthwork Construction Considerations 12

 Construction Observation and Testing 12

Shallow Foundations 13

 Footings 13

 Design Parameters – Compressive Loads 13

 Design Parameters – Overturning and Uplift Loads 15

 Shallow Foundation Construction Considerations 15

Slab on Grade Foundations 16

Floor Slabs 18

 Floor Slab Design Parameters 19

 Floor Slab Construction Considerations..... 19

Comments on Excavation and Trench Safety 20

 General 20

 Construction 20

 Sloping and Benching 21

 Shoring 21

 Trench Shields 22

 Alternate Sidewall Protection Methods..... 22

 Inspection of Excavation Safety System 22

General Comments 23

Figures

GeoModel

Attachments

Exploration and Testing Procedures

Site Location and Exploration Plans

Exploration and Laboratory Results

Supporting Information

Note: This report was also delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the  Terracon logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

Refer to each individual Attachment for a listing of contents.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed in-line pump additions to be located within the existing Northwest Wastewater Treatment Plant (WWTP) at 1601 North First Street in Copperas Cove, Texas. The purpose of these services was to provide information and geotechnical engineering recommendations related to:

- Subsurface soil and rock conditions
- Groundwater conditions
- Seismic site classification per IBC
- Site preparation and earthwork
- Demolition considerations
- Dewatering considerations
- Foundation design and construction
- Floor slab design and construction

The geotechnical engineering Scope of Services for this project included the advancement of test borings, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and boring locations are shown on the [Site Location](#) and [Exploration Plan](#), respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs and as separate graphs in [Exploration and Laboratory Results](#).

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	The project information and Google Earth layout were provided via e-mail on April 17, 2025, by Mr. Mark Rudolph, P.E. with Strand. The 90% Plan Set Draft was provided via e-mail on August 4, 2025, by Mr. Jake Collins, P.E. with Strand.
Project Description	The project includes the construction of an at-grade in-line RAW/WAS pump system and electrical canopy.
Building Construction	Slab-on-grade
Finished Floor Elevation	Finished floor elevation for the pump system is planned to vary from EL 965.83 to 966.08 feet based on the plans provided. The electrical canopy is anticipated to be at a similar FFE as the pump system.
Maximum Loads	Anticipated structural loads were not provided. In the absence of information provided by the design team, we will use the following loads in estimating settlement based on our experience with similar projects. ■ Slabs: 100 to 250 pounds per square foot (psf)
Grading/Slopes	Minimal site grading anticipated for this project.
Building Code	2021 IBC

Terracon should be notified if any of the above information is inconsistent with the planned construction, especially the grading limits, as modifications to our recommendations may be necessary.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project site is located at the City's existing Northwest Wastewater Treatment Plant at 1601 North First Street in Copperas Cove, Texas. Latitude/Longitude (approximate): 31.1499 °N, 97.9066 °W See Site Location
Existing Improvements	Structures associated with the existing wastewater treatment plant.
Current Ground Cover	Earthen (soils and grass) and asphalt.
Existing Topography	A topography plan was not provided to us at this time. Based on Google Earth, existing elevations range from a low elevation of about 966 feet to a high elevation of about 968 feet. Google Earth elevations are estimates and should not be used as a substitute for a professional survey. If the elevations displayed on our logs are incorrect, Terracon should be notified to modify the boring logs and this report as needed.

Geotechnical Characterization

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting, and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in [Exploration and Laboratory Results](#) and the GeoModel can be found in [Figures](#).

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel. Throughout this report, the terms GeoModel Layer and Stratum are synonymous and used interchangeably.

Model Layer	Layer Name	General Description
1	Upper Fat Clays	Dark brown to brown, medium stiff to hard
2	Low to Moderate Plasticity Soils	Brown to light brown, dense to very dense; very stiff to hard
3	Limestone Bedrock	Glen Rose Formation; gray to brown to light gray, slightly to highly fractured

Groundwater

The borings were advanced using solid-stem augers that allow short-term groundwater observations to be made while drilling and at completion of drilling. Groundwater seepage was not encountered within the maximum drilling depth at the time of our field exploration.

Although not encountered, groundwater seepage is possible at this site, particularly in the form of seepage traveling along pervious seams/fissures in the soil, along the soil/limestone interface, and/or in fissures/fractures in the limestone. Groundwater may also be, and is quite frequently, traveling along the softer and more pervious seams/beds (highly weathered limestone or residual soil layers) within the Glen Rose limestone. Groundwater seepage is frequently observed within temporary or permanent cuts in the Glen Rose limestone. Due to the low permeability of the overlying soils encountered in the borings, a relatively long period may be necessary for a groundwater level to develop and stabilize in a borehole. Long term observations (which were outside the scope of services for this project) in piezometers sealed from the influence of surface water are often required to define groundwater levels in materials of this type. Please contact us if this is desired.

Groundwater conditions may change because of seasonal variations in rainfall, construction activities, and other conditions not apparent at the time of drilling, therefore groundwater conditions may be different at the time of construction. The possibility of groundwater should be considered when developing the design and construction plans for the project.

Seismic Site Class

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil and bedrock properties observed at the site and as described on the exploration logs and results, our professional opinion is that a **Seismic Site Classification of C** may be considered for the project. Subsurface explorations at this site were extended to a maximum depth of 20 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

Geotechnical Overview

The near surface, high plasticity fat clay could become problematic with typical earthwork and construction traffic, especially after precipitation events. The effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the [Earthwork](#) section.

Based on our test borings, highly to very highly expansive soils that exhibit a potential for volumetric change during moisture variations are present at this site. These subgrade soils may experience expansion and contraction during the life of the structure. Based on existing grades and dry conditions, the soils at this site could exhibit a Potential Vertical Rise (PVR) of up to about 4¼ inches, as estimated by the TxDOT Method 124-E.

This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and (at least minor) cracking in the structure should be anticipated. The severity of cracking and other damage such as uneven floor slabs will probably increase if modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement and distress may not be feasible, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction.

Based on the conditions encountered and estimated load-settlement relationships, the proposed structures can be supported on conventional continuous or spread footings and a monolithic slab-on-grade. The [Shallow Foundations](#) section addresses support of the structures on footings directly bearing on select fill and the [Slab on Grade Foundations](#) section addresses support of the structures on monolithic slab-on-grade directly bearing on select fill. Grading for the proposed foundations should incorporate the limits of the foundations plus a lateral distance of at least 5 feet beyond the outside edge of footings, where space is available. The [Floor Slabs](#) and [Earthwork](#) sections addresses slab-on-grade support of the structures using overexcavation techniques.

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the [Exploration and Laboratory Results](#)), engineering analyses, and our current understanding of the proposed project. The [General Comments](#) section provides an understanding of the report limitations.

Earthwork

Earthwork is anticipated to include demolition, clearing and grubbing, excavations, and engineered fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for construction of foundations, floor slabs, and general site improvements.

Demolition

The proposed structure will be constructed within the footprint of existing infrastructure for the treatment plant which will need to be demolished. We recommend existing infrastructure be removed from within the proposed structure footprint to a depth of at least 2 feet below finished grades and at least 5 feet beyond the outer edge of foundations. If utilities are planned to be abandoned in place as an alternative to removal, the utility piping should be filled with flowable fill (TxDOT Item No. 401) and plugged such that it does not become a conduit for water flow or a potential voided area.

Site Preparation

Prior to placing fill, existing vegetation, topsoil, loose soil, fill soils, and root mats should be removed. Complete stripping of these materials should be performed in the proposed structure.

Although no evidence of fill or underground facilities (such as utilities) was observed during the exploration and site reconnaissance, such features could be encountered during construction. If unexpected fills or underground facilities are encountered, such features should be removed, and the excavation thoroughly cleaned prior to backfill placement and/or construction.

Excavation

We anticipate that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. The bottom of excavations should be thoroughly cleaned of loose soils and disturbed materials prior to backfill placement and/or construction.

Subgrade Preparation

The exposed final subgrade (including the excavation required for the equipment pad) in all construction areas (can be omitted in landscaping areas) should be proof rolled with an adequately loaded vehicle such as a 20-ton pneumatic roller, a fully loaded tandem-axle dump truck or similar vehicle. The proof rolling should be performed under the observation of the Geotechnical Engineer or representative. Areas excessively deflecting under the proof roll should be delineated and subsequently addressed. Excessively wet or dry material should either be removed, or moisture conditioned and recompacted.

After proofrolling and just prior to placement of fill, the exposed subgrade in all construction areas (may be omitted in landscaping areas) should be evaluated for moisture and density through field density testing. If the moisture and/or density testing results do not meet the moisture and density requirements below, the subgrade should be scarified to a minimum depth of 6 inches, moisture conditioned and compacted as per the fill compaction requirements in **Fill Placement and Compaction Requirements**.

Compacted select fill soils should then be placed to the proposed design grade and the moisture content and compaction of the soils should be maintained until foundation and floor slabs construction.

Based upon the subsurface conditions determined from the geotechnical exploration, subgrade soils exposed during construction are anticipated to be relatively workable; however, the workability of the subgrade may be affected by precipitation, repetitive construction traffic, or other factors. If unworkable conditions develop, workability may be improved by scarifying and drying.

Based on information provided to us, we understand that an FFE of 965.83 to 966.08 feet is planned for the proposed structures. Existing grades at the time of our report in the structural area range from about 965 feet to 966 feet. If the FFE changes, Terracon should be notified to review and modify or verify recommendations in writing.

In order to reduce PVR to about 1-inch, we recommend that the on-site soils be excavated to an elevation of 959.5 feet. The excavated soils must then be replaced with properly compacted select fill, up to finished grades. All fill within building areas must be select fill. A modulus of subgrade reaction of 100 pci may be used if these recommendations are followed.

The above subgrade preparation recommendations should be applied to an area extending a minimum of 5 feet outside of building areas including attached walkways and any other architectural members. We suggest the use of crushed limestone base in the upper 6 inches of the select fill pad from a standpoint of construction access during wet weather, as well as from a standpoint of floor slab support.

For any movement-sensitive flatwork (sidewalk, ramps, etc.) outside of the structure areas, subgrade preparation as discussed above should be considered to reduce differential movements between the flatwork and the adjacent structure. If subgrade preparation as given above for structure areas is not implemented in the exterior flatwork areas, those areas may be susceptible to post-construction movements in excess of that given above.

The potential movement values indicated are based upon moisture variations in the subgrade due to circumstances such as moisture increases due to rainfall and loss due to evapotranspiration. In circumstances where significant water infiltration beneath the floor slab occurs (such as a leaking utility line or water seepage from outside the structure area resulting from poor drainage), movements in isolated floor slab areas could potentially be in excess of those indicated in this report.

The post-construction performance of the foundation will likely be influenced more by post-construction volumetric changes of the subgrade due to in-situ moisture variations than upon settlement due to foundation loads. Settlement response of select fill supported slabs will be influenced as much by the quality of construction and fill placements as by soil-structure interaction. Therefore, it is essential that the recommendations for foundation construction be strictly followed during the construction phases of the building pad and foundation.

Temporary Groundwater Control

Although not encountered during our drilling operations, groundwater seepage could be encountered during construction, especially after periods of wet weather. The volume of groundwater seeping/flowing into the excavation will vary based on rainfall patterns before and during construction. Temporary groundwater control during construction would typically consist of perimeter gravel-packed drains sloping toward common sump areas for groundwater collection and removal. Placement of drain laterals within the excavation could be required to remediate isolated water pockets.

Fill Material Types

Engineered fill required to achieve design grade should be classified as select fill or general fill depending on its application. Select fill is material used below or within 5 feet of structures. General fill is material used to achieve grade in general (non-structural) areas.

Fill soil property requirements for use as general fill and select fill should meet the following property requirements. Regardless of its source, compacted fill should consist of approved materials that are free of organic matter, debris, and other deleterious materials.:

Fill Type ¹	Typical USCS Classification	Acceptable Specifications
Select Fill ^{2,3}	CL, SC, GM, GC	■ TxDOT Item 247, Type A, Grade 3 or better, OR ■ Crushed concrete (TxDOT Item 247, Type D, Grade 3 or better), OR ■ Soils with $7 \leq PI \leq 20$, $\leq 40\%$ retained on No. 4 sieve, and rocks ≤ 4 inches in maximum dimension
General Fill ⁴	CH, CL, GM, GC, SC	■ On-site soils; Rocks ≤ 4 inches in maximum dimension ■ Imported soils; $PI \leq 40$; and rocks ≤ 4 inches in maximum dimension

1. Select and general fill should consist of approved materials free of organic matter, debris, and other deleterious materials. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site. We recommend that periodic testing be performed throughout the material excavation phase to check for conformance with the select fill requirements given above.
2. As an alternative to the Acceptable Specifications above, a low plasticity granular material which does not meet the specifications above may be used only if approved by Terracon.
3. Based on the laboratory testing performed during this exploration, the excavated Stratum 1 soils are not suitable for re-use as select fill. We do not recommend these soils be considered for re-use as select fill when planning budgets.
4. The Stratum 1 soils exhibit high to very high shrink/swell potential. For economic reasons, expansive soils are often used in flatwork areas. The owner should be made aware that the risk exists for future movements of the subgrade soils which may result in movement and/or cracking of flatwork.

Fill Placement and Compaction Requirements

Engineered fill should meet the following compaction requirements.

Material Type		Maximum Lift Thickness	Minimum Compaction Requirements (%) ¹	Water Content Range (%) ¹
Select Fill		≤ 8 inches in loose thickness when heavy, self-propelled compaction equipment is used	95 ²	±3
Moisture Conditioned Building Subgrade	PI ≤ 25	≤ 6 inches in loose thickness when hand-guided equipment (i.e., jumping jack or plate compactor) is used	95	±3
	PI > 25		95	Optimum to +4

1. Maximum dry unit weight and optimum water content as determined by the standard Proctor test (ASTM D 698).
2. **For fills thicker than 5 feet, the compaction should be increased to at least 100 percent of the ASTM D 698 maximum dry unit weight.**

Utility Trench Backfill

Any soft or unsuitable materials encountered at the bottom of utility trench excavations should be removed and replaced with select fill (in building/structural areas), general fill (in non-building/structural areas), or bedding material in accordance with public works specifications for the utility to be supported. This recommendation is particularly applicable to utility work requiring grade control and/or in areas where subsequent grade raising could cause settlement in the subgrade supporting the utility. Trench excavation should not be conducted below a downward 1(H):1(V) projection from foundations without engineering review of shoring requirements and geotechnical observation during construction.

On-site Stratum 1 materials are considered suitable for backfill of utility and pipe trenches in non-structural areas from 1 foot above the top of the pipe to the final ground surface, provided the material is free of organic matter and deleterious substances.

Trench backfill should be mechanically placed and compacted as discussed earlier in this report. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Where trenches are placed in structural areas, the backfill should satisfy the engineered select fill requirements discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

For low permeability subgrades, utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the building. The trench should provide an effective trench plug that extends at least 5 feet from the face of the building exterior. The plug material should consist of cementitious flowable fill or low permeability clay. The trench plug material should be placed to surround the utility line. If used, the clay trench plug material should be placed and compacted to comply with the water content and compaction recommendations for general fill stated previously in this report. If flowable fill is used, it should be in accordance with TxDOT Item 401.

Grading and Drainage

The performance of the proposed structures will not only be dependent upon the quality of construction, but also upon the stability of the moisture content of the near surface soils. Therefore, we highly recommend that site drainage be developed so that ponding of surface runoff near the structures does not occur. Accumulation of water near the structures may cause significant moisture variations in soils adjacent to the structures, thus increasing the potential for structural distress.

All grades must provide effective drainage away from the structures during and after construction and should be maintained throughout the life of the structures. Water retained next to the structures can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs, and roof leaks.

Exposed ground should be sloped and maintained at a minimum 5% away from the building for at least 10 feet beyond the perimeter of the structure. Flatter grades may be necessary to transition ADA access requirements for flatwork. After structure construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Shallow excavations for the proposed structures are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of grade-supported improvements such as floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

Excavations or other activities resulting in ground disturbance have the potential to affect adjoining properties and structures. Our scope of services does not include review of available final grading information or consider potential temporary grading performed by the contractor for potential effects such as ground movement beyond the project limits. A preconstruction/ precondition survey should be conducted to document nearby property/infrastructure prior to any site development activity. Excavation or ground disturbance activities adjacent or near property lines should be monitored or instrumented for potential ground movements that could negatively affect adjoining property and/or structures.

Construction Observation and Testing

The earthwork efforts should be observed by the Geotechnical Engineer (or others under their direction). Observation should include documentation of adequate removal of surficial materials (vegetation, topsoil, and pavements), as well as proofrolling and mitigation of unsuitable areas delineated by the proofroll.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary, as recommended by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the structure areas. Where not specified by local ordinance, one density and water content test should be performed for

every 100 linear feet of compacted utility trench backfill and a minimum of one test performed for every 12 vertical inches of compacted backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated by the Geotechnical Engineer (or others under their direction). If unanticipated conditions are observed, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the opportunity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

Shallow Foundations

Footings

Principal column and wall loads for the proposed structures may be supported on isolated (spread) and/or continuous (strip) footings bearing on compacted select fill or. If the site has been prepared in accordance with the requirements noted in [Earthwork](#), the following design parameters are applicable for shallow foundations.

Design Parameters – Compressive Loads

Item	Description
Maximum Net Allowable Bearing Pressure^{1, 2}	2,500 psf
Required Bearing Stratum³	Select Fill
Minimum Foundation Dimensions	Per IBC 1809.7
Ultimate Passive Resistance⁴ (equivalent fluid pressures)	360 psf per foot of depth
Ultimate Sliding Resistance⁵	0.35 coefficient of friction
Minimum Embedment below Finished Grade⁶	18 inches
Estimated Total Settlement from Structural Loads^{2,7}	About 1-inch or less

Item	Description
Estimated Differential Settlement 2,7,8	About ½ to ¾ of total settlement

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.
2. Values provided are for maximum loads noted in **Project Description**. Additional geotechnical consultation will be necessary if higher loads are anticipated.
3. Unsuitable or soft soils should be overexcavated and replaced per the recommendations presented in **Earthwork**.
4. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted structural fill be placed against the vertical footing face. Assumes no hydrostatic pressure. Passive resistance should be neglected in the first 12 inches below finished grades. Ultimate values should be reduced by an appropriate factor of safety to compute allowable values.
5. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Ultimate values should be reduced by an appropriate factor of safety to compute allowable values. For **select fill**, we recommend the allowable sliding resistance be limited to **500** psf.
6. Embedment necessary to minimize the effects of seasonal water content variations and potential future disturbance around the perimeter. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
7. The estimated post-construction settlement of the shallow footings is assuming proper construction practices are followed. The settlement response of the footings will be more dependent upon the quality of construction than upon the response of the subgrade to the foundation loads.
8. Differential settlements are noted for equivalent-loaded foundations and bearing elevation as measured over a span of 50 feet. Differential settlements may result from variances in subsurface conditions, loading conditions, and construction procedures.

Design Parameters – Overturning and Uplift Loads

Shallow foundations subjected to overturning loads should be proportioned such that the resultant eccentricity is maintained in the center-third of the foundation (e.g., $e < b/6$, where b is the foundation width). This requirement is intended to keep the entire foundation area in compression during the extreme lateral/overturning load event. Foundation oversizing may be required to satisfy this condition.

Uplift resistance of spread footings can be developed from the effective weight of the footing and the overlying soils with consideration to the IBC basic load combinations.

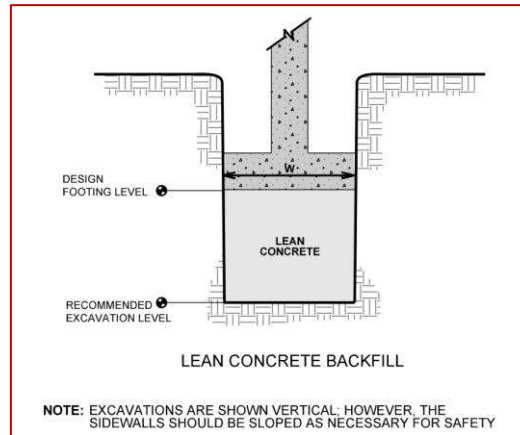
Item	Description
Foundation Unit Weight	As per Structural Engineer
Soil Total Unit Weight¹	120 pcf
Soil weight included in uplift resistance	Soil included within the prism extending up from the top perimeter of the footing at an angle of 20 degrees from vertical to ground surface

1. The nominal values should be reduced by an appropriate factor of safety to compute allowable values. Soil weight should be ignored in potential zones of disturbance and in areas where erosion control measures are not used, or soil might otherwise be removed.

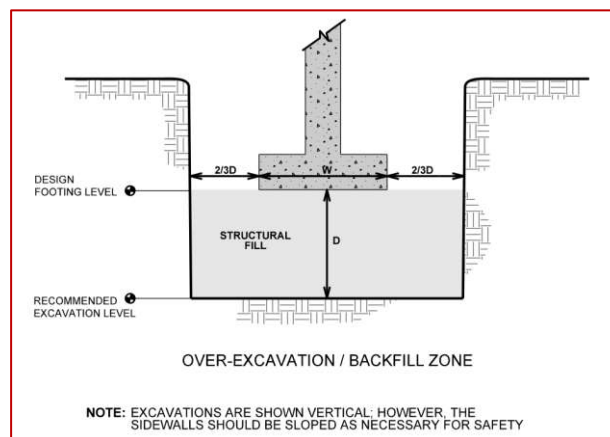
Shallow Foundation Construction Considerations

Footings/Grade beams should be neat excavated, if possible. If neat excavation is not possible, the foundation should be properly formed. If a toothed bucket is used, excavation with this bucket should be stopped approximately 6 inches above final grade of the footing and the footing excavation be completed with a smooth-mouthed bucket or by hand labor. As noted in [Earthwork](#), the footing excavations should be evaluated under the observation of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

If unsuitable bearing soils are observed at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. The lean concrete replacement zone is illustrated on the sketch below.



Overexcavation for structural fill placement below footings should be conducted as shown below. The overexcavation should be backfilled up to the footing base elevation, with select/structural fill placed, as recommended in the [Earthwork](#) section.



Slab on Grade Foundations

A slab on grade beam foundation may be considered to support the structures at this site. Parameters commonly used to design this type of foundation are provided on the table below. The slab foundation design parameters presented are based on the criteria published by the Building Research Advisory Board (BRAB), the Prestressed Concrete Institute (PCI), and the Wire Reinforcement Institute (WRI). These are essentially empirical design methods and the recommended design parameters are based on our understanding of the proposed project, our interpretation of the information and data collected as a part of this study, our area experience, and the criteria published in the BRAB, PCI, and WRI design manuals.

Conventional Method Parameters	Value
Net Allowable Bearing Pressures ¹	2,000 psf
Bearing Stratum	Select Fill
Minimum Embedment of Grade Beams below Final Grade	18 inches
Subgrade Modulus (k)	100 pci
Potential Vertical Rise (PVR)	1 inch ⁷
WRI Method Parameters	
Effective Plasticity Index (PI) ²	24
Climatic Rating (Cw)	17
BRAB Support Index (C)	0.90

1. The net allowable bearing pressure provided above includes a Factor of Safety (FS) of at least 3. Based on building pad preparation recommended in this report.
2. The BRAB effective PI is equal to the near surface PI if that PI is greater than the PI values in the upper 15 feet. The WRI/PCI effective PI is the weighted average of the PI values in the upper 15 feet of the soil profile. The upper 5 feet has a weight factor of 3; the depth range from 5 to 10 feet has a weight factor of 2; the depth range of 10 to 15 feet has a weight factor of 1.
3. Based on our analysis of the field and laboratory data, design parameters were computed using the Addendum to the 2004 Post-Tensioning Institute (PTI) method for slab-on-grade design and the subsequent Errata to the Addendum approved by the PTI Slab-on-Grade Committee on February 7, 2008.
4. The moisture beneath a shallow foundation will change in response to wetting and drying conditions around the foundation perimeter. The moisture condition has a significant effect on slab behavior and is highly variable with time, seasonal changes, annual climate conditions, drainage patterns, ground cover, and vegetation (e.g., trees and shrubs).
5. Differential movements may result from variances in subsurface conditions, loading conditions, and construction procedures. We recommend that measures be taken whenever practical to increase the tolerance of the building to post-construction foundation movements. An example of such measures would be to provide frequent control joints for exterior masonry veneers and interior sheetrock walls (particularly near doors and windows) to control cracking across such walls and concentrate movement along the joints.

We recommend that exterior grade beams (if bearing in select fill) be at least 18 inches below the finished exterior grade. These recommendations are for a proper development of bearing capacity for the continuous beam sections of the foundation system and to reduce the potential for water to migrate beneath the slab foundation. These recommendations are not based on structural considerations. Grade beam depths may need to be greater than recommended herein for structural considerations and should be properly evaluated and designed by the Structural Engineer. The grade beams or slab portions may be thickened and widened to serve as spread footings at concentrated load areas.

For a slab on grade foundation system designed and constructed as recommended in this report, post construction consolidation settlements should be less than 1 inch. Settlement response of a slab on grade foundation is influenced more by the quality of construction than by soil-structure interaction. Therefore, it is essential that the recommendations for foundation construction be strictly followed during the construction phases of the pad and foundation.

The use of a vapor retarder should be considered beneath concrete slabs-on-grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slabs will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer and slab contractor should refer to ACI 302 for procedures and cautions about the use and placement of a vapor retarder.

Floor Slabs

Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

The subgrade soils are comprised of high plasticity clays exhibiting the potential to swell with increased water content. Construction of the floor slab, and revising site drainage creates the potential for gradual increased water contents within the clays. Increases in water content will cause the clays to swell and damage the floor slab. To reduce the PVR to about 1 inch, the recommendations provided in this report should be followed.

Floor Slab Design Parameters

Item	Description
Floor Slab Support	Subgrade and select fill building pad compacted to recommendations in Earthwork
Estimated Modulus of Subgrade Reaction ¹	100 pounds per square inch per inch (psi/in)

1. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in [Earthwork](#), and the floor slab support as noted in this table.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, when the project includes humidity-controlled areas, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut contraction joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations, refer to the ACI Design Manual. Joints or cracks should be sealed with a waterproof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Floor Slab Construction Considerations

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and structural/select fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should observe the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

Comments on Excavation and Trench Safety

The following subsections present comments pertaining to the subsurface conditions encountered in the test borings drilled at the site and the effects these conditions may have upon excavation and/or trench safety. Our comments are based on the data obtained from the field and laboratory test programs, geologic conditions, and our experience with similar projects. We are providing general comments for the most common methods of excavation and/or trench safety, including sloping, benching, shoring, and trench shields. The developer, design engineer, and/or contractor should decide which is the most feasible system for this site depending on factors such as space limitations, construction budget and construction schedule.

General

OSHA Safety and Health Standards (29 CFR Part 1926) require that all trenches in excess of 5 feet deep be shored or appropriately sloped unless the sidewalls are comprised of “stable” rock. State of Texas legislation requires detailed plans and specifications for retention systems that meet OSHA standards for a safe construction environment during utilities installation. The following sections provide general information to aid in designing an excavation retention system for this project based on the subsurface conditions observed at our test boring locations. These comments are intended for use in conjunction with OSHA safety regulations and not in lieu of those regulations. Prior to utility line construction, an excavation/trench safety plan, which is designed by a registered Professional Engineer, should be completed.

Construction

As stated above, OSHA requires all trenches in excess of 5 feet in depth to be shored or appropriately sloped. Currently available and practiced methods for achieving slope and/or sidewall stability includes sloping, benching, combinations of sloping and benching, and installation of shoring systems (e.g., hydraulic, timber, etc.). Trench shields may also be considered for use. However, trench shields only provide protection to workers; they are not means for providing slope or sidewall stability.

Sloping and Benching

If right-of-way is available, sloping, benching, or a combination thereof could be considered. The slope angle and/or vertical height of the bench section will be dependent on the subsurface conditions. In general, temporary excavations may be cut at the slopes indicated previously in **Earthwork**. We recommend that all sloping/benching be performed as directed by OSHA in 29 CFR, Part 1926.

During excavation, slopes or benches should be observed for possible signs of failure such as bulging of the vertical face of the bench, tension cracks at the slope crest and/or raveling of material down the slope. If precariously positioned boulders or rock fragments are encountered, they should be removed. Surcharge loading from spoil piles, traffic, or equipment loading closer than 6 feet from the crest of the slope, which might alter the stability of the slope, should be avoided. If such conditions are observed, workers should not be permitted in the excavation until the conditions noted are corrected by the contractor. If such conditions cannot be avoided, further flattening of the slope may be required. Flattening of the slope may also be necessary if excess amounts of groundwater influx are observed.

Surface water runoff which flows down the slopes or benches and ponds at the toe or crest of an excavation may be detrimental to stability. The excavation slopes should be thoroughly evaluated following a rainfall event and prior to workers entering the excavation.

Shoring

If desired, shoring may be utilized for excavation safety. Earth pressures for design of shoring should be based on a "worst case" condition from an earth pressure standpoint. The appropriate earth pressures to be utilized should be evaluated by the excavation safety system designer. Each strut or brace should be proportioned as if it would be subjected to the maximum lateral load.

Excavation safety systems may be subjected to surcharge loads in the form of construction equipment and/or spoil piles. Surcharge loads from soil surcharge should be considered when calculating earth pressures for the shoring systems. Equipment such as backhoes, front-end loaders, etc., should not operate within a distance of 6 feet from the excavation sidewall (and no vibrating equipment should be used) while workers are in the excavation. The excavation safety system designer should review the surcharge loads imposed on the excavation safety system.

Trench Shields

If sloping, benching, or shoring is not selected, trench shields may be considered to protect the workers from slope instability. As for shoring, the design of the trench shields should be based on a “worst case” earth pressure standpoint, with the appropriate earth pressures properly evaluated by the excavation safety system designer. We should note that trench shields only serve as a means for worker protection; they are not a means of excavation retention. Potential effects of sidewall caving and corresponding damage to adjacent property and personnel should be considered when considering the use of trench shields. As stated above for shoring, hydrostatic pressures and effects of spoil, equipment, and other surcharge loading should be considered.

Alternate Sidewall Protection Methods

Other equivalent methods of slope protection or shoring may be considered for this project. However, any excavation safety system to be utilized should fully comply with OSHA regulations.

Inspection of Excavation Safety System

Inspections of the excavations should be performed by a competent person to perform the following:

- Confirm that actual conditions are as anticipated from analysis of the borings
- To examine for the presence of faults or other geologic features that might be an indication of sidewall instability
- Observe the presence of spoil piles or equipment which could cause surcharge loading
- To help ensure that the excavation safety system design is properly interpreted and incorporated into construction.

The construction sequence should be planned so that an adequate inspection can be performed prior to personnel entering the excavation.

In addition, OSHA regulations require that inspections be made daily by a competent person for situations which could result in a possible cave-in, indications of failure of the protective systems, hazardous atmospheres, or other hazardous conditions. Workers should not be permitted in the excavation until these conditions have been reviewed by a competent person on a daily basis. A competent person is defined within the OSHA Safety and Health Standards and Interpretations Part 1926 of 29 CFR, amended 2989, Subpart P - Excavations, as one who is capable of identifying existing and predictable hazards in the surrounding or working conditions which are unsanitary, hazardous, or

dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly affect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on

Geotechnical Engineering Report

Northwest WWTP In-Line Pump Additions | Copperas Cove, Texas
August 15, 2025 | Terracon Project No. AC255045



nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

Geotechnical Engineering Report

Northwest WWTP In-Line Pump Additions | Copperas Cove, Texas
August 15, 2025 | Terracon Project No. AC255045



Figures

Contents:

GeoModel

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description	Legend	
1	Upper Fat Clays	Dark brown to brown, medium stiff to hard	Fat Clay with Sand	Clayey Sand with Gravel
2	Low to Moderate Plasticity Soils	Brown to light brown, dense to very dense; very stiff to hard	Limestone	Fat Clay
3	Limestone Bedrock	Glen Rose Formation; gray to brown to light gray, slightly to highly fractured	Lean Clay with Sand	

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

Geotechnical Engineering Report

Northwest WWTP In-Line Pump Additions | Copperas Cove, Texas

August 15, 2025 | Terracon Project No. AC255045



Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet)	Location
2	20	In-Line Pump & Electrical Canopy Area

Boring Layout and Elevations: Terracon personnel provided the boring layout using handheld GPS equipment (estimated horizontal accuracy of about ±10 feet) and referencing existing site features. Approximate ground surface elevations were obtained by interpolation from the were estimated using Google Earth. If elevations and a more precise boring layout are desired, we recommend borings be surveyed.

Subsurface Exploration Procedures: Our drilling subcontractor advanced the borings with a truck-mounted, rotary drill rig using continuous flight augers (solid stem). Samples were obtained at approximately two-foot intervals in the upper 10 feet of each boring and at intervals of 5 feet thereafter (unless bedrock was encountered). Soil sampling was performed using shelby tube samplers and/or split-barrel sampling procedures. The split-barrel samplers were driven in accordance with the standard test method for standard penetration test (SPT) and split-barrel sampling of soils. Bedrock was sampled with either split-barrel-sampling spoons or cored using NX rock coring equipment. When sufficient bedrock was sampled, the borings were shallowed at the geotechnical engineer’s discretion. For safety purposes, all borings were backfilled with auger cuttings after their completion.

Our drilling subcontractor observed for possible groundwater levels during drilling and sampling. Groundwater was not observed during our field investigation.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials observed during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Moisture Content
- Dry Unit Weight
- Grain Size Distribution
- Atterberg Limits
- Unconfined Compression

The laboratory testing program included examination of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Rock classification was conducted using locally accepted practices for engineering purposes; petrographic analysis may reveal other rock types. Rock core samples typically provide an improved specimen for this classification. Boring log rock classification was determined using the Description of Rock Properties.

Site Location and Exploration Plans

Contents:

Site Location Plan
Exploration Plan (2 Pages)

Note: All attachments are one page unless noted above.

Geotechnical Engineering Report

Northwest WWTP In-Line Pump Additions | Copperas Cove, Texas
August 15, 2025 | Terracon Project No. AC255045



Site Location



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

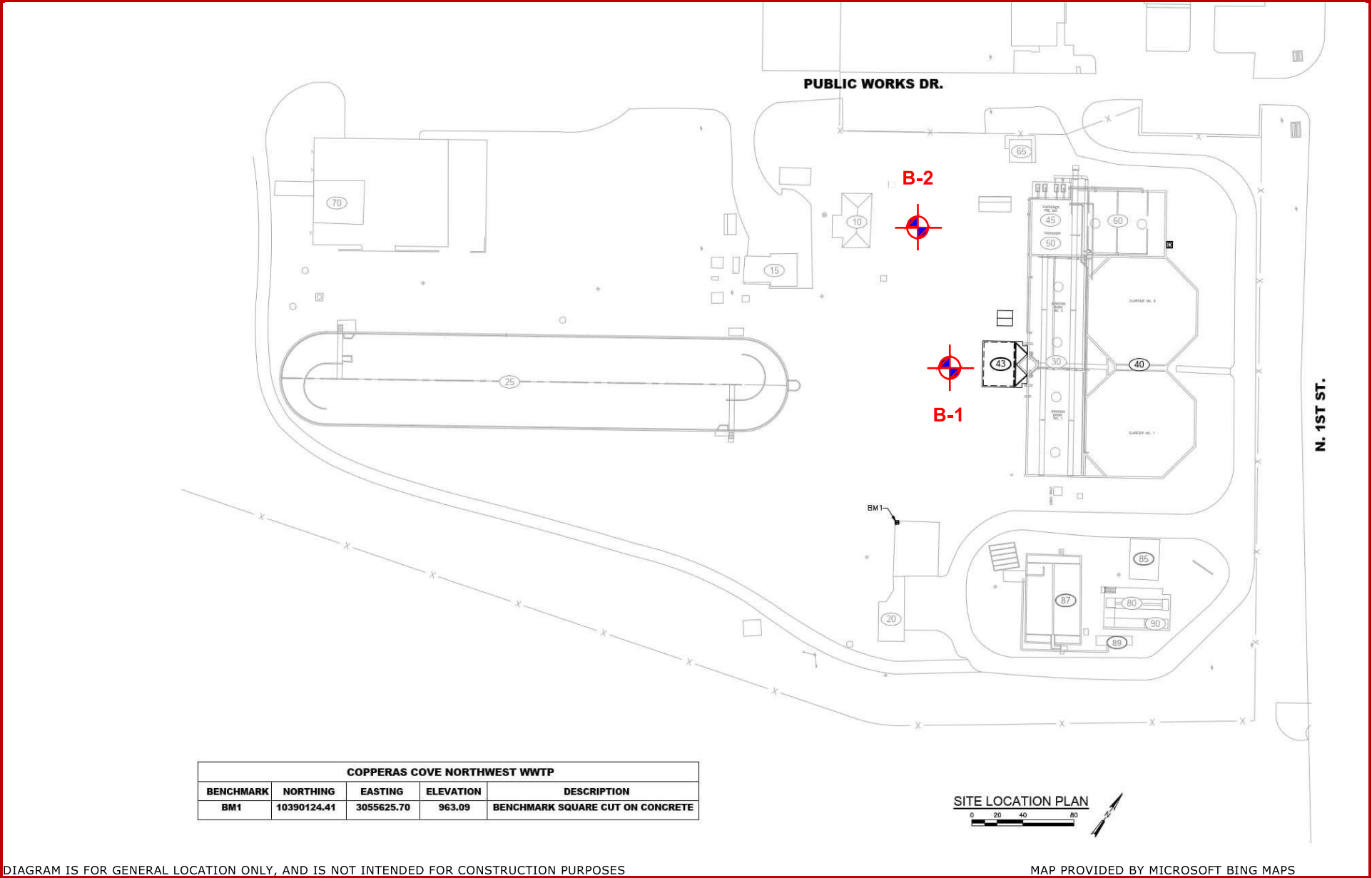


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Geotechnical Engineering Report

Northwest WWTP In-Line Pump Additions | Copperas Cove, Texas
August 15, 2025 | Terracon Project No. AC255045



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration and Laboratory Results

Contents:

Boring Logs B-1 and B-2 (2 Pages)
Grain Size Distribution
Atterberg Limits

Note: All attachments are one page unless noted above.

Boring Log No. B-1

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 31.1500° Longitude: -97.9067° Depth (Ft.) Approximate Elevation: 966.0 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Recovery (%) RQD (%)	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits		
								Test Type	Compressive Strength (tsf)	Strain (%)			LL-PL-PI	Percent Fines	
1		FAT CLAY WITH SAND (CH) , dark brown to brown, stiff to very stiff	5			4-5-6 N=11					15.6	100			
						3.5 tsf (HP)				22.1	69-18-51				85.0
						3.0 tsf (HP)		UC	2.63	3.4	24.1				
2		CLAYEY SAND WITH GRAVEL (SC) , brown to light brown, dense to very dense - limestone fragments below ~13 feet	10			4.5 tsf (HP)					17.9				
						18-20-15 N=35				8.7	42-14-28				49.6
3		LIMESTONE (GLEN ROSE FORMATION) , gray to light gray, moderately fractured - highly fractured, with marly seams from ~17 to 18½ feet	15			13-50/2"	100 70				18.3	2.6	142		
		Boring Terminated at 20 Feet	20												

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevation Reference: Elevations obtained via Google Earth imagery.

Water Level Observations
Groundwater not encountered

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Austin Geo-Logic

Notes

Advancement Method
Augered to 15 feet; Air Rotary coring thereafter

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Logged by
A. Hinojosa

Boring Started
06-26-2025

Boring Completed
06-26-2025

Boring Log No. B-2

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 31.1502° Longitude: -97.9069° Depth (Ft.) Approximate Elevation: 968.0 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Recovery (%) RQD (%)	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits		
								Test Type	Compressive Strength (tsf)	Strain (%)			LL-PL-PI	Percent Fines	
1		FAT CLAY (CH) , dark brown to brown, medium stiff to hard	6.0	962		2-3-3 N=6					25.7	96			
						4.5 tsf (HP)		UC	2.83	8.5	24.7				
2		LEAN CLAY WITH SAND (CL) , brown to light brown, very stiff to hard	10	954.5		4.5 tsf (HP)					20.9		66-17-49	94.3	
						8-8-10 N=18					15.2		35-17-18	81.3	
3		LIMESTONE (GLEN ROSE FORMATION) , gray to brown, slightly to moderately fractured - highly fractured, with clayey seams from ~17 to 18 feet	15	948		19-18-17 N=35					6.3				
						50/3"					7.5				
		Boring Terminated at 20 Feet	20				100 92					2.9	141		

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevation Reference: Elevations obtained via Google Earth imagery.

Water Level Observations
Groundwater not encountered

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Austin Geo-Logic

Notes

Advancement Method
Augered to 15 feet; Air Rotary coring thereafter

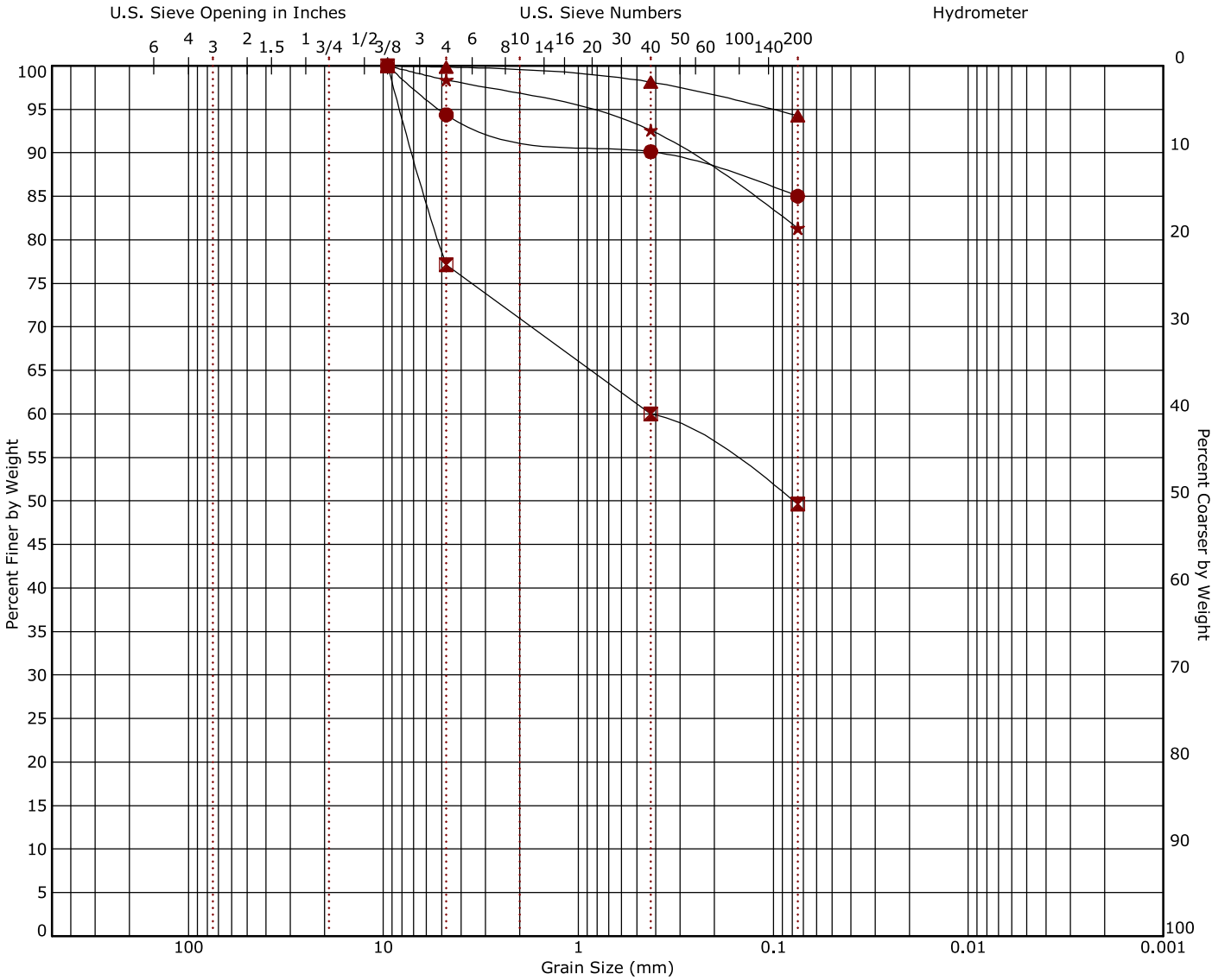
Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Logged by
A. Hinojosa

Boring Started
06-26-2025

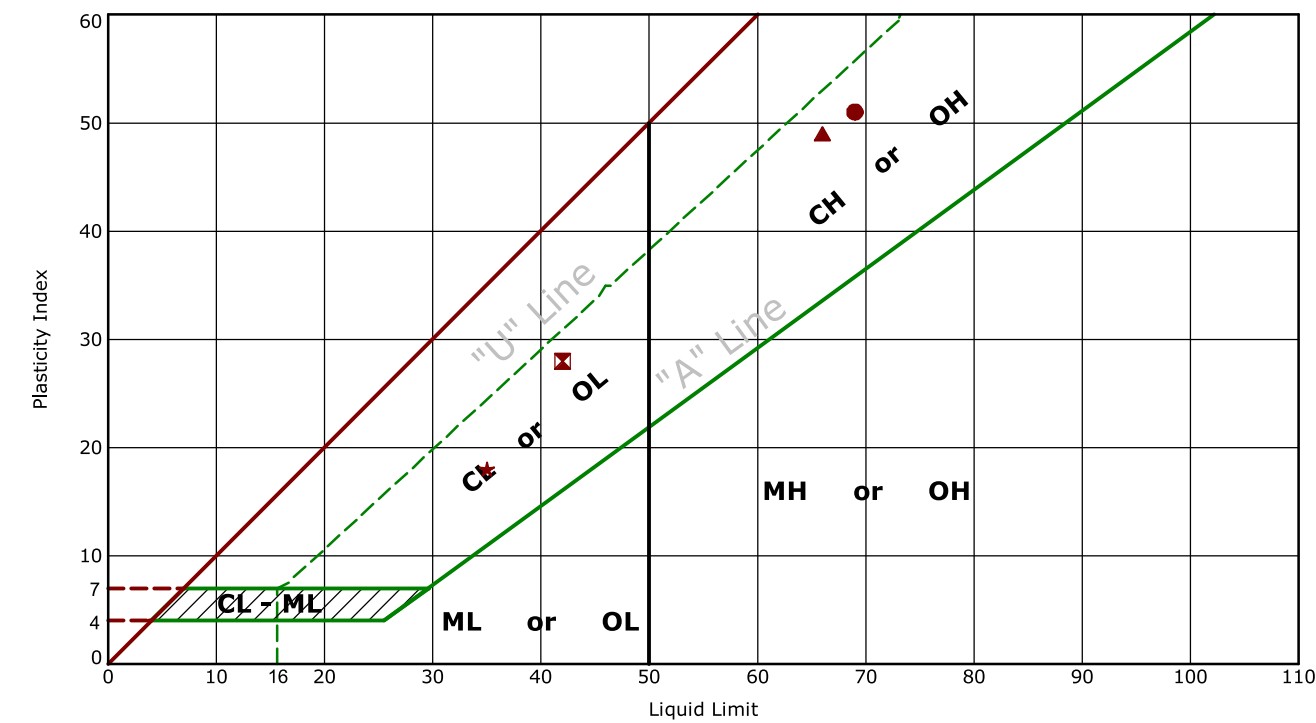
Boring Completed
06-26-2025

Grain Size Distribution
ASTM D422 / ASTM C136 / AASHTO T27



Cobbles		Gravel		Sand			Silt or Clay						
		coarse	fine	coarse	medium	fine							
Boring ID		Depth (Ft)	Description					USCS	LL	PL	PI	Cc	Cu
●	B-1	2 - 4	FAT CLAY					CH	69	18	51		
⊠	B-1	8.5 - 10	CLAYEY SAND with GRAVEL					SC	42	14	28		
▲	B-2	4 - 6	FAT CLAY					CH	66	17	49		
★	B-2	6 - 7.5	LEAN CLAY with SAND					CL	35	17	18		
Boring ID		Depth (Ft)	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay	
●	B-1	2 - 4	9.5				0.0	5.6	9.4	85.0			
⊠	B-1	8.5 - 10	9.5	0.426			0.0	22.9	27.5	49.6			
▲	B-2	4 - 6	9.5				0.0	0.1	5.6	94.3			
★	B-2	6 - 7.5	9.5				0.0	1.6	17.0	81.3			

Atterberg Limit Results
ASTM D4318



	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	B-1	2 - 4	69	18	51	85.0	CH	FAT CLAY
⊠	B-1	8.5 - 10	42	14	28	49.6	SC	CLAYEY SAND with GRAVEL
▲	B-2	4 - 6	66	17	49	94.3	CH	FAT CLAY
★	B-2	6 - 7.5	35	17	18	81.3	CL	LEAN CLAY with SAND

Supporting Information

Contents:

General Notes

Unified Soil Classification System

Description of Rock Properties

Note: All attachments are one page unless noted above.

General Notes

Sampling	Water Level	Field Tests
 Rock Core  Shelby Tube  Standard Penetration Test	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time  Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		Consistency of Fine-Grained Soils (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		Bedrock		
Relative Density	Standard Penetration or N-Value (Blows/Ft.)	Consistency	Unconfined Compressive Strength Qu (tsf)	Standard Penetration or N-Value (Blows/Ft.)	Standard Penetration or N-Value (Blows/Ft.)	Consistency
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1	< 20	Weathered
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4	20 - 29	Firm
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	5 - 8	30 - 49	Medium Hard
Dense	30 - 50	Stiff	1.00 to 2.00	9 - 15	50 - 79	Hard
Very Dense	> 50	Very Stiff	2.00 to 4.00	16 - 30	>79	Very Hard
		Hard	> 4.00	> 30		

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification	
				Group Symbol	Group Name ^B
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	Cu≥4 and 1≤Cc≤3 ^E	GW	Well-graded gravel ^F
			Cu<4 and/or [Cc<1 or Cc>3.0] ^E	GP	Poorly graded gravel ^F
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}
			Fines classify as CL or CH	GC	Clayey gravel ^{F, G, H}
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	Cu≥6 and 1≤Cc≤3 ^E	SW	Well-graded sand ^I
			Cu<6 and/or [Cc<1 or Cc>3.0] ^E	SP	Poorly graded sand ^I
		Sands with Fines: More than 12% fines ^D	Fines classify as ML or MH	SM	Silty sand ^{G, H, I}
			Fines classify as CL or CH	SC	Clayey sand ^{G, H, I}
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	PI > 7 and plots above “A” line ^J	CL	Lean clay ^{K, L, M}
			PI < 4 or plots below “A” line ^J	ML	Silt ^{K, L, M}
		Organic:	$\frac{LL\text{ oven dried}}{LL\text{ not dried}} < 0.75$	OL	Organic clay ^{K, L, M, N} Organic silt ^{K, L, M, O}
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above “A” line	CH	Fat clay ^{K, L, M}
			PI plots below “A” line	MH	Elastic silt ^{K, L, M}
		Organic:	$\frac{LL\text{ oven dried}}{LL\text{ not dried}} < 0.75$	OH	Organic clay ^{K, L, M, P} Organic silt ^{K, L, M, Q}
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

- ^A Based on the material passing the 3-inch (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

^E $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

^F If soil contains ≥ 15% sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
- ^H If fines are organic, add "with organic fines" to group name.

^I If soil contains ≥ 15% gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

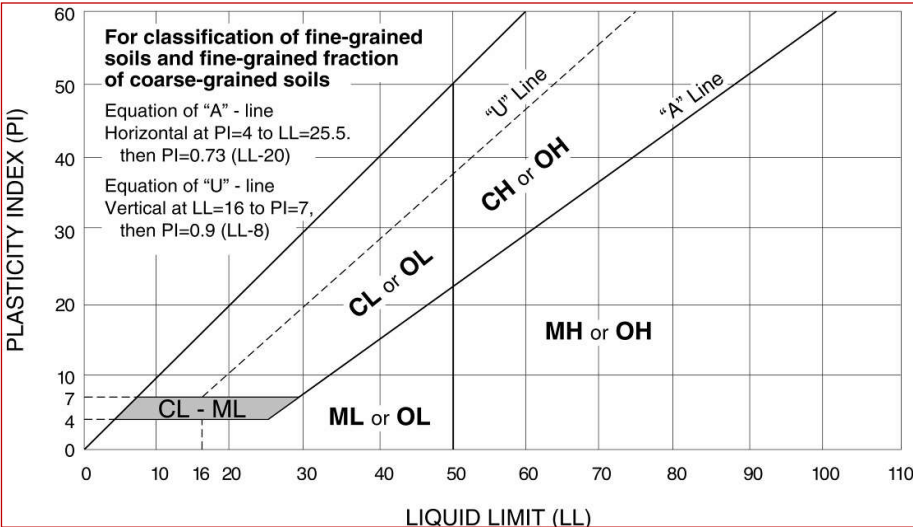
^M If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

^N PI ≥ 4 and plots on or above "A" line.

^O PI < 4 or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



Rock Classification Notes

WEATHERING			
Term	Description		
Fresh	Mineral crystals appear bright; show no discoloration. Features show little or no staining on surfaces. Discoloration does not extend into intact rock.		
Slightly weathered	Rock generally fresh except along fractures. Some fractures stained and discoloration may extend <0.5 inches into rock.		
Moderately weathered	Significant portions of rock are dull and discolored. Rock may be significantly weaker than in fresh state near fractures. Soil zones of limited extent may occur along some fractures.		
Highly weathered	Rock dull and discolored throughout. Majority of rock mass is significantly weaker and has decomposed and/or disintegrated; isolated zones of stronger rock and/or soil may occur throughout.		
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The rock mass or fabric is still evident and largely intact. Isolated zones of stronger rock may occur locally.		
STRENGTH OR HARDNESS			
Description	Field Identification	Uniaxial Compressive Strength, psi (tsf)	
Extremely strong	Can only be chipped with geological hammer. Rock rings on hammer blows. Cannot be scratched with a sharp pick. Hand specimens require several hard hammer blows to break.	>36,000 (>2,592)	
Very strong	Several blows of a geological hammer to fracture. Cannot be scratched with a 20d common steel nail. Can be scratched with a geologist’s pick only with difficulty.	15,000-36,000 (1,080-2,592)	
Strong	More than one blow of a geological hammer needed to fracture. Can be scratched with a 20d nail or geologist’s pick. Gouges or grooves to ¼ inch deep can be excavated by a hard blow of a geologist’s pick. Hand specimens can be detached by a moderate blow.	7,500-15,000 (540-1,080)	
Medium strong	One blow of geological hammer needed to fracture. Can be distinctly scratched with 20d nail. Can be grooved or gouged 1/16 in. deep by firm pressure with a geologist's pick point. Can be fractured with single firm blow of geological hammer. Can be excavated in small chips (about 1-in. maximum size) by hard blows of the point of a geologist’s pick;	3,500-7,500 (252-540)	
Weak	Shallow indent by firm blow with geological hammer point. Can be gouged or grooved readily with geologist's pick point. Can be excavated in pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.	700-3,500 (50.4-252)	
Very weak	Crumbles under firm blow with geological hammer point. Can be excavated readily with the point of a geologist's pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.	150-700 (10.8-50.4)	
DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		Bedding Spacing (May Include Foliation or Banding)	
Description	Spacing	Description	Spacing
Intensely fractured	< 2.5 inches	Laminated	< ½-inch
Highly fractured	2.5 – 8 inches	Very thin	½ – 2 inches
Moderately fractured	8 inches to 2 feet	Thin	2 inches – 1 foot
Slightly fractured	2 to 6.5 feet	Medium	1 – 3 feet
Very slightly fractured	> 6.5 feet	Thick	3 – 10 feet
		Massive	> 10 feet
ROCK QUALITY DESIGNATION (RQD) ¹			
Description		RQD Value (%)	
Very Poor		0 - 25	
Poor		25 – 50	
Fair		50 – 75	
Good		75 – 90	
Excellent		90 - 100	

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

For more location information
please visit www.strand.com

Office Locations

Ames, Iowa | 515.233.0000

Brenham, Texas | 979.836.7937

Cincinnati, Ohio | 513.861.5600

Columbus, Indiana | 812.372.9911

Columbus, Ohio | 614.835.0460

Joliet, Illinois | 815.744.4200

Lexington, Kentucky | 859.225.8500

Louisville, Kentucky | 502.583.7020

Madison, Wisconsin* | 608.251.4843

Milwaukee, Wisconsin | 414.271.0771

Nashville, Tennessee | 615.800.5888

Phoenix, Arizona | 602.437.3733

*Corporate Headquarters

