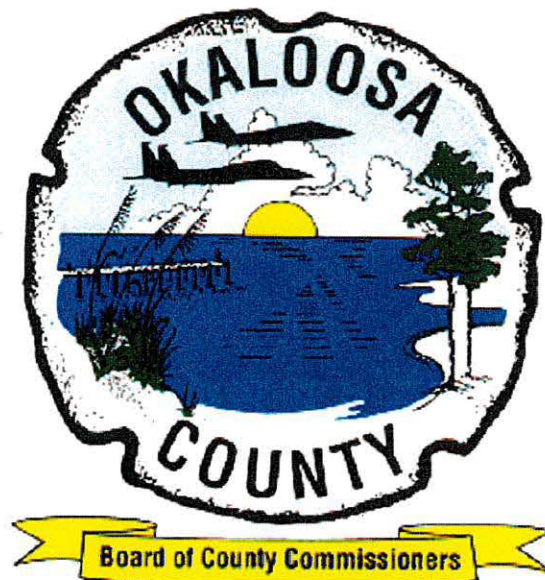


BID DOCUMENTS AND TECHNICAL SPECIFICATIONS

ARBENNIE PRITCHETT WRF RECLAIMED WATER EXPANSION PROJECT

PREPARED FOR THE
OKALOOSA COUNTY WATER & SEWER



ITB WS 07-19

March 2019
Project No. 100501



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INVITATION TO BID (ITB) & RESPONDENT'S ACKNOWLEDGEMENT

ITB TITLE:
Arbennie Pritchett WRF Reclaimed Water Expansion Project

ITB NUMBER:
ITB WS 07-19

ISSUE DATE: March 25, 2019 8:00 A.M. CT

MANDATORY PRE-BID MEETING: April 2, 2019 9:00 A.M. CT

LAST DAY FOR QUESTIONS: April 15, 2019 3:00 P.M. CT

ITB OPENING DATE & TIME: April 24, 2019 3:15 P.M. CT

NOTE: BIDS RECEIVED AFTER THE BID OPENING DATE & TIME WILL NOT BE CONSIDERED.

Okaloosa County, Florida solicits your company to submit a bid on the above referenced goods or services. All terms, specifications and conditions set forth in this ITB are incorporated into your response. A bid will not be accepted unless all conditions have been met. All bids must have an authorized signature in the space provided below. All bids must be sealed and received by the Okaloosa County Clerk of Court by the "ITB Opening Date & Time" referenced above. Okaloosa County is not responsible for lost or late delivery of bids by the U.S. Postal Service or other delivery services used by the respondent. Neither faxed nor electronically submitted bids will be accepted. Bids may not be withdrawn for a period of ninety (90) days after the bid opening unless otherwise specified

RESPONDENT ACKNOWLEDGEMENT FORM BELOW MUST BE COMPLETED, SIGNED, AND RETURNED AS PART OF YOUR BID. BIDS WILL NOT BE ACCEPTED WITHOUT THIS FORM, SIGNED BY AN AUTHORIZED AGENT OF THE RESPONDENT.

COMPANY NAME _____
MAILING ADDRESS _____
CITY, STATE, ZIP _____
FEDERAL EMPLOYER'S IDENTIFICATION NUMBER (FEIN): _____
TELEPHONE NUMBER: _____ EXT: _____ FAX: _____
EMAIL: _____

I CERTIFY THAT THIS BID IS MADE WITHOUT PRIOR UNDERSTANDING, AGREEMENT, OR CONNECTION WITH ANY OTHER RESPONDENT SUBMITTING A BID FOR THE SAME MATERIALS, SUPPLIES, EQUIPMENT OR SERVICES, AND IS IN ALL RESPECTS FAIR AND WITHOUT COLLUSION OR FRAUD. I AGREE TO ABIDE BY ALL TERMS AND CONDITIONS OF THIS BID AND CERTIFY THAT I AM AUTHORIZED TO SIGN THIS BID FOR THE RESPONDENT.

AUTHORIZED SIGNATURE: _____ TYPED OR PRINTED NAME _____

TITLE: _____ DATE _____

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NOTICE TO RESPONDENTS
ITB WS 07-19

Notice is hereby given that the Board of County Commissioners of Okaloosa County, FL, will accept sealed bids until **3:15 p.m. (CST) April 24, 2019**, for **Arbennie Pritchett WRF Reclaimed Water Expansion Project**. Interested respondents desiring consideration shall provide an original and two (2) copies (total three (3)) of their Invitation to Bids (ITB) response with the respondent's areas of expertise identified. Submissions shall be portrait orientation, unbound, and 8 1/2" x 11" where practical. All originals must have original signatures in blue ink.

Bid Documents can be viewed at <https://www.bidnetdirect.com/florida> or at <http://www.co.okaloosa.fl.us/purchasing/home> then accessing the link "View Current Solicitations"

A mandatory pre-bid conference is scheduled for 9:00 am (local time) on April 2, 2019. The conference will be held at the Okaloosa County Water & Sewer Administration Building, Small Conference Room, 1804 Lewis Turner Blvd, #300, Fort Walton Beach, Florida, 32547. You must attend this pre-bid conference in order to submit a bid.

At **3:15 p.m. (CST), April 24, 2019**, all bids will be opened and read aloud. All bids must be in sealed envelopes reflecting on the outside thereof the Respondent's name and "**Arbennie Pritchett WRF Reclaimed Water Expansion Project**". The Board of County Commissioners will consider all bids properly submitted at its scheduled bid opening in the Okaloosa County Courthouse located at 101 E. James Lee Boulevard #282, Crestview, FL 32536. Bids may be submitted in the prior to bid opening or delivered to the Clerk of Circuit Court, 101 E. James Lee Boulevard, #282, Crestview, FL 32536. **NOTE: MUST RING DOORBELL TO GAIN ENTRANCE INTO ROOM 282. THE CLERK WILL COME ACCEPT YOUR PACKAGE OR SHOW YOU TO THE CONFERENCE ROOM FOR THE SCHEDULED BID OPENING**

NOTE: THE NEW CRESTVIEW COURTHOUSE HAS SECURITY AT ENTRY POINT-PLEASE ALLOW FOR TIME TO GET THROUGH SECURITY WHEN ARRIVING FOR THE BID OPENING. *NOTE: Crestview, FL is not a next day guaranteed delivery location by most delivery services.** Respondents using mail or delivery services assume all risks of late or non-delivery.

The County reserves the right to award the bid to the lowest responsive respondent and to waive any irregularity or technicality in bids received. Okaloosa County shall be the sole judge of the bid and the resulting negotiated agreement that is in its best interest and its decision shall be final.

Any Respondent failing to mark outside of the envelope as set forth herein may not be entitled to have their bid considered.

All bids should be addressed as follows:

**Arbennie Pritchett WRF Reclaimed Water
Expansion Project**

Clerk of Circuit Court

Attn: BCC Records

101 E. James Lee Boulevard., #282

Crestview FL 32536

Jeff Hyde

Purchasing Manager

Date

OKALOOSA COUNTY
BOARD OF COUNTY COMMISSIONERS

Charles K. Windes, Jr. Chairman

BID REQUIREMENTS

BID #: ITB WS 07-19

BID ITEM: Arbennie Pritchett WRF Reclaimed Water Expansion Project

SCOPE

This bid includes the material, equipment, and labor services for a new chlorine contact basin (CCB), reclaimed pumping station using Owner Pre-Purchased vertical turbine pumps, chemical feed system and prefabricated concrete building, a new 4.0 MGD Tertiary Filtration Unit and relocation of an existing onsite unit, interconnecting piping, electrical and control integration and associated site work, start-up service, and other associated items specified herein and all other appurtenances and related work required to complete the Work. No substitutions will be accepted unless approved by the Purchasing and the Water & Sewer Department. **Note: Evaluation of bid will be based on “TOTAL BASE BID AMOUNT”. All bids shall include itemized unit cost for each identified item.**

Coordination of OWNER Furnished Equipment (FOB)

BIDDER shall include in the Lump Sum Amount all cost, including labor and materials necessary to manage, coordinate delivery, storage, and install the OWNER Furnished Equipment (FOB) as listed below. No additional compensation will be made for this Coordination and Work. Refer to Section 01010 “SUMMARY OF WORK”.

OWNER FURNISHED EQUIPMENT

- a. Two (2) Goulds 125 HP Vertical Turbine Pumps (Morrow Water)**
- b. Two (2) Goulds 50 HP Vertical Turbine Pumps (Morrow Water)**

Price shall be guaranteed for 90 days after the bids are read and received. Price shall include delivery of all equipment and appurtenances.

Coordination of OWNER Furnished Construction Water

Contractor is required to coordinate submittal, fabrication and shipping once a construction contract has been executed between the County and a Contractor. For any construction water utilized via a hydrant meter, the contractor shall setup an account with OCWS' Customer Service office and provide contract information. The account shall be setup in the contractor's name with a deposit and service fee paid by the contractor. The deposit will be refunded when the account terminates if the meter has not been damaged or lost. OCWS will be responsible for setting the hydrant, along with the monthly reading. If the hydrant meter needs to be relocated, contractor to coordinate this with OCWS Maintenance. Water usage will not be charged to the contractor, provided that the above conditions are met.

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GENERAL SERVICES INSURANCE REQUIREMENTS

REVISED: 08/1/2018

CONTRACTORS INSURANCE

1. The Contractor shall not commence any work in connection with this Agreement until he has obtained all required insurance and such insurance has been approved by the Okaloosa County Risk Manager or designee.
2. All insurance policies shall be with insurers authorized to do business in the State of Florida.
3. All insurance shall include the interest of all entities named and their respective officials, employees & volunteers of each and all other interests as may be reasonably required by Okaloosa County. The coverage afforded the Additional Insured under this policy shall be primary insurance. If the Additional Insured have other insurance that is applicable to the loss, such other insurance shall be on an excess or contingent basis. The amount of the company's liability under this policy shall not be reduced by the existence of such other insurance.
4. The County shall be shown as an Additional Insured on ALL policies with a Waiver of Subrogation on the Certificate of Insurance.
5. The County shall retain the right to reject all insurance policies that do not meet the requirement of this Agreement. Further, the County reserves the right to change these insurance requirements with 60-day notice to the Contractor.
6. The County reserves the right at any time to require the Contractor to provide copies (redacted if necessary) of any insurance policies to document the insurance coverage specified in this Agreement.
7. The designation of Contractor shall include any associated or subsidiary company which is involved and is a part of the contract and such, if any associated or subsidiary company involved in the project must be named in the Workers' Compensation coverage.
8. Any exclusions or provisions in the insurance maintained by the Contractor that excludes coverage for work contemplated in this agreement shall be deemed unacceptable and shall be considered breach of contract.

WORKERS' COMPENSATION INSURANCE

1. The Contractor shall secure and maintain during the life of this Agreement Workers' Compensation insurance for all of his employees employed for the project or any site connected with the work, including supervision, administration or management, of this project and in case any work is sublet, with the approval of the County, the Contractor shall require the Subcontractor similarly to provide Workers' Compensation insurance for all employees employed at the site of the project, and such evidence of insurance shall be furnished to the County not less than ten (10) days prior to the commencement of any and all sub-contractual Agreements which have been approved by the County.
2. Contractor must be in compliance with all applicable State and Federal workers' compensation laws, including the U.S. Longshore Harbor Workers' Act or Jones Act, if applicable.

3. No class of employee, including the Contractor himself, shall be excluded from the Workers' Compensation insurance coverage. The Workers' Compensation insurance shall also include Employer's Liability coverage.

BUSINESS AUTOMOBILE LIABILITY

Coverage must be afforded for all Owned, Hired, Scheduled, and Non-Owned vehicles for Bodily Injury and Property Damage in an amount not less than \$1,000,000 combined single limit each accident. If the contractor does not own vehicles, the contractor shall maintain coverage for Hired & Non-Owned Auto Liability, which may be satisfied by way of endorsement to the Commercial General Liability policy or separate Business Auto Policy. Contractor must maintain this insurance coverage throughout the life of this Agreement. In addition, the County shall be shown as Additional Insured.

COMMERCIAL GENERAL LIABILITY INSURANCE

1. The Contractor shall carry other Commercial General Liability insurance against all other Bodily Injury, Property Damage and Personal and Advertising Injury exposures.
2. All liability insurance (other than Professional Liability) shall be written on an occurrence basis and shall not be written on a claims-made basis. If the insurance is issued with an aggregate limit of liability, the aggregate limit of liability shall apply only to the locations included in this Agreement. If, as the result of any claims or other reasons, the available limits of insurance reduce to less than those stated in the Limits of Liability, the Contractor shall notify the County representative in writing. The Contractor shall purchase additional liability insurance to maintain the requirements established in this Agreement. Umbrella or Excess Liability insurance can be purchased to meet the Limits of Liability specified in this Agreement.
3. Commercial General Liability coverage shall include the following:
 - 1.) Premises & Operations Liability
 - 2.) Bodily Injury and Property Damage Liability
 - 3.) Independent Contractors Liability
 - 4.) Contractual Liability
 - 5.) Products and Completed Operations Liability
4. Contractor shall agree to keep in continuous force Commercial General Liability coverage for the length of the contract.

ENVIRONMENTAL IMPAIRMENT LIABILITY INSURANCE

Environmental Impairment Liability Insurance in the amount of \$2 million per claim to include Third Party liability, remediation and cleanup costs as well hazardous waste transportation coverage. Okaloosa County Board of County Commissioners is to be listed as Additional Insured.

LIMITS OF LIABILITY

The insurance required shall be written for not less than the following, or greater if required by law and shall include Employer's liability with limits as prescribed in this contract:

		<u>LIMIT</u>
1.	Worker's Compensation	
	1.) State	Statutory
	2.) Employer's Liability	\$500,000 each accident
2.	Business Automobile	\$1,000,000 each accident (A combined single limit)
3.	Commercial General Liability	\$1,000,000 each occurrence for Bodily Injury & Property Damage \$1,000,000 each occurrence Products and completed operations
4.	Personal and Advertising Injury	\$1,000,000 each occurrence
5.	Environmental Insurance	\$2,000,000 each occurrence

NOTICE OF CLAIMS OR LITIGATION

The Contractor agrees to report any incident or claim that results from performance of this Agreement. The County representative shall receive written notice in the form of a detailed written report describing the incident or claim within ten (10) days of the Contractor's knowledge. In the event such incident or claim involves injury and/or property damage to a third party, verbal notification shall be given the same day the Contractor becomes aware of the incident or claim followed by a written detailed report within ten (10) days of verbal notification.

INDEMNIFICATION & HOLD HARMLESS

Contractor shall indemnify and hold harmless the County, its officers and employees from liabilities, damages, losses, and costs including but not limited to reasonable attorney fees, to the extent caused by the negligence, recklessness, or wrongful conduct of the Contractor and other persons employed or utilized by the Contractor in the performance of this contract.

Note: For Contractor's convenience, this certification form is enclosed and is made a part of the bid package.

CERTIFICATE OF INSURANCE

1. Certificates of insurance indicating the job site and evidencing all required coverage must be submitted not less than 10 days prior to the commencement of any of the work. The certificate holder(s) shall be as follows: Okaloosa County, 5479A Old Bethel Road, Crestview, Florida, 32536.
2. The contractor shall provide a Certificate of Insurance to the County with a thirty (30) day notice of cancellation; ten (10 days' notice if cancellation is for nonpayment of premium).
3. In the event that the insurer is unable to accommodate the cancellation notice requirement, it shall be the responsibility of the contractor to provide the proper notice. Such notification shall be in writing by registered mail, return receipt requested, and addressed to the Okaloosa County Purchasing Department at 5479-A Old Bethel Road, Crestview, FL 32536.
4. In the event the contract term goes beyond the expiration date of the insurance policy, the contractor shall provide the County with an updated Certificate of insurance no later than ten (10) days prior to

the expiration of the insurance currently in effect. The County reserves the right to suspend the contract until this requirement is met.

5. The certificate shall indicate if coverage is provided under a claims-made or occurrence form. If any coverage is provided on a claims-made form, the certificate will show a retroactive date, which should be the same date of the initial contract or prior.
6. All certificates shall be subject to Okaloosa County's approval of adequacy of protection and the satisfactory character of the Insurer.
7. All deductibles or SIRs, whether approved by Okaloosa County or not, shall be the Contractor's full responsibility. In particular, the Contractor shall afford full coverage as specified herein to entities listed as Additional Insured.
8. In no way will the entities listed as Additional Insured be responsible for, pay for, be damaged by, or limited to coverage required by this schedule due to the existence of a deductible or SIR.

GENERAL TERMS

Any type of insurance or increase of limits of liability not described above which, the Contractor required for its own protection or on account of statute shall be its own responsibility and at its own expense.

Any exclusions or provisions in the insurance maintained by the contractor that excludes coverage for work contemplated in this contract shall be deemed unacceptable and shall be considered breach of contract.

The carrying of the insurance described shall in no way be interpreted as relieving the Contractor of any responsibility under this contract.

Should the Contractor engage a subcontractor or sub-subcontractor, the same conditions will apply under this Agreement to each subcontractor and sub-subcontractor.

The Contractor hereby waives all rights of subrogation against Okaloosa County and its consultants and other indemnities of the Contractor under all the foregoing policies of insurance.

UMBRELLA INSURANCE

The Contractor shall have the right to meet the liability insurance requirements with the purchase of an umbrella insurance policy. In all instances, the combination of primary and umbrella liability coverage must equal or exceed the minimum liability insurance limits stated in this Agreement.

GENERAL SERVICES BID CONDITIONS

1. PRE-BID ACTIVITY -

Addendum - Except as provided in this section, respondents are prohibited from contacting or lobbying the County, County Administrator, Commissioners, County staff, and Review Committee members, or any other person authorized on behalf of the County related or involved with the solicitation. All inquiries on the scope of work, specifications, additional requirements, attachments, terms and general conditions or instructions, or any issue must be directed in writing, by US mail or email to:

DeRita Mason
Contracts and Lease Coordinator
Okaloosa County Purchasing Department
5479A Old Bethel Road
Crestview, Florida 32536
(850) 689-5960 dmason@myokaloosa.com

All questions or inquiries must be received no later than the last day for questions (reference ITB & Respondent's Acknowledgement form). Any addenda or other modification to the bid documents will be issued by the County five (5) days prior to the date and time of bid closing, as written addenda, and will be posted to <http://www.bidnetdirect.com/florida> and the Okaloosa County website at <http://www.co.okaloosa.fl.us/purchasing/current-solicitations>.

Such written addenda or modification shall be part of the bid documents and shall be binding upon each respondent. Each respondent is required to acknowledge receipt of any and all addenda in writing and submit with their bid. No respondent may rely upon any verbal modification or interpretation.

- 2. PREPARATION OF BID** – The bid form is included with the bid documents. Additional copies may be obtained from the County. The respondent shall submit an original and two (2) copies {total three (3)} of the bid documents.

All blanks in the bid documents shall be completed by printing in ink or by typewriter in both words and numbers with the amounts extended, totaled and the bid signed. A bid price shall be indicated for each section, bid item, alternative, adjustment unit price item, and unit price item listed therein, or the words “No Bid”, “No Change”, or “Not Applicable” entered. No changes shall be made to the phraseology of the form or in the items mentioned therein. In case of any discrepancy between the written amount and the numerical figures, the written amount shall govern. Any bid which contains any omissions, erasures, alterations, additions, irregularities of any kind, or items not called for which shall in any manner fail to conform to the conditions of public notice inviting bids may be rejected.

A bid submitted by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature). The official address of the partnership shall be shown below the signature.

A bid submitted by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown below the signature.

A bid submitted by an individual shall show the respondent's name and official address.

A bid submitted by a joint venture shall be executed by each joint venture in the manner indicated on the bid form. The official address of the joint venture must be shown below the signature.

It is preferred that all signatures be in blue ink with the names type or printed below the signature. Okaloosa County does not accept electronic signatures.

The bid shall contain an acknowledgement of receipt of all Addenda, the numbers of which shall be filled in on the form. The address and telephone # for communications regarding the bid shall be shown.

If the respondent is an out-of-state corporation, the bid shall contain evidence of respondent's authority and qualification to do business as an out-of-state corporation in the State of Florida in accordance with Article 3. A state contractor license # for the State of Florida shall also be included on the bid form. Respondent shall be licensed in accordance with the requirements of Chapter 489, Florida Statutes.

3. **INTEGRITY OF BID DOCUMENTS** - Respondents shall use the original Bid documents provided by the Purchasing Department and enter information only in the spaces where a response is requested. Respondents may use an attachment as an addendum to the Bid documents if sufficient space is not available. Any modifications or alterations to the original bid documents by the respondent, whether intentional or otherwise, will constitute grounds for rejection of a bid. Any such modification or alteration that a respondent wishes to propose must be clearly stated in the respondent's response in the form of an addendum to the original bid documents.
4. **SUBMITTAL OF BID** – A bid shall be submitted no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid and shall be enclosed in an opaque sealed envelope plainly marked with the project title (and, if applicable, the designated portion of the project for which the bid is submitted), the name and address of the respondent, and shall be accompanied by the bid security and other required documents. It is the respondent's responsibility to assure that its bid is delivered at the proper time and place. Offers by telegram, facsimile, or telephone will **NOT** be accepted.

Note: Crestview is not a next day delivery site for overnight carriers.

5. **MODIFICATION & WITHDRAWAL OF BID** - A bid 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 prior to the date and time for the opening of bids.

If within 24 hours after bids are opened any respondent files a duly signed written notice with the County and promptly thereafter demonstrates to the reasonable satisfaction of the County that there was a material substantial mistake in the preparation of its bid, that respondent may withdraw its bid, and the bid security may be returned. Thereafter, if the work is rebid, that respondent will be disqualified from 1) further bidding on the work, and 2) doing any work on the contract, either as a subcontractor or in any other capacity.

6. **BIDS TO REMAIN SUBJECT TO ACCEPTANCE** – All bids will remain subject to acceptance or rejection for ninety (90) calendar days after the day of the bid opening, but the County may, in its sole discretion, release any bid and return the bid security prior to the end of this period.

7. **IDENTICAL TIE BIDS** – In case of identical procurement responses, the award shall be determined either by lot or on the basis of factors deemed to serve the interest of the County. In the case of the latter, there must be adequate documentation to support such a decision.
8. **CONDITIONAL & INCOMPLETE BIDS** - Okaloosa County specifically reserves the right to reject any conditional bid and bids which make it impossible to determine the true amount of the bid.
9. **BID PRICE** – The bid price shall include all equipment, labor, materials, permit(s), freight, taxes, required insurance, Public Liability, Property Damage and Workers’ Compensation, etc. to cover the finished work called for.
10. **ADDITION/DELETION OF ITEM** – The County reserves the right to add or delete any item from this bid or resulting contract when deemed to be in the County’s best interest.
11. **SPECIFICATION EXCEPTIONS** – Specifications are based on the most current literature available. Respondent shall clearly list any change in the manufacturer’s specifications which conflict with the bid specifications. Respondent must also explain any deviation from the bid specification in writing, as a foot note on the applicable bid page and enclose a copy of the manufacturer’s specifications data detailing the changed item(s) with their bid. Failure of the respondent to comply with these provisions will result in respondents being held responsible for all costs required to bring the equipment in compliance with bid specifications.
12. **APPLICABLE LAWS & REGULATIONS** – All applicable Federal and State laws, County and municipal ordinances, orders, rules and regulations of all authorities having jurisdiction over the project shall apply to the bid throughout, and they will be deemed to be included in the contract the same as though they were written in full therein.
13. **DISQUALIFICATION OF RESPONDENTS** - Any of the following reasons may be considered as sufficient for the disqualification of a respondent and the rejection of its bid:
 - a. Submission of more than one bid for the same work from an individual, firm or corporation under the same or different name.
 - b. Evidence that the respondent has a financial interest in the firm of another respondent for the same work.
 - c. Evidence of collusion among respondents. Participants in such collusion will receive no recognition as respondents for any future work of the County until such participant has been reinstated as a qualified respondent.
 - d. Uncompleted work which in the judgment of the County might hinder or prevent the prompt completion of additional work if awarded.
 - e. Failure to pay or satisfactorily settle all bills due for labor and material on former contracts in force at the time of advertisement of bids.
 - f. Default under previous contract.
 - g. Listing of the respondent by the Local, State or Federal Government on its barred/suspended vendor list.

14. AWARD OF BID

- a. **Okaloosa County Review** - Okaloosa County designated Staff will review all bids and will participate in the Recommendation to Award.
- b. The County will award the bid to the lowest respondent, and the County reserves the right to award the bid to the respondent submitting a responsive bid with a resulting negotiated agreement which is most advantageous and in the best interest of the County, and to reject any and all bids or to waive any irregularity or technicality in bids received. Okaloosa County shall be the sole judge of the bid and the resulting negotiated agreement that is in its best interest and its decision shall be final.
- c. Okaloosa County reserves the right to waive any informalities or reject any and all bids, in whole or part, to utilize any applicable state contracts in lieu of or in addition to this bid and to accept the bid that in its judgment will best serve the interest of the County.
- d. Okaloosa County specifically reserves the right to reject any conditional bids and will normally reject those which made it impossible to determine the true amount of the bid. Each item must be bid separately and no attempt is to be made to tie any item or items to any other item or items.

15. WARRANTY – (The warranty will be in the name of Okaloosa County) Warranty work specified herein is for defects in materials and in labor and workmanship. State the manufacturer’s warranty with your bid. A minimum of 1 year on parts and labor is required from the date of acceptance, or the manufacturer’s warranty, whichever is longer.

16. PAYMENTS – The respondent shall be paid upon submission of invoices and approval of acceptance by Okaloosa County Board of County Commissioners, Finance Office, 302 N. Wilson St., #203, Crestview FL 32536, for the prices stipulated herein for articles delivered and accepted. Invoices must show Contract #.

17. DISCRIMINATION - An entity or affiliate who has been placed on the discriminatory vendor list may not submit a bid on a contract to provide goods or services to a public entity, may not submit a bid on a contract with a public entity for the construction or repair of a public building or public work, may not submit bids on leases of real property to a public entity, may not award or perform work as a contractor, supplier, subcontractor, or consultant under contract with any public entity, and may not transact business with any public entity.

18. PUBLIC ENTITY CRIME INFORMATION - Pursuant to Florida Statute 287.133, a respondent may not be awarded or perform work as a contractor, supplier, subcontractor, or consultant under a contract with any public entity; and may not transact business with any public entity in excess of the threshold amount provided in s. [287.017](#) for CATEGORY TWO for a period of 36 months following the date of being placed on the convicted vendor list.

19. CONFLICT OF INTEREST - The award hereunder is subject to the provisions of Chapter 112, Florida Statutes. All respondents must disclose with their bids the name of any officer, director, or agent who is also a public officer or an employee of the Okaloosa Board of County Commissioners, or any of its agencies. Furthermore, all respondents must disclose the name of any County officer or employee who owns, directly or indirectly, an interest of five percent (5%) or more in the firm or any of its branches.

Note: For respondent's convenience, this certification form is enclosed and is made a part of the bid package.

- 20. REORGANIZATION OR BANKRUPTCY PROCEEDINGS** – Bids will not be considered from respondents who are currently involved in official financial reorganization or bankruptcy proceedings.
- 21. INVESTIGATION OF RESPONDENT** – The County may make such investigations, as it deems necessary to determine the stability of the respondent to perform the work and that there is no conflict of interest as it relates to the project. The respondent shall furnish to the Owner any additional information and financial data for this purpose as the County may request.
- 22. CONE OF SILENCE** - The Okaloosa County Board of County Commissioners has established a solicitation silence policy (**Cone of Silence**) that prohibits oral and written communication regarding all formal solicitations for goods and services (formal proposals, Request for Proposals, Requests for Qualifications) issued by the Board through the County Purchasing Department. The period commences from the date of advertisement until award of contract.

Note: For respondent's convenience, this certification form is enclosed and is made a part of the bid package.

- 23. REVIEW OF PROCUREMENT DOCUMENTS** - Per Florida Statute 119.071 (2) 2 sealed bids, proposals, or replies received by the County pursuant to a competitive solicitation are exempt from public disclosure until such time as the County provides notice of an intended decision or until 30 days after opening the bids, proposals, or final replies, whichever is earlier.
- 24. COMPLIANCE WITH FLORIDA STATUTE 119.0701** - The Respondent shall comply with all the provisions of section 119.0701, Florida Statutes relating to the public records which requires, among other things, that the Respondent: (a) Keep and maintain public records; (b) Provide the public with access to public records on the same terms and conditions that the public agency would provide the records; (c) ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law; and (d) Meet all requirements for retaining public records and transfer, at no cost, to the public agency all public records in possession of the respondent upon termination of the contract.
- 25. PUBLIC RECORDS** - Any record created by either party in accordance with this Contract shall be retained and maintained in accordance with the public records law, Florida Statutes, Chapter 119.

IF THE CONTRACTOR HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO THE CONTRACTOR'S DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS CONTRACT, CONTACT THE CUSTODIAN OF PUBLIC RECORDS AT OKALOOSA COUNTY RISK MANAGEMENT DEPARTMENT 5479 OLD BETHEL ROAD CRESTVIEW, FL 32536 PHONE: (850) 689-5977 riskinfo@myokaloosa.com.

Contractor must comply with the public records laws, Florida Statute chapter 119, specifically Contractor must:

1. Keep and maintain public records required by the County to perform the service.
2. Upon request from the County's custodian of public records, provide the County with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at a

cost that does not exceed the cost provided in chapter 119 Florida Statutes or as otherwise provided by law.

3. Ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law for the duration of the contract term and following completion of the contract if the contractor does not transfer the records to the County.

4. Upon completion of the contract, transfer, at no cost, to the County all public records in possession of the contractor or keep and maintain public records required by the County to perform the service. If the contractor transfers all public records to the public agency upon completion of the contract, the contractor shall destroy any duplicate public records that are exempt or confidential and exempt from public records disclosure requirements. If the contractor keeps and maintains public records upon completion of the contract, the contractor shall meet all applicable requirements for retaining the public records. All records stored electronically must be provided to the public agency, upon the request from the public agency's custodian of public records, in a format that is compatible with the information technology systems of the public agency.

26. PROTECTION OF RESIDENT WORKERS – The Okaloosa County Board of County Commissioners actively supports the Immigration and Nationality Act (INA) which includes provisions addressing employment eligibility, employment verifications, and nondiscrimination. Under the INA, employers may hire only persons who may legally work in the United States (i.e., citizens and nationals of the U.S.) and aliens authorized to work in the U.S. The employer must verify the identity and employment eligibility of anyone to be hired, which includes completing the Employment Eligibility Verifications. The respondent shall establish appropriate procedures and controls so no services or products under the Contract Documents will be performed or manufactured by any worker who is not legally eligible to perform such services or employment. Okaloosa County reserves the right to request documentation showing compliance with the requirements.

Respondents doing construction business with Okaloosa County are required to use the Federal Government Department of Homeland Security's website and use the E-Verify Employment Eligibility Verifications System to confirm eligibility of all employees to work in the United States.

27. SUSPENSION OR TERMINATION FOR CONVENIENCE - The County may, at any time, without cause, order Respondent in writing to suspend, delay or interrupt the work in whole or in part for such period of time as the County may determine, or to terminate all or a portion of the Contract for the County's convenience. Upon such termination, the Contract Price earned to the date of termination shall be paid to Respondent, but Respondent waives any claim for damages, including loss of profits arising out of or related to the early termination. Those Contract provisions which by their nature survive final acceptance shall remain in full force and effect. If the County orders a suspension, the Contract price and Contract time may be adjusted for increases in the cost and time caused by suspension, delay or interruption. No adjustment shall be made to the extent that performance is, was or would have been so suspended, delayed or interrupted by reason for which Respondent is responsible; or that an equitable adjustment is made or denied under another provision of this Contract.

28. FAILURE OF PERFORMANCE/DELIVERY - In case of default by the respondent, the County after due notice (oral or written) may procure the necessary supplies or services from other sources and hold the respondent responsible for difference in cost incurred. Continuous instances of default shall result in cancellation of the award and removal of the respondent from the bid list for duration of one (1) year, at the option of the County.

- 29. AUDIT** - If requested, respondent shall permit the County or an authorized, independent audit agency to inspect all data and records of respondent relating to its performance and its subcontracts under this bid from the date of the award through and until the expiration of contract.
- 30. EQUAL EMPLOYMENT OPPORTUNITY; NON DISCRIMINATION** – Respondent will not discriminate against any employee or an applicant for employment because of race, color, religion, gender, sexual orientation, national origin, age, familial status or handicap.
- 31. NON-COLLUSION** – Respondent certifies that it has entered into no agreement to commit a fraudulent, deceitful, unlawful or wrongful act, or any act which may result in an unfair advantage over other respondents. See Florida Statute 838.22.
- 32. UNAUTHORIZED ALIENS/PATRIOT’S ACT** – The knowing employment by respondent or its subcontractors of any alien not authorized to work by the immigration laws is prohibited and shall be a default of the contract. In the event that the respondent is notified or becomes aware of such default, the respondent shall take steps as are necessary to terminate said employment with 24 hours of notification or actual knowledge that an alien is being employed. Respondent’s failure to take such steps as are necessary to terminate the employment of any said alien within 24 hours of notification or actual knowledge that an alien is being employed shall be grounds for immediate termination of the contract. Respondent shall take all commercially reasonable precautions to ensure that it and its subcontractors do not employ persons who are not authorized to work by the immigration laws.
- 33. EQUIPMENT ACCEPTANCE** - Delivery of material to Okaloosa Board of County Commissioners does not constitute acceptance for the purpose of payment. Final acceptance and authorization of payment shall be given only after a thorough inspection indicates that the material meets contract specifications and conditions as listed. Should the delivered material differ in any respect from specifications, payment will be withheld until such time as the supplier takes necessary corrective action. The Purchasing Department shall be notified of the deviation in writing within 10 days and the provisions of the delivery paragraph shall prevail. If the proposed corrective action is not acceptable to Okaloosa County, the final acceptance of the material shall remain the property of the supplier and the county shall not be liable for payment for any portion thereof.
- 34. TERMS AND CONDITIONS** – All bidders shall review the Terms and Conditions attached hereto and if the Board accepts their bid and executes a contract, the bidder awarded the contract (Seller) shall agree to the Terms and Conditions, completely, and agree to furnish the materials and services specified herein in accordance with the Specifications and Terms and Conditions herein.
- 35. DELIVERY SCHEDULE**- Submittal data to be delivered for approval with the Bid. Operation & Maintenance manuals to be delivered for approval no later than 30 calendar days prior to start-up and after receipt of Approved or Approved as Noted submittal data. Delivery of on-site Equipment/Materials shall be no later than calendar days identified on the Bid, after receipt of Purchase Order and shall be coordinated with the on-site installation Contractor.
- 36. The following documents are to be submitted with the proposal packet:**
- A. Drug-Free Workplace Certification Form
 - B. Conflict of Interest
 - C. Federal E-Verify
 - D. Indemnification and Hold Harmless

- E. Certification Regarding Lobbying Proposal Sheet
- F. Cone of Silence
- G. Company Data
- H. System of Awards Management
- I. Addendum Acknowledgement
- J. Bid Form
- K. Anti-Collusion Statement
- L. Government Debarment & Suspension
- M. Bid Bond
- N. Qualifications Statement
- O. Schedule A, B and C

DRUG-FREE WORKPLACE CERTIFICATION

THE BELOW SIGNED RESPONDENT CERTIFIES that it has implemented a drug-free workplace program. In order to have a drug-free workplace program, a business shall:

1. Publish a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the workplace and specifying the actions that will be taken against employees for violations of such prohibition.
2. Inform employees about the dangers of drug abuse in the workplace, the business's policy of maintaining a drug-free workplace, any available drug counseling, rehabilitation and employee assistance programs, and the penalties that may be imposed upon employees for drug abuse violations.
3. Give each employee engaged in providing the commodities or contractual services that are under quote a copy of the statement specified in subsection 1.
4. In the statement specified in subsection 1, notify the employees that, as a condition of working on the commodities or contractual services that are under quote, the employee will abide by the terms of the statement and will notify the employer of any conviction of, or plea of guilty or nolo contendere to, any violation of Chapter 893, Florida Statutes, or of any controlled substance law of the United States or any state, for a violation occurring in the workplace no later than five (5) days after such conviction.
5. Impose a sanction on, or require the satisfactory participation in, drug abuse assistance or rehabilitation program if such is available in employee's community, by any employee who is convicted.
6. Make a good faith effort to continue to maintain a drug-free workplace through implementation of this section.

As the person authorized to sign this statement, I certify that this firm complies fully with the above requirements.

DATE: _____

SIGNATURE: _____

COMPANY: _____

NAME: _____

(Typed or Printed)

ADDRESS: _____

TITLE: _____

E-MAIL: _____

PHONE NO.: _____

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CONFLICT OF INTEREST DISCLOSURE FORM

For purposes of determining any possible conflict of interest, all respondents, must disclose if any Okaloosa Board of County Commissioner, employee(s), elected officials(s), or if any of its agencies is also an owner, corporate officer, agency, employee, etc., of their business.

Indicate either “yes” (a county employee, elected official, or agency is also associated with your business), or “no”. If yes, give person(s) name(s) and position(s) with your business.

YES _____

NO _____

NAME(S)

POSITION(S)

FIRM NAME: _____

BY (PRINTED): _____

BY (SIGNATURE): _____

TITLE: _____

ADDRESS: _____

PHONE NO. _____

E-MAIL _____

DATE _____

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FEDERAL E-VERIFY COMPLIANCE CERTIFICATION

In accordance with Okaloosa County Policy and Executive Order Number 11-116 from the office of the Governor of the State of Florida, Respondent hereby certifies that the U.S. Department of Homeland Security's E-Verify system will be used to verify the employment eligibility of all new employees hired by the respondent during the contract term, and shall expressly require any subcontractors performing work or providing services pursuant to the contract to likewise utilize the U.S. Department of Homeland Security's E-Verify system to verify the employment eligibility of all new employees hired by the subcontractor during the contract term; and shall provide documentation such verification to the COUNTY upon request.

As the person authorized to sign this statement, I certify that this company complies/will comply fully with the above requirements.

DATE: _____

SIGNATURE: _____

COMPANY: _____

NAME: _____

ADDRESS: _____

TITLE: _____

E-MAIL: _____

PHONE NO.: _____

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INDEMNIFICATION AND HOLD HARMLESS

Respondent shall indemnify and hold harmless the County, its officers and employees from liabilities, damages, losses, and costs including but not limited to reasonable attorney fees, to the extent caused by the negligence, recklessness, or intentional wrongful conduct of the Respondent and other persons employed or utilized by the Respondent in the performance of this Agreement.

_____ Respondent's Company Name	_____ Authorized Signature – Manual
_____ Physical Address	_____ Authorized Signature – Typed
_____ Mailing Address	_____ Title
_____ Phone Number	_____ FAX Number
_____ Cellular Number	_____ After-Hours Number(s)
_____ Date	_____ Email

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LOBBYING - 31 U.S.C. 1352, 49 CFR Part 19, 49 CFR Part 20

APPENDIX A, 49 CFR PART 20--CERTIFICATION REGARDING LOBBYING

Certification for Contracts, Grants, Loans, and Cooperative Agreements

(To be submitted with each bid or offer exceeding \$100,000)

The undersigned [Contractor] certifies, to the best of his or her knowledge and belief, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for making lobbying contacts to an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form--LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions [as amended by "Government wide Guidance for New Restrictions on Lobbying," 61 Fed. Reg. 1413 (1/19/96). Note: Language in paragraph (2) herein has been modified in accordance with Section 10 of the Lobbying Disclosure Act of 1995 (P.L. 104-65, to be codified at 2 U.S.C. 1601, *et seq.*.)]
3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31, U.S.C. § 1352 (as amended by the Lobbying Disclosure Act of 1995). Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

[Note: Pursuant to 31 U.S.C. § 1352(c)(1)-(2)(A), any person who makes a prohibited expenditure or fails to file or amend a required certification or disclosure form shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such expenditure or failure.]

The Contractor, _____, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 U.S.C. A 3801, *et seq.*, apply to this certification and disclosure, if any.

_____ Signature of Contractor's Authorized Official

_____ Name and Title of Contractor's Authorized Official

_____ Date

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CONE OF SILENCE

The Board of County Commissioners have established a solicitation silence policy (**Cone of Silence**) that prohibits oral and written communication regarding all formal solicitations for goods and services (ITB, RFP, ITQ, ITN, and RFQ) or other competitive solicitation between the bidder (or its agents or representatives) or other entity with the potential for a financial interest in the award (or their respective agents or representatives) regarding such competitive solicitation, and any County Commissioner or County employee, selection committee member or other persons authorized to act on behalf of the Board including the County’s Architect, Engineer or their subconsultants, or anyone designated to provide a recommendation to award a particular contract, other than the Purchasing Department Staff..

The period commences from the time of advertisement until contract award.

Any information thought to affect the committee or staff recommendation submitted after bids are due, should be directed to the Purchasing Manager or an appointed representative. It shall be the Purchasing Manager’s decision whether to consider this information in the decision process.

Any violation of this policy shall be grounds to disqualify the respondent from consideration during the selection process.

All respondents must agree to comply with this policy by signing the following statement and including it with their submittal.

I _____ representing _____
Signature Company Name

On this ___ day of _____ 2019 hereby agree to abide by the County’s “**Cone of Silence Clause**” and understand violation of this policy shall result in disqualification of my proposal/submittal.

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COMPANY DATA

Respondent's Company Name: _____

Physical Address & Phone #: _____

Contact Person (Typed-Printed): _____

Phone #: _____

Cell #: _____

Federal ID or SS #: _____

DUNNS/SAM #: _____

Respondent's License #: _____

Fax #: _____

Emergency #'s After Hours,
Weekends & Holidays: _____

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System for Award Management (Oct 2016)

(a) Definitions. As used in this provision.

“Electronic Funds Transfer (EFT) indicator” means a four-character suffix to the unique entity identifier. The suffix is assigned at the discretion of the commercial, nonprofit, or Government entity to establish additional System for Award Management records for identifying alternative EFT accounts (see [subpart 32.11](#)) for the same entity.

“Registered in the System for Award Management (SAM) database” means that:

(1) The Offeror has entered all mandatory information, including the unique entity identifier and the EFT indicator, if applicable, the Commercial and Government Entity (CAGE) code, as well as data required by the Federal Funding Accountability and Transparency Act of 2006 (see [subpart 4.14](#)) into the SAM database;

(2) The offeror has completed the Core, Assertions, and Representations and Certifications, and Points of Contact sections of the registration in the SAM database;

(3) The Government has validated all mandatory data fields, to include validation of the Taxpayer Identification Number (TIN) with the Internal Revenue Service (IRS). The offeror will be required to provide consent for TIN validation to the Government as a part of the SAM registration process; and

(4) The Government has marked the record “Active”.

“Unique entity identifier” means a number or other identifier used to identify a specific commercial, nonprofit, or Government entity. See www.sam.gov for the designated entity for establishing unique entity identifiers.

(b)(1) By submission of an offer, the offeror acknowledges the requirement that a prospective awardee shall be registered in the SAM database prior to award, during performance, and through final payment of any contract, basic agreement, basic ordering agreement, or blanket purchasing agreement resulting from this solicitation.

(2) The Offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation “Unique Entity Identifier” followed by the unique entity identifier that identifies the Offeror’s name and address exactly as stated in the offer. The Offeror also shall enter its EFT indicator, if applicable. The unique entity identifier will be used by the Contracting Officer to verify that the Offeror is registered in the SAM database.

(c) If the Offeror does not have a unique entity identifier, it should contact the entity designated at www.sam.gov for establishment of the unique entity identifier directly to obtain one. The Offeror should be prepared to provide the following information:

- (1) Company legal business name.
- (2) Tradestyle, doing business, or other name by which your entity is commonly recognized.
- (3) Company Physical Street Address, City, State, and Zip Code.
- (4) Company Mailing Address, City, State and Zip Code (if separate from physical).
- (5) Company telephone number.
- (6) Date the company was started.
- (7) Number of employees at your location.
- (8) Chief executive officer/key manager.
- (9) Line of business (industry).
- (10) Company Headquarters name and address (reporting relationship within your entity).

(d) If the Offeror does not become registered in the SAM database in timely manner, the Contracting Officer may proceed to award to the next otherwise successful registered Offeror.

(e) Processing time, which normally takes 48 hours, should be taken into consideration when registering. Offerors who are not registered should consider applying for registration immediately upon receipt of this solicitation.

(f) Offerors may obtain information on registration at <https://www.acquisition.gov> .

Offerors SAM information:

Entity Name: _____

Entity Address: _____

Duns Number: _____

CAGE Code: _____

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ADDENDUM ACKNOWLEDGEMENT
ITB WS 07-19

Acknowledgment is hereby made of the following addenda (identified by number) received since issuance of solicitation:

<u>ADDENDUM NO.</u>	<u>DATE</u>

NOTE: Prior to submitting the response to this solicitation, it is the responsibility of the respondent to confirm if any addenda have been issued. If such addenda have been issued, acknowledge receipt by noting number(s) and date(s) above.

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BID FORM

ARTICLE 1 – BID RECIPIENT

The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER’S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 90 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

- A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents.
- B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding 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 Bidder; and (3) Bidder’s safety precautions and programs.
- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder 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 Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.

- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER’S CERTIFICATION

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
 - 1. “corrupt practice” means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process;
 - 2. “fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and
 - 4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
1	Mobilization/ Demobilization	1	LS		
2	Relocation of the Existing 2.0 MGD Automatic Discfilter Unit	1	LS		
3	New 4.0 MGC Automatic Backwash Discfilter System, Elevated Walkway, and Control Panel.	1	EA		
4	Reclaimed Water Pumping Station and Control Panel with Owner Purchased Pumps	1	EA		
5	Chlorine Contact Basin (CCB)	1	LS		
6	Gas Chlorination System and Pre-Fabricated Concrete Building	1	LS		
7	Site Concrete	120	CY		
8	Sitework	1	LS		
9	Restoration of Disturbed Areas	1	LS		
10	Yard Piping	1	LS		
11	New Electrical Service and Electrical Wiring	1	LS		
12	Dewatering	1	LS		
Lump Sum Bid Price				\$ _____	
Owner Contingency Allowance				<u>\$30,0000</u>	
Total Base Bid				\$ _____	
_____ Dollars _____ Cents					

Lump Sum Items

Item 1 – Mobilization and Demobilization shall include all cost associated with the mobilization and demobilization of equipment and assets required at the construction site to perform the project as shown on the plans and meeting the requirements of the specifications.

Item 2 – Relocation of the Existing 2.0 MGD Discfilter may include but is not limited to excavation, demolition, crane lift, reassembly, inlet and outlet piping, flow meter, valves, fitting and testing as shown on the drawings. The price shall include the installation, labor, equipment, and materials as required to complete the complete construction

Item 3 – Installation of a new 4.0 MGD Discfilter including but is not limited to excavation, coordination and installation of Owner Purchased Pumps, access stairs and railing, crane lift, inlet and outlet piping, flow meter, valves, fittings, controls system, startup services as shown on the drawings and meeting the requirements of the specifications. The price shall include the installation, labor, equipment, and materials as required to complete the complete construction.

Item 4 – Installation of a new Reclaimed Water Pump Station including but is not limited to excavation, concrete structure, aluminum access platform, crane lift, inlet and outlet piping, flow meter, valves, control panel, startup services as shown on the drawings and meeting the requirements of the specifications. The price shall include the installation, labor, equipment, and materials as required to complete the complete construction.

Item 5 - Installation of a new Chlorine Contact Basin (CCB) including but is not limited to excavation, concrete structure, aluminum access platform, inlet and outlet piping, chlorine analyzers, turbidity analyzer, and gates as shown on the drawings and meeting the requirements of the specifications. The price shall include the installation, labor, equipment, and materials as required to complete the complete construction.

Item 6 - Installation of a new Gaseous Chlorination System including but is not limited to site work, foundation, new gaseous chlorination system, ventilation, pre-fabricated concrete building, fencing and access road as shown on the drawings and meeting the requirements of the specifications. The price shall include the installation, labor, equipment, and materials as required to complete the complete construction.

Item 7 – Sitework Concrete includes Discfilter foundation, sidewalks and pipe supports as shown on the drawings and meeting the requirements of the specifications. The price shall include the installation, labor, equipment, and materials as required to complete the construction.

Item 8 – Sitework includes site grading, earthwork, clearing, erosion control, relocation of existing underground piping as shown on the drawings and meeting the requirements of the specifications. The price shall include the installation, labor, equipment, and materials as required to complete the construction.

Item 9 – Restoration of Disturbed Areas shall include all driveways, roadways, curbs, grassing, and restoration of areas disturbed due to installation of the piping as structures as shown on the plans and meeting the requirements of the specifications. The price shall include all labor, equipment, and materials as required to complete the construction of these items.

Item 10 – Yard Piping all piping to connect to the existing effluent pump station discharge piping, new and existing Discfilters, CCB, Reclaimed Water Pump Station, stub-outs for connection to Reclaimed Water Force Mains (By Others), and Gas Chlorination System shall include the pipe, fitting and associated appurtenances necessary to complete the tie-in connections. The price shall include the installation, labor, equipment, and materials as required construction.

Item 11 – New Electrical Service shall include all equipment, wiring, conduit, lighting, connectivity of the control panels, motor controls, analyzers and new power service and hardware required on the drawings and meeting the requirements of the specifications. The price shall include the installation, labor,

equipment, and materials as required to complete the construction.

Item 12 – Dewatering shall include dewatering of the area as required for the installation for CCB and Reclaimed Water Pump Station. The price shall include the installation, labor, equipment, and materials as required for this process.

ARTICLE 6 – TIME OF COMPLETION

- 6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.
- 6.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 7 – ATTACHMENTS TO THIS BID

- 7.01 The following documents are submitted with and made a condition of this Bid:
 - A. Required Bid security;
 - B. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids;
 - C. Contractor's License No.: _____ Evidence of Bidder's ability to obtain a State Contractor's License and a covenant by Bidder to obtain said license within the time for acceptance of Bids;

Major Equipment Items

- A. The project will be awarded based on the base bid equipment listed below. The bidder must base his lump sum base bid on the listed equipment/suppliers in the Base Bid column of the schedule. Deductions for equipment substitutions will not be considered in determining the basis of award. The bidder may indicate substitute equipment/supplier items by writing in the substitute equipment/supplier item and the amount of deduction for that substitute name write-in.
- B. Substitute equipment/supplier will be deemed as equal if the substitute is the same or better than the product named and described in the specifications in function, performance, reliability, quality and general configuration. Determination of the equality of a substitute shall be determined by the Engineer after the bid, based on submittal data received with the Contractor's bid documents. Should the write-in substitute be determined "not equal", then the bidder shall supply the equipment listed in the Base Bid column. The Owner may determine any substitute "not equal" as the Owner determines to suit his sole best interests at any time.
- C. Evaluation data to determine if a substitute equipment manufacturer/ supplier is an acceptable substitute must be submitted by the bidder with the bid. Information submitted after the bid will not be considered. Information submitted directly by equipment manufacturers/suppliers will not be evaluated. Minimum evaluation data shall include submittal information in conformance with Section 01001 of the contract documents. Data and drawing submittal shall be prepared specifically for this project. Incomplete submittals that do not conform with Section 01001 will not be considered. Sales catalog cuts or marked up drawings from previous projects will not be reviewed. The Bidder shall reimburse the Owner for any engineering costs associated with the review of any substitutes in accordance with the terms of the Engineer's Agreement with the Owner. The Owner is no way obligated to review substitute equipment submittals.
- D. No substitute equipment/supplier will be considered unless, in the opinion of the Owner or Engineer, it conforms to the contract drawings and specifications in all respects, except for the make and manufacture and minor details. Design and preparation of these plans and specifications are based on the equipment/supplier noted in the Base Bid column of the schedule. The bidder shall be responsible for

any and all changes necessary to accommodate the substitute equipment/supplier items. The Owner shall be reimbursed for any and all associated redesign and/or construction drawings in accordance with the terms of the Engineer's Agreement with the Owner. The bidder shall also include any and all costs associated with additional construction costs (mechanical, structural, electrical, architectural, engineering, construction observation, etc.) as the result of a substitute item. The bid shall also include any paid up licenses necessary for the use of the equipment as required.

EQUIPMENT/SUPPLIER SCHEDULE				
SPEC SECTION	DESCRIPTION	EQUIPMENT MANUFACTURERS/SUPPLIERS		AMOUNT OF DEDUCTION FOR SUBSTITUTION
		Base Bid	Substitute	
11312	4.0 MGD AUTOMATIC BACKWASH DISCFILTER SYSTEM with CONTROL PANEL	WesTec SuperDisc Model TD 2415-15 Kruger Model 2216		\$
11261	Gas Chlorination System	DE NORA Water Technologies Hydro-Instruments		\$

ARTICLE 8 – DEFINED TERMS

8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – BID SUBMITTAL

BIDDER: *[Indicate correct name of bidding entity]*

By: _____
[Signature]

[Printed name]

(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____
[Signature]

[Printed name]

Title: _____

Submittal Date: _____

Address for giving notices:

Telephone Number: _____

Fax Number: _____

Contact Name and e-mail address: _____

Bidder's License No.: _____
(where applicable)

NOTE TO USER: Use in those states or other jurisdictions where applicable or required.

Bidder's Company Name

Authorized Signature – Manual

Authorized Signature – Typed

Address

Title

Phone #

Fax #

Federal ID # or SS #

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ANTI-COLLUSION STATEMENT: The below signed bidder has not divulged to, discussed or compared his bid with other bidders and has not **colluded with any other bidder or parties to bid whatever.** **Note: No premiums, rebates, or gratuities permitted either with, prior to, or after any** delivery of materials. Any such violation will result in the cancellation and/or return of material (as applicable) and the removal from bid list(s).

Bidder's Company Name

Authorized Signature – Manual

Address

Authorized Signature – Typed

Address

Title

Phone #

Fax #

Federal ID # or SS #

Date Submitted: _____

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Government Debarment & Suspension

Instructions

1. By signing and submitting this form, the prospective lower tier participant is providing the certification set out in accordance with these instructions.
2. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension or debarment.
3. The prospective lower tier participant shall provide immediate written notice to the person(s) to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.
4. The terms "covered transaction," "debarred," "suspended," "ineligible," "lower tier covered transaction," "participant," "person," "primary covered transaction," "principal," "proposal," and "voluntarily excluded," as used in this clause, have the meanings set out in the Definitions and Coverage sections of the rules implementing Executive Orders 12549, at Subpart C of OMB 2 C.F.R. Part 180 and 3000.332. You may contact the department or agency to which this proposal is being submitted for assistance in obtaining a copy of those regulations.
5. The prospective lower tier participant agrees by submitting this form that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.
6. The prospective lower tier participant further agrees by submitting this form that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.
7. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the System for Award Management (SAM) database.
8. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.
9. Except for transactions authorized under paragraph (5) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

**Certification Regarding Debarment, Suspension,
Ineligibility and Voluntary Exclusion
Lower Tier Covered Transactions**

The following statement is made in accordance with the Privacy Act of 1974 (5 U.S.C. § 552(a), as amended). This certification is required by the regulations implementing Executive Orders 12549, Debarment and Suspension, and OMB 2 C.F.R. Part 180, Participants' responsibilities. The regulations were amended and published on August 31, 2005, in 70 Fed. Reg. 51865-51880.

[READ INSTRUCTIONS ON PREVIOUS PAGE BEFORE COMPLETING CERTIFICATION]

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency;

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal

Printed Name and Title of Authorized Representative

Signature

Date

Standard Contract Clauses

Title VI Clauses for Compliance with Nondiscrimination Requirements

Compliance with Nondiscrimination Requirements

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the “contractor”) agrees as follows:

1. **Compliance with Regulations:** The contractor (hereinafter includes consultants) will comply with the Title VI List of Pertinent Nondiscrimination Acts And Authorities, as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.
2. **Non-discrimination:** The contractor, with regard to the work performed by it during the contract, will not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor will not participate directly or indirectly in the discrimination prohibited by the Nondiscrimination Acts and Authorities, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR part 21.
3. **Solicitations for Subcontracts, Including Procurements of Materials and Equipment:** In all solicitations, either by competitive bidding, or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the contractor of the contractor’s obligations under this contract and the Nondiscrimination Acts And Authorities on the grounds of race, color, or national origin.
4. **Information and Reports:** The contractor will provide all information and reports required by the Acts, the Regulations, and directives issued pursuant thereto and will permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the sponsor or the Federal Aviation Administration to be pertinent to ascertain compliance with such Nondiscrimination Acts And Authorities and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish the information, the contractor will so certify to the sponsor or the Federal Aviation Administration, as appropriate, and will set forth what efforts it has made to obtain the information.
5. **Sanctions for Noncompliance:** In the event of a contractor’s noncompliance with the Non-discrimination provisions of this contract, the sponsor will impose such contract sanctions as it or the Federal Aviation Administration may determine to be appropriate, including, but not limited to:
 - a. Withholding payments to the contractor under the contract until the contractor complies; and/or
 - b. Cancelling, terminating, or suspending a contract, in whole or in part.
6. **Incorporation of Provisions:** The contractor will include the provisions of paragraphs one through six in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations and directives issued pursuant thereto. The contractor will take action

with respect to any subcontract or procurement as the sponsor or the Federal Aviation Administration may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the contractor may request the sponsor to enter into any litigation to protect the interests of the sponsor. In addition, the contractor may request the United States to enter into the litigation to protect the interests of the United States.

Title VI List of Pertinent Nondiscrimination Acts and Authorities

Title VI List of Pertinent Nondiscrimination Acts and Authorities

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the “contractor”) agrees to comply with the following non-discrimination statutes and authorities; including but not limited to:

- Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d *et seq.*, 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin);
- 49 CFR part 21 (Non-discrimination In Federally-Assisted Programs of The Department of Transportation—Effectuation of Title VI of The Civil Rights Act of 1964);
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 U.S.C. § 4601), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);
- Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. § 794 *et seq.*), as amended, (prohibits discrimination on the basis of disability); and 49 CFR part 27;
- The Age Discrimination Act of 1975, as amended, (42 U.S.C. § 6101 *et seq.*), (prohibits discrimination on the basis of age);
- Airport and Airway Improvement Act of 1982, (49 USC § 471, Section 47123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);
- The Civil Rights Restoration Act of 1987, (PL 100-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, The Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms “programs or activities” to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);
- Titles II and III of the Americans with Disabilities Act of 1990, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. §§ 12131 – 12189) as implemented by Department of Transportation regulations at 49 CFR parts 37 and 38;
- The Federal Aviation Administration’s Non-discrimination statute (49 U.S.C. § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures non-discrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;

- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);
- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S.C. 1681 et seq).

FEDERAL FAIR LABOR STANDARDS ACT (FEDERAL MINIMUM WAGE)

All contracts and subcontracts that result from this solicitation incorporate by reference the provisions of 29 CFR part 201, the Federal Fair Labor Standards Act (FLSA), with the same force and effect as if given in full text. The FLSA sets minimum wage, overtime pay, recordkeeping, and child labor standards for full and part time workers.

The [*contractor / consultant*] has full responsibility to monitor compliance to the referenced statute or regulation. The [*contractor / consultant*] must address any claims or disputes that arise from this requirement directly with the U.S. Department of Labor – Wage and Hour Division

OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970

All contracts and subcontracts that result from this solicitation incorporate by reference the requirements of 29 CFR Part 1910 with the same force and effect as if given in full text. Contractor must provide a work environment that is free from recognized hazards that may cause death or serious physical harm to the employee. The Contractor retains full responsibility to monitor its compliance and their subcontractor’s compliance with the applicable requirements of the Occupational Safety and Health Act of 1970 (20 CFR Part 1910). Contractor must address any claims or disputes that pertain to a referenced requirement directly with the U.S. Department of Labor – Occupational Safety and Health Administration.

E-VERIFY

Enrollment and verification requirements.

- (1) If the Contractor is not enrolled as a Federal Contractor in E-Verify at time of contract award, the Contractor shall-
 - a. Enroll. Enroll as a Federal Contractor in the E-Verify Program within thirty (30) calendar days of contract award;
 - b. Verify all new employees. Within ninety (90) calendar days of enrollment in the E-Verify program, begin to use E-Verify to initiate verification of employment eligibility of all new hires of the Contractor, who are working in the United States, whether or not assigned to the contract, within three (3) business days after the date of hire (but see paragraph (b)(3) of this section); and,

- c. Verify employees assigned to the contract. For each employee assigned to the contract, initiate verification within ninety (90) calendar days after date of enrollment or within thirty (30) calendar days of the employee's assignment to the contract, whichever date is later (but see paragraph (b)(4) of this section.)
- (2) If the Contractor is enrolled as a Federal Contractor in E-Verify at time of contract award, the Contractor shall use E-Verify to initiate verification of employment eligibility of
- a. All new employees.
 - i. Enrolled ninety (90) calendar days or more. The Contractor shall initiate verification of all new hires of the Contractor, who are working in the United States, whether or not assigned to the contract, within three (3) business days after the date of hire (but see paragraph (b)(3) of this section); or
 - ii. Employees assigned to the contract. For each employee assigned to the contract, the Contractor shall initiate verification within ninety (90) calendar days after date of contract award or within thirty (30) days after assignment to the contract, whichever date is later (but see paragraph (b)(4) of this section.)
 - b. Enrolled less than ninety (90) calendar days. Within ninety (90) calendar days after enrollment as a Federal Contractor in E-Verify, the Contractor shall initiate verification of all new hires of the contractor, who are working in the United States, whether or not assigned to the contract, within three (3) business days after the date of hire (but see paragraph (b)(3) of this section); or
- (3) If the Contractor is an institution of higher education (as defined at 20 U.S.C. 1001(a)); a State of local government or the government of a Federally recognized Indian tribe, or a surety performing under a takeover agreement entered into with a Federal agency pursuant to a performance bond, the Contractor may choose to verify only employees assigned to the contract, whether existing employees or new hires. The Contractor shall follow the applicable verification requirements of (b)(1) or (b)(2), respectively, except that any requirement for verification of new employees applies only to new employees assigned to the contract.
- (4) Option to verify employment eligibility of all employees. The Contractor may elect to verify all existing employees hired after November 6, 1986 (after November 27, 2009, in the Commonwealth of the Northern Mariana Islands), rather than just those employees assigned to the contract. The Contractor shall initiate verification for each existing employee working in the United States who was hired after November 6, 1986 (after November 27, 2009, in the Commonwealth of the Northern Mariana Islands), within one hundred eighty (180) calendar days of-
- i. Enrollment in the E-Verify program; or
 - ii. Notification to E-Verify Operations of the Contractor's decision to exercise this option, using the contract information provided in the E-Verify program Memorandum of Understanding (MOU)
- (5) The Contractor shall comply, for the period of performance of this contract, with the requirements of the E-Verify program MOU.

- i. The Department of Homeland Security (DHS) or the Social Security Administration (SSA) may terminate the Contractor's MOU and deny access to the E-Verify system in accordance with the terms of the MOU. In such case, the Contractor, will be referred to a suspension or debarment official.
- ii. During the period between termination of the MOU and a decision by the suspension or debarment official whether to suspend or debar, the contractor is excused from its obligations under paragraph (b) of this clause. If the suspension or debarment official determines not to suspend or debar the Contractor, then the Contractor must reenroll in E-Verify.
- iii. Web site. Information on registration for and use of the E-Verify program can be obtained via the Internet at the Department of Homeland Security Web site:
<http://www.dhs.gov/E-Verify>.

Individuals previously verified. The Contractor is not required by this clause to perform additional employment verification using E-Verify for any employee-

- (a) Whose employment eligibility was previously verified by the Contractor through the E-Verify program;
- (b) Who has been granted and holds an active U.S. Government security clearance for access to confidential, secret, or top secret information in accordance with the National Industrial Security Program Operating Manual; or
- (c) Who has undergone a completed background investigation and been issued credentials pursuant to Homeland Security Presidential Directive (HSPD)-12. Policy for a Common Identification Standard for Federal Employees and Contractors.

Subcontracts. The Contractor shall include the requirements of this clause, including this paragraph € (appropriately modified for identification of the parties in each subcontract that-

- (1) Is for-(i) Commercial and noncommercial services (except for commercial services that are part of the purchase of a COTS item (or an item that would be a COTS item, but for minor modifications), performed by the COTS provider, and are normally provided for that COTS item); or
(ii) Construction;
- (2) Has a value of more than \$3,500; and
- (3) Includes work performed in the United States.

SECTION C-430

BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER (*Name and Address*):

SURETY (*Name, and Address of Principal Place of Business*):

OWNER (*Name and Address*):

Bid Due Date:

BOND

Bond Number:

Date:

Penal sum

\$

(Words)

(Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER

SURETY

(Seal)

(Seal)

Bidder's Name and Corporate Seal

Surety's Name and Corporate Seal

By:

Signature

By:

Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest:

Signature

Title

Attest:

Signature

Title

Note: Addresses are to be used for giving any required notice.

Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation shall be null and void if:
 - 3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2 All Bids are rejected by Owner, or
 - 3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

SECTION C-451

QUALIFICATIONS STATEMENT

THE INFORMATION SUPPLIED IN THIS DOCUMENT IS CONFIDENTIAL TO THE EXTENT PERMITTED BY LAWS AND REGULATIONS

1. SUBMITTED BY:

Official Name of Firm: _____

Address: _____

2. SUBMITTED TO:

3. SUBMITTED FOR:

Owner: _____

Project Name: _____

TYPE OF WORK:

4. CONTRACTOR'S CONTACT INFORMATION

Contact Person: _____

Title: _____

Phone: _____

Email: _____

5. AFFILIATED COMPANIES:

Name: _____

Address: _____

6. TYPE OF ORGANIZATION:

SOLE PROPRIETORSHIP

Name of Owner: _____

Doing Business As: _____

Date of Organization: _____

PARTNERSHIP

Date of Organization: _____

Type of Partnership: _____

Name of General Partner(s): _____

CORPORATION

State of Organization: _____

Date of Organization: _____

Executive Officers:

- President: _____

- Vice President(s): _____

- Treasurer: _____

- Secretary: _____

LIMITED LIABILITY COMPANY

State of Organization: _____

Date of Organization: _____

Members: _____

JOINT VENTURE

Sate of Organization: _____

Date of Organization: _____

Form of Organization: _____

Joint Venture Managing Partner

- Name: _____

- Address: _____

Joint Venture Managing Partner

- Name: _____

- Address: _____

Joint Venture Managing Partner

- Name: _____

- Address: _____

7. LICENSING

Jurisdiction: _____

Type of License: _____

License Number: _____

Jurisdiction: _____

Type of License: _____

License Number: _____

8. CERTIFICATIONS

CERTIFIED BY:

Disadvantage Business Enterprise: _____

Minority Business Enterprise: _____

Woman Owned Enterprise: _____

Small Business Enterprise: _____

Other (_____): _____

9. BONDING INFORMATION

Bonding Company: _____

Address: _____

Bonding Agent: _____

Address: _____

Contact Name: _____

Phone: _____

Aggregate Bonding Capacity: _____

Available Bonding Capacity as of date of this submittal: _____

10. FINANCIAL INFORMATION

Financial Institution: _____

Address: _____

Account Manager: _____

Phone: _____

INCLUDE AS AN ATTACHMENT AN AUDITED BALANCE SHEET FOR EACH OF THE LAST 3 YEARS

11. CONSTRUCTION EXPERIENCE:

Current Experience:

List on **Schedule A** all uncompleted projects currently under contract (If Joint Venture list each participant's projects separately).

Previous Experience:

List on **Schedule B** all projects completed within the last 5 Years (If Joint Venture list each participant's projects separately).

Has firm listed in Section 1 ever failed to complete a construction contract awarded to it?

YES NO

If YES, attach as an Attachment details including Project Owner's contact information.

Has any Corporate Officer, Partner, Joint Venture participant or Proprietor ever failed to complete a construction contract awarded to them in their name or when acting as a principal of another entity?

YES NO

If YES, attach as an Attachment details including Project Owner's contact information.

Are there any judgments, claims, disputes or litigation pending or outstanding involving the firm listed in Section 1 or any of its officers (or any of its partners if a partnership or any of the individual entities if a joint venture)?

YES NO

If YES, attach as an Attachment details including Project Owner's contact information.

12. SAFETY PROGRAM:

Name of Contractor's Safety Officer: _____

Include the following as attachments:

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) OSHA No. 300- Log & Summary of Occupational Injuries & Illnesses for the past 5 years.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all OSHA Citations & Notifications of Penalty (monetary or other) received within the last 5 years (indicate disposition as applicable) - IF NONE SO STATE.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all safety citations or violations under any state all received within the last 5 years (indicate disposition as applicable) - IF NONE SO STATE.

Provide the following for the firm listed in Section 5 (and for each proposed Subcontractor furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) the following (attach additional sheets as necessary):

Workers' compensation Experience Modification Rate (EMR) for the last 5 years:

YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
	_____		_____

Total Recordable Frequency Rate (TRFR) for the last 5 years:

YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
	_____		_____

13. EQUIPMENT:

MAJOR EQUIPMENT: NOT USED

I HEREBY CERTIFY THAT THE INFORMATION SUBMITTED HEREWITH, INCLUDING ANY ATTACHMENTS, IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

NAME OF ORGANIZATION: _____

BY: _____

TITLE: _____

DATED: _____

NOTARY ATTEST:

SUBSCRIBED AND SWORN TO BEFORE ME

THIS _____ DAY OF _____, 20____

NOTARY PUBLIC - STATE OF _____

MY COMMISSION EXPIRES: _____

REQUIRED ATTACHMENTS

1. Schedule A (Current Experience).
2. Schedule B (Previous Experience).
3. Audited balance sheet for each of the last 3 years for firm named in Section 1.
4. Evidence of authority for individuals listed in Section 7 to bind organization to an agreement.
5. Required safety program submittals listed in Section 13.
6. Additional items as pertinent.

SCHEDULE A

CURRENT EXPERIENCE

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B

PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

EJCDC® C-510, Qualifications Statement.

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SECTION C-520

AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

THIS AGREEMENT is by and between Okaloosa County Board of County Commissioners (“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:*

ARTICLE 2 – THE PROJECT

2.01 *The Project, of which the Work under the Contract Documents is a part, is generally described as follows: Arbennie Pritchett WRF Reclaimed Water Expansion Project*

ARTICLE 3 – ENGINEER

3.01 *The part of the Project that pertains to the Work has been designed by Constantine Engineering, Inc.*

3.02 *The Owner has retained Constantine Engineering, Inc. (“Engineer”) to act as Owner’s representative, 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 4 – CONTRACT TIMES

4.01 Time of the Essence

A. 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

A. The Work will be substantially completed within 240 days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within 285 days after the date when the Contract Times commence to run.

4.03 Liquidated Damages

A. 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 proceeding the actual loss suffered by Owner if the Work is not completed on time.

ARTICLE 7 – INTEREST

7.01 *All amounts not paid when due shall bear interest at the rate of 10 percent per annum.*

ARTICLE 8 – 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 Supplementary Conditions, 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 9 – CONTRACT DOCUMENTS

9.01 Contents

- A. The Contract Documents consist of the following:
 - 1. This Agreement (pages 1 to , inclusive).

2. Performance bond (pages ___ to ___, inclusive).
 3. Payment bond (pages ___ to ___, inclusive).
 4. General Conditions (pages ___ to ___, inclusive).
 5. Supplementary Conditions (pages ___ to ___, inclusive).
 6. Specifications as listed in the table of contents of the Project Manual.
 7. Drawings (not attached but incorporated by reference) consisting of ___ sheets with each sheet bearing the following general title: Water Treatment Plant No. 3, Division 1 – Water Treatment Plant.
 8. Addenda (numbers ___ to ___, inclusive).
 9. Exhibits to this Agreement (enumerated as follows):
 - a. Contractor's Bid (pages ___ to ___, inclusive).
 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.
- 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 9.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

ARTICLE 10 – 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 Contractor’s Certifications

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
 1. “corrupt practice” means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 2. “fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 3. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
 4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

10.06 Other Provisions

- A. Owner stipulates that if the General Conditions that are made a part of this Contract are based on EJCDC® C-700, Standard General Conditions for the Construction Contract, published by the Engineers Joint Contract Documents Committee®, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or “track changes” (redline/strikeout), or in the Supplementary Conditions.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____ (which is the Effective Date of the Contract).

OWNER:

CONTRACTOR:

Okaloosa County Board of County Commissioners

By: _____

By: _____

Title: _____

Title: _____

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____

Attest: _____

Title: _____

Title: _____

Address for giving notices:

Address for giving notices:

License No.: _____
(where applicable)

(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

NOTE TO USER: Use in those states or other jurisdictions where applicable or required.

NOTICE TO PROCEED

TO:

PROJECT: Arbennie Pritchett WRF Reclaimed Water Expansion Project

DESCRIPTION: ITB 07-19, Contract C _____

You are hereby notified you are able to commence WORK in accordance with the Agreement dated _____, 2019. The work shall be completed within 90 days from the commencement date.

You are required to return an acknowledged copy of this **NOTICE TO PROCEED** to the **OWNER**: Okaloosa County Purchasing, Attention: DeRita Mason, 5479A Old Bethel Road, Crestview, FL 32536, within 15 days from the date this **NOTICE TO PROCEED** is fully executed.

Dated this _____ day of _____, 2019

OKALOOSA COUNTY BOARD OF COUNTY COMMISSIONERS
OWNER

BY: _____
Greg Kisela, Acting OMB Director

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged.

Date of Commencement of Work: _____.

Company Name

This the _____ day of _____, 2019

Signature

By: _____
Type or Print Name/Title

SECTION C-610
PERFORMANCE BOND

CONTRACTOR *(name and address):*

SURETY *(name and address of principal place of business):*

OWNER *(name and address):*

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description:

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract):*

Amount:

Modifications to this Bond Form: None See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal *(seal)*

Surety's Name and Corporate Seal *(seal)*

By: _____
Signature

By: _____
Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

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

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner

and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

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

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages

16. Modifications to this Bond are as follows:

to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

EJCDC® C-610, Performance Bond

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SECTION C-615

PAYMENT BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER:

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description:

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:

Amount:

Modifications to this Bond Form: None See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

_____ *(seal)*
 Contractor's Name and Corporate Seal

_____ *(seal)*
 Surety's Name and Corporate Seal

By: _____
 Signature

By: _____
 Signature *(attach power of attorney)*

 Print Name

 Print Name

 Title

 Title

Attest: _____
 Signature

Attest: _____
 Signature

 Title

 Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond shall arise after the following:
 - 5.1 Claimants who do not have a direct contract with the Contractor,
 - 5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
 - 5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).
 - 5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
 - 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
 - 7.2 Pay or arrange for payment of any undisputed amounts.
 - 7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.
8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this

Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.
14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.
15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.
16. **Definitions**
 - 16.1 **Claim:** A written statement by the Claimant including at a minimum:
 1. The name of the Claimant;
 2. The name of the person for whom the labor was done, or materials or equipment furnished;
 3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
 4. A brief description of the labor, materials, or equipment furnished;
 5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
 6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
 7. The total amount of previous payments received by the Claimant; and
 8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.
 - 16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
 - 16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
 - 16.4 **Owner Default:** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
 - 16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

18. Modifications to this Bond are as follows:

SECTION C-625

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner:	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer: Constantine Engineering, Inc.	Engineer's Project No.:
Project:	Contract Name:

This [preliminary] [final] Certificate of Substantial Completion applies to:

All Work The following specified portions of the Work:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work shall be as provided in the Contract, except as amended as follows: *[Note: Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.]*

Amendments to Owner's responsibilities: None
 As follows

Amendments to Contractor's responsibilities: None
 As follows:

The following documents are attached to and made a part of this Certificate: *[punch list; others]*

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract.

EXECUTED BY ENGINEER:		RECEIVED:		RECEIVED:	
By:	_____	By:	_____	By:	_____
	(Authorized signature)		Owner (Authorized Signature)		Contractor (Authorized Signature)
Title:	_____	Title:	_____	Title:	_____
Date:	_____	Date:	_____	Date:	_____

**SECTION C-700
STANDARD GENERAL CONDITIONS OF THE
CONSTRUCTION CONTRACT**

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 Defined Terms

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. *Bidder*—An individual or entity that submits a Bid to Owner.
 6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
 7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer has declined to address. A demand for money or services by a third party is not a Claim.
 11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. ("CERCLA"); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5101 et seq.; (c) the Resource Conservation

and Recovery Act, 42 U.S.C. §§6901 et seq. (“RCRA”); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.
13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .
15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
17. *Cost of the Work*—See Paragraph 13.01 for definition.
18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
20. *Engineer*—The individual or entity named as such in the Agreement.
21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.
23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.
26. *Notice of Award*—The written notice by Owner to a Bidder of Owner’s acceptance of the Bid.
27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor’s plan to accomplish the Work within the Contract Times.
30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.
32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or “RPR” includes any assistants or field staff of Resident Project Representative.
33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals and the performance of related construction activities.
35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor’s Applications for Payment.
36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.
37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.
38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.
42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.

43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.
45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
46. *Unit Price Work*—Work to be paid for on the basis of unit prices.
47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.
48. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 Terminology

- A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:*
 1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. *Day:*
 1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective:*

1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).

E. *Furnish, Install, Perform, Provide:*

1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 Delivery of Bonds and Evidence of Insurance

- A. *Bonds:* When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Contractor’s Insurance:* When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.
- C. *Evidence of Owner’s Insurance:* After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 Copies of Documents

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 Before Starting Construction

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:
 - 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 - 2. a preliminary Schedule of Submittals; and
 - 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 Preconstruction Conference; Designation of Authorized Representatives

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 Initial Acceptance of Schedules

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
 - 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
 - 2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
 - 3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

2.06 Electronic Transmittals

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.
- B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 Intent

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 Reference Standards

- A. Standards Specifications, Codes, Laws and Regulations
 - 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 - 2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 Reporting and Resolving Discrepancies

- A. *Reporting Discrepancies:*
 - 1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent

figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 Requirements of the Contract Documents

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 Reuse of Documents

- A. Contractor and its Subcontractors and Suppliers shall not:
 - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
 - 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 Commencement of Contract Times; Notice to Proceed

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. ~~In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.~~

4.02 Starting the Work

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to such date.

4.03 Reference Points

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 Progress Schedule

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.
 - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 Delays in Contractor's Progress

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
 - 1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 - 2. abnormal weather conditions;
 - 3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
 - 4. acts of war or terrorism.
- D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.
- E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.
- F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.
- G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 Availability of Lands

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's

interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 Use of Site and Other Areas

A. *Limitation on Use of Site and Other Areas:*

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

- D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 Subsurface and Physical Conditions

- A. *Reports and Drawings:* The Supplementary Conditions identify:
1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and
 3. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, 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; or
 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 Differing Subsurface or Physical Conditions

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or
 2. is of such a nature as to require a change in the Drawings or Specifications; or
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in

question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Possible Price and Times Adjustments:*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
 2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or
 - b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 5.04.A.
 3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
 4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 Underground Facilities

- A. *Contractor's Responsibilities:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:
1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;
 - c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 - d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.
- C. *Engineer's Review:* Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Possible Price and Times Adjustments:*
 1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and
 - d. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 Hazardous Environmental Conditions at Site

- A. *Reports and Drawings:* The Supplementary Conditions identify:
1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
 2. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, 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; or
 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question,

then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.
- H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.
- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 Performance, Payment, and Other Bonds

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations

under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.

- B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in “Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies” as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual’s authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.
- C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.
- D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.
- E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner’s termination rights under Article 16.
- F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 Insurance—General Provisions

- A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles.

Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

- E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.
- H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.
- I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.
- J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 Contractor's Insurance

- A. *Workers' Compensation*: Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
 - 2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
 - 3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).
 - 4. Foreign voluntary worker compensation (if applicable).
- B. *Commercial General Liability—Claims Covered*: Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:
 - 1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
 - 2. claims for damages insured by reasonably available personal injury liability coverage.
 - 3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- C. *Commercial General Liability—Form and Content*: Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:
 - 1. Products and completed operations coverage:
 - a. Such insurance shall be maintained for three years after final payment.

- b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
 2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Broad form property damage coverage.
 4. Severability of interest.
 5. Underground, explosion, and collapse coverage.
 6. Personal injury coverage.
 7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.
 8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- D. *Automobile liability:* Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.
- E. *Umbrella or excess liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.
- F. ~~*Contractor's pollution liability insurance:* Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.~~
- G. *Additional insureds:* The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.
- H. *Contractor's professional liability insurance:* If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.

- I. *General provisions:* The policies of insurance required by this Paragraph 6.03 shall:
 - 1. include at least the specific coverages provided in this Article.
 - 2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.
 - 3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.
 - 4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.
 - 5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.
- J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 Owner's Liability Insurance

- A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.
- B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.05 Property Insurance

- A. *Builder's Risk:* Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
 - 1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."
 - 2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated

electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.

3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
 4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).
 5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
 6. extend to cover damage or loss to insured property while in transit.
 7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
 8. allow for the waiver of the insurer's subrogation rights, as set forth below.
 9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
 10. not include a co-insurance clause.
 11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
 12. include performance/hot testing and start-up.
 13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.
- B. *Notice of Cancellation or Change:* All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.
- C. *Deductibles:* The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.
- D. *Partial Occupancy or Use by Owner:* If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.

- E. *Additional Insurance*: If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.
- F. *Insurance of Other Property*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 Waiver of Rights

- A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:
 - 1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 - 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.
- D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.07 Receipt and Application of Property Insurance Proceeds

- A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.
- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 Supervision and Superintendence

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.02 Labor; Working Hours

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 Services, Materials, and Equipment

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish

satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.04 "Or Equals"

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) it has a proven record of performance and availability of responsive service; and
 - 4) it is not objectionable to Owner.
 - b. Contractor certifies that, if approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense:* Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.
- D. *Effect of Engineer's Determination:* Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.
- E. *Treatment as a Substitution Request:* If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 Substitutes

- A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.
1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.
 2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
 3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - a. shall certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design,
 - 2) be similar in substance to that specified, and
 - 3) be suited to the same use as that specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from that specified, and
 - 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

- D. *Reimbursement of Engineer's Cost:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- E. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination:* If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 Concerning Subcontractors, Suppliers, and Others

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.
- B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.
- E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.
- F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.
- H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

- I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.
- J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.
- K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.
- L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.
- N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.
- O. Nothing in the Contract Documents:
 - 1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor
 - 2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 Patent Fees and Royalties

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of

patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 Permits

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work

7.09 Taxes

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.10 Laws and Regulations

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 Record Documents

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.12 Safety and Protection

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
1. all persons on the Site or who may be affected by the Work;
 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
- C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
- D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).
- G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 Safety Representative

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

7.14 Hazard Communication Programs

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 Emergencies

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

7.16 Shop Drawings, Samples, and Other Submittals

A. *Shop Drawing and Sample Submittal Requirements:*

1. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

- a. Contractor shall submit the number of copies required in the Specifications.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.

2. *Samples:*
 - a. Contractor shall submit the number of Samples required in the Specifications.
 - b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.
3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Other Submittals:* Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.
- D. *Engineer's Review:*
 1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
 3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
 4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.
 5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.
 6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
 7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.
 8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.
- E. *Resubmittal Procedures:*
 1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.
 2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item

requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 Contractor's General Warranty and Guarantee

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. use or occupancy of the Work or any part thereof by Owner;
 5. any review and approval of a Shop Drawing or Sample submittal;
 6. the issuance of a notice of acceptability by Engineer;
 7. any inspection, test, or approval by others; or
 8. any correction of defective Work by Owner.
- D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 Indemnification

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor,

any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.

- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
 - 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 Delegation of Professional Design Services

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.
- B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.
- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 Other Work

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.
- D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.02 Coordination

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
 - 1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
 - 2. an itemization of the specific matters to be covered by such authority and responsibility; and
 - 3. the extent of such authority and responsibilities.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 Legal Relationships

- A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner for whom the Owner is responsible causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account

information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.
- C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.
- D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 Communications to Contractor

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 Replacement of Engineer

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

9.03 Furnish Data

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 Pay When Due

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

- 9.05 Lands and Easements; Reports, Tests, and Drawings
- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
 - B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
 - C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.
- 9.06 Insurance
- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.
- 9.07 Change Orders
- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.
- 9.08 Inspections, Tests, and Approvals
- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.
- 9.09 Limitations on Owner's Responsibilities
- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- 9.10 Undisclosed Hazardous Environmental Condition
- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.
- 9.11 Evidence of Financial Arrangements
- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).
- 9.12 Safety Programs
- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
 - B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

- 10.01 Owner's Representative
- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 Visits to Site

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 Project Representative

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.04 Rejecting Defective Work

- A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 Shop Drawings, Change Orders and Payments

- A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.
- B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.
- C. Engineer's authority as to Change Orders is set forth in Article 11.
- D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 Determinations for Unit Price Work

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.07 Decisions on Requirements of Contract Documents and Acceptability of Work

- A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.08 Limitations on Engineer's Authority and Responsibilities

- A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.
- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 Compliance with Safety Program

- A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 Amending and Supplementing Contract Documents

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
 - 1. *Change Orders:*
 - a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.
 - b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.
 - 2. *Work Change Directives:* A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract

Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. *Field Orders*: Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 Owner-Authorized Changes in the Work

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.03 Unauthorized Changes in the Work

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

11.04 Change of Contract Price

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:
 1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or
 2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or
 3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work

(determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or
2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.04.C.2.a and 11.04.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;
 - d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
 - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 Change of Contract Times

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.
- B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 Change Proposals

- A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.
 1. *Procedures*: Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The

Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.

2. *Engineer's Action:* Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.
 3. *Binding Decision:* Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- B. *Resolution of Certain Change Proposals:* If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 Execution of Change Orders

- A. Owner and Contractor shall execute appropriate Change Orders covering:
1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and
 4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 Notification to Surety

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12 – CLAIMS

12.01 Claims

- A. *Claims Process:* The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:
1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.
- B. *Submittal of Claim:* The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are 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. *Review and Resolution:* The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation:*
1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.
 3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval:* If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim:* If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results:* If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the

agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 Cost of the Work

- A. *Purposes for Determination of Cost of the Work:* The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
 2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included:* Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:
1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.
 2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
 3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
 4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
 5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

- b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.
 - g. The cost of utilities, fuel, and sanitary facilities at the Site.
 - h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
 - i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.
- C. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:
- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
 - 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
 - 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
 - 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.
- D. *Contractor's Fee*: When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.
- E. *Documentation*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

13.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances*: Contractor agrees that:
 1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

13.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.
- E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;
2. there is no corresponding adjustment with respect to any other item of Work; and
3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.01 Access to Work

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

14.02 Tests, Inspections, and Approvals

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. ~~Owner~~ **Contractor** shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by ~~Owner~~ **Contractor**, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
 1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 3. by manufacturers of equipment furnished under the Contract Documents;
 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 Defective Work

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects:* Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 Acceptance of Defective Work

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 Uncovering Work

- A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 - 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 Owner May Stop the Work

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 Owner May Correct Defective Work

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 Progress Payments

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments:*
1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
 2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
 3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.
- C. *Review of Applications:*
1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
 2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of

- quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
- c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
 4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
 5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
 6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or
 - e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due:*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner:*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
 - b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. the Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. the Contract Price has been reduced by Change Orders;
 - i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;
 - j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - l. there are other items entitling Owner to a set off against the amount recommended.
2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.
3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

15.02 Contractor's Warranty of Title

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.03 Substantial Completion

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.
- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 Partial Use or Occupancy

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 - 1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.

2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

15.05 Final Inspection

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 Final Payment

A. *Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.
2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all disputes that Contractor believes are unsettled; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.

D. *Payment Becomes Due:* Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 Waiver of Claims

- A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 Correction Period

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 1. correct the defective repairs to the Site or such other adjacent areas;
 2. correct such defective Work;
 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work

corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).

- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 Owner May Suspend Work

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 Owner May Terminate for Cause

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate

in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 Owner May Terminate For Convenience

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 Contractor May Stop Work or Terminate

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 Methods and Procedures

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this Article:
 - 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and
 - 2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this Article, Owner or Contractor may:
 - 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or
 - 2. agree with the other party to submit the dispute to another dispute resolution process; or
 - 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.01 Giving Notice

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
 - 1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
 - 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 Computation of Times

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 Cumulative Remedies

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The

provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 Limitation of Damages

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 No Waiver

- A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 Survival of Obligations

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

18.07 Controlling Law

- A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 Headings

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SECTION 01001

GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL

- A. A brief description of the Work is stated in the Advertisement for Bids. To determine the full scope of the project or any particular part of the project, coordinate the applicable information in the several parts of these Contract Documents.

PART 2 SEQUENCE OF OPERATIONS

2.01 SCHEDULING

- A. Prior to starting the Work, confer with the Engineer and Owner's representative to develop an approved Work schedule. Do not make connections between existing Work and new Work until necessary inspection and tests have been completed on the new Work and it is found to conform in all respects to the requirements of the Contract Documents.
- B. Work on existing facilities shall be performed on a schedule and in a manner that will permit the existing water system to operate continuously, unless agreed to by the Owner as described herein.

2.02 SHUTDOWN OR ALTERATION OF EXISTING OPERATIONS OR UTILITIES

- A. Continuous operation of the existing water system is of critical importance.
- B. Connections to existing services or utilities, or other Work that requires the temporary shutdown of any existing operations or utilities shall be planned in detail with appropriate scheduling of the Work and coordinated with the Owner or Engineer. The approved schedule for shutdown or restart shall be indicated on the Contractor's Progress Schedule, and advance notice shall be given in order that the Owner or Engineer may witness the shutdown, tie-in, and startup.
- C. All materials and equipment (including emergency equipment) necessary to expedite tie-ins shall be on hand prior to the shutdown of existing services or utilities.

2.03 OPERATION OF EXISTING SYSTEM PROHIBITED

- A. At no time undertake to close off any lines or open valves or take any other action which would affect the operation of the existing system, except as specifically required by the Drawings and Specifications and after approval is granted by the Owner. Request approval to change the system operation three (3) working days in advance of the time that interruption of the existing system is required.

2.04 EQUIPMENT AND SYSTEM TESTING

- A. Functional (or run) testing, in the presence of the manufacturer's representative and/or Engineer, will be required for each item of equipment following installation. Functional testing

is defined, as that testing necessary to determine if installed equipment and systems will operate as intended.

- B. In addition to the functional test, specific performance testing of installed equipment and systems shall be conducted by the Contractor as required in the section specifying the equipment or system.
- C. The Contractor shall furnish all labor, materials, tools, equipment, instruments, and services necessary to perform the functional and performance testing.

2.05 SEQUENCE OF OPERATIONS

- A. The Work shall proceed in the following sequence:
 - 1. The Work sequence shall be scheduled by the Contractor.

PART 3 SITE CONDITIONS

3.01 SITE INVESTIGATION AND REPRESENTATION

- A. The Contractor acknowledges satisfaction as to the nature and location of the Work, the general and local conditions, particularly those bearing upon availability of transportation, access to the site, disposal, handling and storage of materials, availability of labor, water, electric power, roads, and uncertainties of weather, river stages, or similar physical conditions at the site, the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during the prosecution of the Work, and all other matters which can in any way affect the Work or the cost thereof under this Contract.
- B. The Contractor further acknowledges satisfaction as to character, quality, and quantity of surface and subsurface materials to be encountered from his inspection of the site and from reviewing any available records of exploratory Work furnished by the Owner or included in these Documents. Failure by the Contractor to become acquainted with the physical conditions of the site and all the available information will not relieve the Contractor from responsibility for properly estimating the difficulty or cost of successfully performing the Work.
- C. The Contractor warrants that as a result of examination and investigation of all the aforesaid data, the Contractor can perform the Work in a good and workmanlike manner and to the satisfaction of the Owner. The Owner assumes no responsibility for any representations made by any of its officers or agents during or prior to the execution of this Contract, unless (1) such representations are expressly stated in the Contract, and (2) the Contract expressly provides that the responsibility therefor is assumed by the Owner.

3.02 INFORMATION ON SITE CONDITIONS

- A. General: Any information obtained by the Engineer regarding site conditions, groundwater elevations, existing construction of site facilities as applicable, and similar data will be available for inspection at the office of the Engineer upon request. Such information is offered as supplementary information only. Neither the Engineer nor the Owner assumes any responsibility for the completeness or interpretation of such supplementary information.

3.03 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTIES AND SERVICE

- A. Utilities and structures adjacent to or expected to be encountered in the Work are the Contractor's sole responsibility to locate. A utility notification service is available and shall be used to notify those utilities that participate in the service.
- B. Where the Contractor's operations could cause damage or inconvenience to railway, telegraph, telephone, television, power, oil, gas, water, sewer, or irrigation systems, the operations shall be suspended until all arrangements necessary for the protection of these utilities and services have been made by the Contractor.
- C. Notify all utility offices which are affected by the construction operation at least forty-eight (48) hours in advance. Under no circumstances expose any utility without first obtaining permission from the appropriate agency. Once permission has been granted, locate, expose, and provide temporary support for all existing underground utilities.
- D. The Contractor shall be solely and directly responsible to the Owner and operators of such properties for any damage, injury, expense, loss, inconvenience, delay, suits, actions, or claims of any character brought because of any injuries or damage which may result from the construction operations under this Contract.
- E. Neither the Owner nor its officers or agents shall be responsible to the Contractor for damages as a result of the Contractor's failure to protect utilities encountered in the Work.
- F. If the Contractor while performing the Contract discovers utility facilities not identified by the public agency in the Contract Drawings or Specifications, he shall immediately notify the public agency and utility in writing.
- G. The public utility, where they are the Owner, shall have the sole discretion to perform repairs or relocation Work or permit the Contractor to do such repairs or relocation Work at a reasonable price.
- H. The Contractor shall replace, at his own expense, all existing utilities or structures removed or damage during construction, unless otherwise provided for in these Contract Documents or ordered by the Engineer.

3.04 INTERFERING STRUCTURES

- A. Take necessary precautions to prevent damage to existing structures whether on the surface, aboveground, or underground. An attempt has been made to show major structures on the Drawings. The completeness and accuracy of information shown cannot be guaranteed, and it is presented simply as a guide to avoid known possible difficulties.
- B. Protect underground and aboveground existing structures from damage, whether or not they lie within the limits of the easements obtained by the Owner. Where such existing fences, gates, barns, sheds, buildings, or any other structure must be removed in order to properly carry out the construction, or are damaged during construction, restore to their original condition to the satisfaction of the property owner involved at the Contractor's own expense. Notify the Engineer of any damaged underground structure, and make repairs or replacements before backfilling.

- C. Without additional compensation, the Contractor may remove and replace in a condition as good as or better than original, such small miscellaneous structures as fences, mailboxes, and signposts that interfere with the Contractor's operation.

3.05 FIELD RELOCATION

- A. During the progress of construction, it is expected that minor relocations of the Work will be necessary. Such relocations shall be made only by direction of the Engineer. If existing structures are encountered which prevent the construction, and which are not properly shown on the Drawings, notify the Engineer before continuing with the construction in order that the Engineer may make such field revisions as necessary to avoid conflict with the existing structures. If the Contractor fails to so notify the Engineer when an existing structure is encountered, and proceeds with the construction despite this interference, he shall do so at his own risk.

PART 4 SALVAGE OF MATERIALS

4.01 SALVAGE OF EQUIPMENT AND MATERIALS REMOVED

- A. If existing equipment or materials are removed and replaced, they shall be salvaged by the Contractor.

PART 5 TEMPORARY CONSTRUCTION UTILITIES AND FACILITIES

5.01 TEMPORARY WATER

- A. The Contractor shall provide all water required to accomplish the actual construction, including water required for testing, flushing and sterilization. Temporary piping for transporting the water to the Work shall be paid for by the Contractor.
- B. The Contractor shall setup an account with OCWS Customer Service office and provide contract information. The account shall be setup in the contractor's name with a deposit and service fee paid by the contractor. The deposit will be refunded when the account terminates if the meter has not been damaged or lost. OCWS will be responsible for setting the hydrant, along with the monthly reading. If the hydrant meter needs to be relocated, the Contractor to coordinate this with OCWS Maintenance. Water usage will not be charged to the contractor, provided that the above conditions are met.

5.02 TEMPORARY ELECTRIC POWER

- A. The Contractor shall be responsible for obtaining a source of electric power for construction. The Contractor shall pay the cost of electric service for construction and testing until substantial completion is achieved.

5.03 SAFETY REQUIREMENT FOR TEMPORARY ELECTRIC POWER

- A. Temporary electric power installation shall meet the construction safety requirements of OSHA, State, and other governing agencies.

5.04 SANITARY FACILITIES

GENERAL REQUIREMENTS

- A. The Contractor shall provide and maintain sanitary facilities for his employees and his subcontractors' employees that will comply with the regulations of the local and state departments of health and as directed by the Engineer.

5.05 RECEIVING, INSPECTION, AND UNLOADING PRODUCTS

- A. Contractor shall record the receipt of products at the job site.
- B. Upon receipt of products at the job site, Contractor shall inspect for completeness and evidence of damage during shipment.
 - 1. Owner's representative may be present for inspection.
 - 2. Should there appear to be damage, notify the Owner's representative immediately and inform the Manufacturers and the Transportation Company.
 - 3. Expedite replacement of damaged, incomplete, or lost items.
- C. After completion of inspection, unload products in accordance with manufacturer's instructions for unloading, or as specified. Do not unload damaged or incomplete products to be returned to manufacturer for replacement, except as necessary to expedite return shipment.

5.06 HANDLING, STORAGE, AND MAINTENANCE OF PRODUCTS

- A. Handle products in accordance with the manufacturer's written recommendations, and in a manner to prevent damage.
- B. Store products prior to installation as recommended by the manufacturer.
 - 1. Store products such as pipe and reinforcing steel off the ground in approved storage yards.
 - 2. Store items subject to damage by the elements, vandalism, or theft in secure buildings.
 - 3. Provide environmentally controlled storage facilities for items requiring environmental control for protection.
- C. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by Owner.
- D. Store products to provide access for inspection and inventory control. Contractor shall document products in storage to facilitate inspection and to estimate progress payments for products delivered but not installed in the Work.

5.07 STORAGE OF MATERIALS

- A. Materials shall be so stored as to ensure the preservation of their quality and fitness for the Work. When considered necessary, they shall be placed on wooden platforms or other hard, clean surfaces, and not on the ground. Stored materials shall be located so as to facilitate prompt inspection. Private property shall not be used for storage purposes without the written permission of the Owner or lessee.

- B. Delicate instruments and materials subject to vandalism shall be placed under locked cover and, if necessary, provide with temperature control as recommended by the manufacturer.

PART 6 SAFETY AND CONVENIENCE

6.01 CONSTRUCTION SAFETY PROGRAM

- A. The Contractor shall develop and maintain for the duration of this Contract, a safety program that will effectively incorporate and implement all required safety provisions. The Contractor shall appoint an employee who is qualified and authorized to supervise and enforce compliance with the safety program.
- B. The duty of the Engineer to conduct construction review of the Contractor's performance is not intended to include a review or approval of the adequacy of the Contractor's safety supervisor, the safety program, or any safety measures taken in, on, or near the construction site.

6.02 SAFETY EQUIPMENT

- A. The Contractor, as part of his safety program, shall maintain at his office or other well-known place at the job site, safety equipment applicable to the Work as prescribed by the governing safety authorities, all articles necessary for giving first-aid to the injured, and shall establish the procedure for the immediate removal to a hospital or a doctor's care of any person who may be injured on the job site.
- B. The Contractor shall do all Work necessary to protect the general public from hazards, including, but not limited to, pedestrian sidewalk or walkway, and trenches or excavations in roadway. Barricades, lanterns, and proper signs shall be furnished in sufficient amount to safeguard the public and the Work.
- C. The performance of all Work and all completed construction, particularly with respect to ladders, platforms, structure openings, scaffolding, shoring, lagging, machinery guards and the like, shall be in accordance with the applicable governing safety authorities.
- D. During construction, the Contractor shall construct and at all times maintain satisfactory and substantial temporary chain link fencing, solid fencing, railing, barricades or steel plates, as applicable, at all openings, obstruction, or other hazards in streets, sidewalks, floors, roofs, and walkways. All such barriers shall have adequate warning light as necessary, or required, for safety.

6.03 ACCIDENT REPORTS

- A. If death or serious injuries or serious damage are caused, the accident shall be reported immediately by telephone or messenger to the Engineer. In addition, the Contractor must promptly report in writing to the Engineer all accidents whatsoever arising out of or in connection with, the performance of the Work whether on, or adjacent to, the site, giving full details and statements of witnesses.

- B. If claim is made by anyone against the Contractor or any subcontractor on account of any accidents, the Contractor shall promptly report the facts in writing to the Engineer, giving full details of the claim.

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

- A. Authorized representatives of the GEPD and other government officials shall at all time have safe access to the Work, and the Contractor shall provide proper facilities for such access and inspection.

6.05 PROTECTION OF PROPERTY

- A. Protect stored materials, cultivated trees and crops, and other items located adjacent to the proposed Work. Notify property owners affected by the construction at least forty-eight (48) hours in advance of the time construction begins. During construction operations, construct and maintain such facilities as may be required to provide access by all property owners to their property. No person shall be cut off from access to his residence or place of business for a period exceeding eight (8) hours, unless the Contractor has made special arrangements with the affected persons.

6.06 FIRE PREVENTION AND PROTECTION

- A. The Contractor shall perform all Work in a fire-safe manner. He shall supply and maintain on the site adequate fire-fighting equipment capable of extinguishing incipient fires. The Contractor shall comply with applicable Federal, State, and local fire-prevention regulations. Where these regulations do not apply, applicable parts of the National Fire Prevention Standard for Safeguarding Building Construction Operation (NFPA No. 241) shall be followed.

6.07 TRAFFIC MAINTENANCE AND SAFETY

- A. Comply with all rules and regulations of the State, County, and City authorities regarding closing or restricting the use of public streets or highways. No public or private road shall be closed, except by express permission of the Owner. Conduct the Work so as to assure the least possible obstruction to traffic and normal commercial pursuits. Protect all obstructions within traveled roadways by installing approved signs, barricades, and lights where necessary for the safety of the public. The convenience of the general public and residents adjacent to the project and the protection of persons and property are of prime importance and shall be provided for in an adequate and satisfactory manner.
- B. When flagmen and guards are required by regulation or when deemed necessary for safety, they shall be furnished with approved orange wearing apparel and other regulation traffic-control devices.

6.08 ACCESS AND NOTIFICATION FOR POLICE, FIRE, AND POSTAL SERVICE

- A. Notify the fire department and police department before closing any street or portion thereof. No closing shall be made without the Owner's approval. Notify said departments when the streets are again passable for emergency vehicles. Conduct operations with the least interference to fire equipment access and at no time prevent such access.

- B. The Contractor shall leave a night emergency telephone number or numbers with the police departments, so that contact may be made easily at all times in case of barricade or flare trouble or other emergencies.
- C. Maintain postal service facilities in accordance with the requirements of the U.S. Postal Service, and at the completion of the Work in each area, replace them in their original location and in a condition satisfactory to the U.S. Postal Service.

PART 7 USE OF EXPLOSIVES

- A. The Contractor shall use all precaution, control, and safety features necessary to insure the safety of life or property in the area of operation.
- B. Blasting operations shall be performed under the most skilled supervision. Where necessary, Contractor shall use suitable mats or other approved methods to smother blast.
- C. No loaded holes shall be left unattended.
- D. Extreme care shall be taken to minimize the amount and degree of ground vibration, noise, overpressure, and flying debris.
- E. All explosives shall be stored in a safe manner, in compliance with local, state and federal laws and ordinances.

PART 8 PRESERVATION, RESTORATION, AND CLEANUP

8.01 EROSION CONTROL

- A. The Contractor shall protect floodplains and wetlands by complying with the requirements in Title 33 of the Code of Federal Regulations Part 330, Appendix A and storm water permit.

8.02 SITE RESTORATION AND CLEANUP

- A. At all times during the Work, keep the premises clean and orderly, and upon completion of the Work, repair all damage caused by equipment and leave the project free of rubbish or excess materials of any kind.
- B. All existing drainage ditches and culverts shall be reopened and graded and natural drainage restored. Restore culverts broken or damaged to their original condition and location.

8.03 FINISHING OF SITE, BORROW, AND STORAGE AREAS

- A. Upon completion of the project, all areas used by the Contractor shall be properly cleared of all temporary structures, rubbish, and waste materials and properly graded to drain and blend in with the abutting property. Areas used for the deposit of waste materials shall be finished to properly drain and blend with the surrounding terrain.

8.04 RESEEDING AND FERTILIZING

GENERAL REQUIREMENTS

- A. If damaged originally seeded areas inside and outside of the construction area shall be fertilized and reseeded with first-quality seed or planted with new sod as approved by the property owner. All ground preparation, reseeding, and sodding shall be done in accordance with the best accepted practices for lawn planting. The Contractor shall be responsible for obtaining a satisfactory grass turf acceptable to the property owner.

8.05 STREET CLEANUP DURING CONSTRUCTION

- A. Thoroughly clean all foreign material caused by the construction operations from all streets and roads at the conclusion of each day's operation.

PART 9 SUBMITTALS DURING CONSTRUCTION

9.01 GENERAL

- A. Requirements in this Section are in addition to any specific requirements for submittals specified in other Sections of these Contract Documents.
- B. Submitted data shall be fully sufficient in detail for determination of compliance with the Contract Documents.
- C. Review, acceptance, or approval of substitutions, schedules, shop Drawings, lists of materials, and procedures submitted or requested by the Contractor shall not add to the Contract amount, and all additional costs which may result therefrom shall be solely the obligation of the Contractor.
- D. The Owner is not precluded, by virtue of review, acceptance, or approval, from obtaining a credit for construction savings resulting from allowed concessions in the Work or materials therefore.
- E. It shall not be the responsibility of the Owner to provide engineering or other services to protect the Contractor from additional costs accruing from such approvals.
- F. No equipment or material for which listings, Drawings, or descriptive material is required shall be installed until the Engineer has on hand copies of such approved lists and the appropriately stamped final shop Drawings.
- G. The review of Drawings by the Engineer will be limited to general design requirements only, and shall in no way relieve the Contractor from responsibility for errors or omissions contained therein.
- H. Submittals will be acted upon by the Engineer as promptly as possible, and returned to the Contractor no later than the time allowed for review in SHOP DRAWING SUBMITTAL PROCEDURE. Delays caused by the need for resubmittals shall not constitute reason for an extension of Contract time.

9.02 SHOP DRAWING SUBMITTAL PROCEDURE

- A. The Contractor shall submit an electronic PDF to the Engineer for his review, of shop Drawings, electrical diagrams, and catalog cuts for fabricated items and manufactured items (including mechanical and electrical equipment) furnished under this Contract. Shop

GENERAL REQUIREMENTS

Drawings shall be submitted in sufficient time to allow the Engineer not less than twenty (20) regular working days for examining the shop Drawings.

- B. These shop Drawings shall be accurate, distinct, and complete, and shall contain all required information, including satisfactory identification of items, units, and assemblies in relation to the Contract Drawings and Specifications.
- C. Shop Drawings shall be submitted only by the Contractor, who shall indicate by a signed stamp on the shop Drawings, or other approved means, that he (the Contractor) has checked and approved the shop Drawings, and that the Work shown is in accordance with Contract requirements and has been checked for dimensions and relationship with Work of all other trades involved. The practice of submitting incomplete or unchecked shop Drawings for the Engineer to correct or finish will not be acceptable, and shop Drawings which, in the opinion of the Engineer, clearly indicate that they have not been checked by the Contractor will be considered as not complying with the intent of the Contract Documents and will be returned to the Contractor for resubmission in the proper form.
- D. When the shop Drawings have been reviewed by the Engineer, a PDF will be returned to the Contractor appropriately stamped. If major changes or corrections are necessary, the shop Drawing may be rejected and returned to the Contractor with such changes or corrections indicated, and the Contractor shall correct and resubmit the shop Drawings in the same manner and quantity as specified for the original submittal, unless otherwise directed by the Engineer. If changes are made by the Contractor (in addition to those requested by the Engineer) on the resubmitted shop Drawings, such changes shall be clearly explained in a transmittal letter accompanying the resubmitted shop Drawings.
- E. The review of such shop Drawings and catalog cuts by the Engineer shall not relieve the Contractor from responsibility for correctness of dimension, fabrication details, and space requirements, or for deviations from the Contract Drawings or Specifications, unless the Contractor has called attention to such deviations in writing by the letter accompanying the shop Drawings and the Engineer approves the change or deviation in writing at the time of submission; nor shall review by the Engineer relieve the Contractor from the responsibility for errors in the shop Drawings.
- F. The Contractor agrees that shop Drawing submittals processed by the Engineer do not become Contract Documents and are not Change Orders; that the purpose of the shop Drawing review is to establish a reporting procedure and is intended for the Contractor's convenience in organizing his Work and to permit the Engineer to monitor the Contractor's progress and understanding of the design.

9.03 SHOP DRAWING REQUIREMENTS

- A. Shop Drawings referred to herein shall include shop Drawings and other submittals for both shop and field-fabricated items. The Contractor shall submit, as applicable, the following for all prefabricated or manufactured structural, mechanical, electrical, plumbing, process systems, and equipment:
 - 1. Shop Drawings or equipment Drawings, including dimensions, size and location of connections to other Work, and weight of equipment.
 - 2. Catalog information and cuts.

GENERAL REQUIREMENTS

3. Installation or placing Drawings for equipment, drives, and bases.
 4. Supporting calculations for equipment and associated supports specified to be designed by equipment manufacturers or suppliers.
 5. Wiring and control diagrams of systems and equipment.
 6. Complete manufacturer's specifications, including materials description and paint system.
 7. List of special motor features being provided (i.e., space heaters, altitude corrections, thermal protectors, etc.).
 8. Complete motor rating for all motors fifteen (15) hp and larger, including motor no-load, starting, and full-load current at rated voltage; full-load speed and full-load current at one hundred-ten (110%) percent voltage; motor efficiency and power factor at $\frac{1}{2}$, $\frac{3}{4}$, and full load at rated voltage.
 9. Performance data and pump curves.
 10. Suggested spare parts list.
 11. List of special tools required for checking, testing, parts replacement, and maintenance (Special tools are those which have been specially designed or adapted for use on parts of the equipment, and which are not customarily and routinely carried by maintenance mechanics).
 12. List of special tools furnished with the equipment.
 13. List of materials and supplies required for the equipment prior to and during startup.
 14. List of materials and supplies furnished with the equipment.
 15. Samples of finish colors for selection.
 16. Special handling instructions.
 17. Requirements for storage and protection prior to installation.
 18. Requirements for routine maintenance required prior to plant startup.
 19. List of all requested exceptions to the Contract Documents.
- B. The submittals shall include satisfactory identification of items, units, and assemblies in relation to the Specification Section number, and the system or equipment identification or tag number shown on the Drawings or as provided in the applicable Specification Section.
- C. Should the Contractor propose any item on his shop Drawings, or incorporate an item into the Work, and that item should subsequently prove to be defective or otherwise unsatisfactory,

(regardless of the Engineer's preliminary review), the Contractor shall, at his own expense, replace the item with another item that will perform satisfactorily.

9.04 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. The CONTRACTOR shall furnish four (4) copies and one (1) PDF of a complete instruction manual for installation, operation, maintenance, and lubrication requirements for each component of mechanical and electrical equipment or system under this Contract. All equipment manufacturers and/or suppliers shall be made aware of these requirements and all associated costs shall be included in the costs for furnishing the equipment or system. Each instruction manual furnished shall be fixed in a hard-back binder which is clearly labeled to designate the system or equipment for which it is intended with reference to the building and equipment number and the Specification section where the item is specified.
- B. The manuals shall be furnished at least thirty (30) calendar days prior to the scheduled completion of the Work but in no case shall submission of the manuals be delayed beyond seventy-five (75%) percent completion point of the Work. Submission of the manuals shall precede any payment to the CONTRACTOR for Work completed in excess of the seventy-five (75%) percent completion level. Any deficiencies found by the ENGINEER to exist in the manuals submitted shall be corrected by the CONTRACTOR within thirty (30) calendar days following notification by the ENGINEER of the deficiencies.
- C. Each instruction manual shall include, but not be limited, to the following:
 - 1. Diagrams and illustrations.
 - 2. Detailed description of the function of each principal component of the system.
 - 3. Performance and nameplate data.
 - 4. Installation instructions.
 - 5. Procedure for starting.
 - 6. Proper adjustment.
 - 7. Test procedures.
 - 8. Procedure for operating.
 - 9. Shutdown instructions.
 - 10. Emergency operating instructions and troubleshooting guide.
 - 11. Safety precautions.
 - 12. Maintenance and overhaul instructions which shall include detailed assembly Drawings with part numbers, parts list, instructions for ordering spare parts, and complete preventive maintenance instruction required to ensure satisfactory performance and longevity of the equipment.

GENERAL REQUIREMENTS

13. Lubrication instructions, which shall list points to be greased or oiled, shall recommend type, grade, and temperature range of lubricants, and shall recommend frequency of lubrication.
 14. List of electrical relay settings and control and alarm contact settings.
 15. Electrical interconnection wiring diagram for equipment furnished, including all control and lighting systems.
 16. Start-up reports.
- D. Manuals shall be complete in all respects for all equipment, controls, accessories, and associated appurtenances.
- E. Manuals shall be assembled in one (1) or more binders, each with title page, typed table of contents, and heavy section dividers with numbered plastic index tabs. Each manual shall be divided into sections paralleling the equipment Specifications. Binders shall be three (3) ring, hard-back type. All data shall be punched for binding and composition and printing shall be arranged so that punching does not obliterate any data. The Project title, division designation, and manual title printed thereon shall be furnished by the ENGINEER.
- F. Where more than one (1) binder is required, they shall be labeled "Vol. 1", "Vol. 2", and so on. The table of contents for the entire set, identified by volume number, shall appear in each binder. Submit manual organization and format to the Engineer for approval prior to manual preparation.
- G. Each O & M Manual shall be transmitted to the ENGINEER prior to the installation of the equipment and all equipment shall be serviced in accordance with the manufacturer's recommendations prior to operation. A service record shall be maintained on each item of equipment and shall be delivered to the ENGINEER prior to final acceptance of the Project.

9.05 MAINTENANCE SUMMARY FORMS

- A. In addition to the O & M Manuals, provide Maintenance Summaries in the format of the form bound at the end of this Section and described below. The timing of submission of these forms shall be the same as prescribed above for the Operation and Maintenance Manuals.
- B. An individual Maintenance Summary for each equipment item shall be completed following the outlined provided; and four (4) copies and one (1) PDF submitted for review by the ENGINEER. The manufacturer's standard form will not be acceptable as a substitute for the Maintenance Summary.
- C. The term "Maintenance Operation" as used in the Maintenance Summary bound at the end of this Section is understood to mean any routine operation required to ensure the satisfactory performance and longevity of the equipment. Examples of some typical Maintenance Operations are lubrications, belt tensioning, adjustment of pump packing glands, routine adjustments, etc.
- D. The Maintenance Summary may take as many pages as required. However, the order and format shown must be adhered to. Only 8½ inch by eleven (11) inch paper will be accepted.

9.06 RECORD DRAWINGS

- A. Comply with SECTION 01720.

9.07 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

- A. Where required in the Specifications, the Contractor shall submit manufacturer's certification of proper installation of equipment prior to startup or performance testing. Such certificate shall state that the equipment or system has been installed in accordance with the manufacturer's recommendation 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, and the proper electrical and mechanical connections have been made.

9.08 MATERIAL AND EQUIPMENT COLORS

- A. The Engineer will provide a schedule of colors within thirty (30) days after approval of materials and equipment and after receiving samples of all standard colors those items requiring selections.
- B. No individual color selections will be made until after approval of all pertinent materials and equipment and after receipt of appropriate samples.

9.09 CERTIFICATES OF COMPLIANCE WITH SPECIFIED STANDARDS AND CODES

- A. A Certificate of Compliance shall be furnished for materials specified to a recognized standard or code prior to the use of any such materials in the Work. The Engineer may permit the use of certain materials or assemblies prior to sampling and testing if accompanied by a Certificate of Compliance. The certificate shall be signed by the manufacturer of the material or the manufacturer of assembled materials and shall state that the materials involved comply in all respects with the requirements of the Specifications. A Certificate of Compliance shall be furnished with each lot of material delivered to the Work and the lot so certified shall be clearly identified in the certificate.
- B. All materials used on the basis of a Certificate of Compliance may be sampled and tested at any time. The fact that material is used on the basis of a Certificate of Compliance shall not relieve the Contractor of responsibility for incorporating material in the Work which conforms to the requirements of the Contract Documents and any such material not conforming to such requirements will be subject to rejection whether in place or not.
- C. The Engineer reserves the right to refuse permission for use of material on the basis of a Certificate of Compliance.
- D. The form of the Certificate of Compliance and its disposition shall be as directed by the Engineer.

9.10 STARTING OF SYSTEMS

- A. Definitions:

GENERAL REQUIREMENTS

1. System: A system means the overall process or a portion thereof, that performs a specific function. A system may consist of two (2) or more subsystems as well as two (2) or more types of equipment.
2. Subsystem: A subsystem is a portion of a larger systems consisting of two (2) or more types of equipment.
3. Functional Testing: Tests necessary to demonstrate that installed equipment and systems function as specified and operate in the manner intended. Functional testing is a prerequisite to performance testing for equipment and systems specified to have a performance test.
4. Performance Testing: Tests necessary to demonstrate, after successful functional testing, that equipment and systems meet specified performance requirements.
5. Startup:
 - a. Startup of any portion of the entire facility is considered complete when, in the opinion of the Engineer, the facility or designated portion has properly operated for seven (7) continuous days without significant interruption. The startup period is in addition to the specified functional and performance testing and training.
 - b. Significant interruption during startup shall include any of the following events:
 1. Failure of a system (process, control, building service, etc.) that is not permanently corrected within four (4) hours after such failure occurs.
 2. Failure of a process equipment unit (mechanical, electrical, instrument, etc.) that is not permanently corrected within six (6) hours after such failure occurs.
 3. Failure of an analytical, HVAC, building service, or hoisting equipment unit that is not permanently corrected within eight (8) hours after such failure occurs.
 - c. "Permanently corrected" shall consist of all the following:
 1. Work repaired and replaced to conform with specified requirements.
 2. Parts and components replaced as recommended by original manufacturer and conforming with reviewed submittals.
 3. Piping and valves properly installed and connected.
 4. Wiring properly terminated and enclosed in raceways.
 5. Accessories, including spare parts and lubricants, furnished as specified.

GENERAL REQUIREMENTS

- d. Occurrence of a significant interruption shall require startup then in progress to be stopped and restarted after permanent corrections are made.
 6. Operation: The operation period begins when the facility has been substantially completed as defined in the GENERAL CONDITIONS.
- B. Testing and Startup Responsibilities
1. Contractor's Responsibilities: The Contractor shall:
 - a. Furnish labor and materials, tools, instruments, and service for checking, testing, and startup specified for each equipment item. This includes such services as required by the manufacturer's representatives, subcontractors, electricians, instrumentation technicians, and pipe fitters.
 - b. Prepare testing schedule and incorporate testing and startup activities in the progress schedule for the Work.
 - c. Designate one (1) person (other than field superintendent) to be responsible for coordinating and expediting testing and start-up responsibilities, and to be present during all pre-startup meetings and available to Owner's personnel during the testing and startup.
 - d. Obtain and furnish qualified manufacturer's representative to assist testing of each equipment type and system.
 - e. Develop a standard testing log to be used as a record of testing each item and subsystem. This log shall:
 1. Be subject to approval of Engineer.
 2. Include subsystem and equipment name.
 3. Have provisions for recording dates of completion for checking, inspection by manufacturer, verification of instrumentation and controls, and completion of subsystem tests, and;
 4. Provide space for problems remaining with equipment and for signature of Engineer and manufacturer's representative indicating acceptance.
 - f. Notify Engineer and Owner at least fourteen (14) days prior to the date when each equipment system is scheduled to be initially started; also submit testing plan starting schedule, quantity and source of utilities, chemicals, and other materials needed.
 - g. Furnish spare parts and special tools as specified for the respective equipment.
 - h. Furnish O & M information needed for O & M Manuals, as specified herein.
 2. Owner's Responsibilities: The Owner will:

- a. Furnish for Contractor's use during startup:
 1. Potable and/or raw water for testing, as appropriate.
 2. Chemicals including chlorine, polyaluminum chloride, lime, sodium bisulfite and sodium hexametaphosphate, provided adequate prior notice is given by Contractor.
 3. Sample containers for Contractor's use in sample collection.
 - b. Provide sampling labor and materials and laboratory analysis.
 - c. Furnish Owner's representative to witness all tests.
- C. Testing Preparation
1. Cleaning and Checking: Prior to initial startup of equipment:
 - a. Inspect and clean equipment, devices, and connected piping so they are free of foreign material.
 - b. Lubricate equipment in accordance with manufacturer's instructions.
 - c. Turn rotating equipment by hand and check motor-driven equipment for correct rotation.
 - d. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
 - e. Check power supply to electric-powered equipment for correct voltage.
 - f. Obtain manufacturer's certification of proper installation, where specified.
 2. Ready-To-Test Determination: Equipment shall be determined ready to test by Engineer based on the following:
 - a. Notification by Contractor of equipment and system readiness for testing.
 - b. Submittal of testing plan stating detailed procedures including quantity and source of utilities, chemicals, and other materials needed for each test.
 - c. Receipt of O & M Manuals incorporating review comments.
 - d. Receipt of manufacturer's certification of proper installation, where specified.
 - e. Cleanliness of equipment, devices, and connected work.
 - f. Adequate completion of work adjacent to, or interfacing with, equipment to be tested.

3. Pre-testing Meeting: Contractor shall arrange a meeting to review the Contractor's detailed testing plan for each equipment item and system, at least two (2) days prior to the first test run.

D. Functional Testing

1. Subsystem Tests: Startup and operate the individual components and subsystems that make up each equipment system, as specified in the respective sections of the Specifications. Functional testing of a complete system shall not begin until subsystem testing is completed to the Engineer's satisfaction.
2. Equipment and System Tests: Contractor shall functionally test each separate piece of equipment, and each system requiring simultaneous operation of interdependent equipment, in accordance with the following procedures:
 - a. Separate items of equipment demonstrated to function properly during subsystem testing shall require no further functional test, if documentation of subsystem testing is accepted by Engineer.
 - b. Functional testing of each system shall begin after subsystems and equipment units have been satisfactorily tested.
 - c. Functional testing will begin at a time mutually agreed upon by the Engineer, Owner, Manufacturer's Representative(s) and Contractor.
 1. The Owner or Engineer will be present during tests.
 2. Notify Engineer, Owner, and Manufacturer's Representative at least seven (7) days prior to schedule date of functional tests.
 - d. Performance tests, where specified for individual equipment, shall not begin until functional testing of the complete systems in which they operate is completed to the satisfaction of the Engineer.
 - e. If, in the opinion of the Engineer, each system meets the requirements specified, they will be accepted as conforming for the purposes of advancing to the performance testing phase. If, in the opinion of the Engineer, the functional test results do not meet the requirements specified, the systems will be considered as nonconforming.
 1. In the case of a nonconforming system, advancement to the performance testing phase shall not commence until the Contractor has made such adjustments, changes, and additions necessary to correct the system and retest it as specified and, in the opinion of the Engineer, the system functions as specified.
3. Documentation: Contractor shall document subsystem and system tests in writing, in a format acceptable to the Engineer. Obtain respective manufacturer's signature and approval for subsequent performance testing or startup on the appropriate test logs.

E. Performance Testing

GENERAL REQUIREMENTS

1. Testing Fluid: Performance testing shall use plant fluid or material that the equipment or system is designed to handle during normal service conditions, unless otherwise specified.
2. Equipment and Subsystem Tests: Contractor shall:
 - a. Clean and check equipment and devices, as specified herein prior to starting equipment and subsystem performance tests.
 - b. Performance testing will begin at a time mutually agreed upon by the Engineer, Owner, Manufacturer's Representative(s), and Contractor.
 1. The Owner or Engineer will be present during tests.
 2. Notify Engineer, Owner, and manufacturer's representative at least seven (7) days prior to schedule date of performance testing.
 - c. Operate the necessary equipment units as specified in the respective O & M Manuals for a continuous period of four (4) hours.
 - d. Follow Engineer-approved testing plan and detailed procedures specified for each equipment unit and subsystem.
 - e. Complete acceptable performance testing of all equipment and subsystems included in a system, and submit test documentation before starting the system performance test.

F. Startup

1. Performance testing of all individual equipment and subsystems shall be completed before the startup period begins, unless otherwise allowed by the Engineer.
2. Prepare startup activity schedule.
 - a. Schedule shall identify and sequence distinct activities to be conducted or tasks to be accomplished.
 - b. Examples of startup activities to be conducted are:
 1. Demonstrate manual and automatic operation of equipment.
 2. Simulate power failure and observe operation of components, tripping of breakers, etc.
 - c. Conduct additional non process activities such as:
 1. Operate all plumbing systems.
 2. Open, close lids.

3. Check all electrical and lighting systems.
 - d. Indicate timing and interdependence of activities in the program, indicating each system, subsystem, and unit to be operated. Allow for rotation of standby units with operating units so that each unit is started and stopped at least twice and receives approximately the same elapsed time of operation.
 3. After review and revisions requested by Engineer and Owner, begin the startup activities. Attend a pre-startup meeting not more than five (5) days to startup to review the program and resolve questions.
 4. During startup operations, keep complete records of each activity and performance of each system, subsystem, and equipment unit. Use similar forms approved for functional testing, or as otherwise submitted and approved by Engineer.
 5. If performance testing of certain systems cannot be completed before successful startup, continue such performance tests after entire facility is in continuous operation.
 6. After successful startup as defined in this Section, perform remaining Work to not interfere with facility operations.
- G. Continuous Operation
1. Owner will accept equipment and systems as ready for continuous operation only after successful testing and startup is completed and documented, test and startup reports submitted and manufacturers' services completed for training of Owner's personnel.
 2. After successful performance testing of a particular equipment type or system, Owner may elect to start up a portion of the equipment or system for continuous operation in accordance with the GENERAL CONDITIONS. Such operation will not interfere with testing of other equipment and systems that may still be underway, and shall not preclude the need to start up the portion operated in combination with the rest of the facility when all testing is completed.
 3. Where completed systems require disinfection, they shall only be accepted for continuous operation after disinfection work specified is satisfactorily completed.

9.11 SUPPLIERS'/ MANUFACTURERS' SPECIAL SERVICES

- A. Installation Assistance: Competent and experienced technical personnel shall represent the manufacturers of all equipment and systems as may be necessary to resolve assembly or installation problems at the Work site which are attributable to, or associated with, the equipment furnished.
- B. Functional Testing: Where functional testing services are called for in the Technical Specifications, or when technical assistance is necessary to resolve performance problems that may become apparent during the performance test, the manufacturer's representative shall provide such assistance as necessary to demonstrate the specified performance.

GENERAL REQUIREMENTS

- C. Startup: Where startup services are called for in the Technical Specifications, or when technical assistance is necessary due to any malfunction of the equipment or system furnished, the manufacturer's representative shall provide such services as necessary to provide the Owner with an acceptable operating facility.
- D. Costs for Services:
 - 1. Costs for providing services during installation, testing, and for the training of Owner's personnel shall be included in the costs for providing the applicable specified equipment.
 - 2. Where the number of days for services is not stated in the Technical Specifications, services shall be furnished for installation, testing, and plant startup as required to provide the Owner with a satisfactory operating facility.

END SECTION

TYPICAL MAINTENANCE SUMMARY FORM

1. EQUIPMENT ITEM
2. MANUFACTURER
3. NAMEPLATE DATE (hp, voltage, speed, etc.)
4. MANUFACTURER'S LOCAL REPRESENTATIVE

Name _____ Telephone Number _____

Address _____

5. SPARE PARTS. Include your recommendations regarding what spare parts, if any should be kept on the job.
6. MAINTENANCE REQUIREMENTS

Maintenance Operation ¹	Frequency ²	Lubricant (If Applicable) ³	Comments

1. List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable.
2. List required frequency of each maintenance operation.
3. List lubricant manufacturers, types, and identification numbers.

SECTION 01100
SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Work covered by the Contract Documents.
2. Organization and interpretation of Contract Documents.
3. Measurement and Payment

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work consists of the following:

1. This bid includes the material, equipment, and labor services for a new chlorine contact basin (CCB), reuse pumping station using Owner Pre-Purchased vertical turbine pumps, chemical feed system and prefabricated concrete building, a new 4.0 MGD Tertiary Filtration Unit and relocation of an existing onsite unit, interconnecting piping, electrical and control integration and associated site work, start-up service, and other associated items specified herein and all other appurtenances and related work required to complete the Work. No substitutions will be accepted unless approved by the Purchasing and the Water & Sewer Department. Note: Evaluation of bid will be based on "TOTAL BASE BID AMOUNT". All bids shall include itemized unit cost for each identified item.

B. Project will be constructed under a single prime contract.

1.3 WORK BY OTHERS

A. The following work will be performed by others concurrently with the Work of this Contract:

1. Provide and install SCADA integration and wiring to control panel terminal strip.
2. Provide and install fiber optic, including termination connections and splice.
3. Furnish on board (FOB) new 2- 125 HP & 2- 50 HP vertical turbine pumps and control panel to be installed by the Contractor.

1.4 ORGANIZATION AND INTERPRETATION OF CONTRACT DOCUMENTS

A. Specifications and Drawings included in these Contract Documents establish the performance, quality requirements, location and general arrangement of materials and equipment, and establish the minimum standards for quality of workmanship and appearance.

B. A part of the work that is necessary or required to make each installation satisfactory and operable for its intended purpose, even though it is not specifically included in the

Specifications or on the Drawings, shall be performed as incidental work as if it were described in the Specifications and shown on the Drawings.

1.5 SEQUENCE OF WORK

- A. Include the Milestones and sequences of Work specified herein as part of the progress schedule.
1. Construct the Work in the following sequences:
 2. All existing plant facilities shall remain in operation except as noted below. Construction shall be on the activities in the sequence given below. Activity 2 & 3 may be undertaken simultaneously with Activity 1. Activity 4 can only begin after Activity 1 thru 3 are completed. Activity 5 can only begin after Activity 1, 2, 3, and 4 are completed. Activity 6 can only begin after Activity 5 is complete. Activity 7 can only begin after Activity 6 is completed.

Activity 1 Tasks:

- Construct new chlorine contact basin, prefabricated chemical building, and reuse pumping station.
- Install new electrical services.
- Install connecting piping, electrical and controls/monitoring equipment.

Activity 2 Tasks:

- Install new 4.0 MGD Discfilter, including concrete pad, piping and electrical.

Activity 3 Tasks:

- Construct new concrete prefabricated chemical feed building, CL2 system, cylinder storage and access driveway.

Activity 4 Tasks:

- Tie in new filter, chlorine contact, pumping station, chemical feed system yard piping.

Activity 5 Tasks:

- Relocate existing 16" FM yard piping at existing effluent discharge piping.
- Remove existing flow meter and vault.
- Start up the new 4.0 MGD Filter , chlorine contact basin, CL2 building,

Activity 6 Tasks:

- Relocate existing 2.0 MGD Discfilter.

Activity 7 Tasks:

- Construct Work in stages to allow OWNER's continuous occupancy and uninterrupted operation during construction. Coordinate construction schedule and operation with the OWNER.

- Be responsible for bypass facilities and temporary connections required to maintain OWNER's operations. Sequences other than those specified will be considered by ENGINEER, provided they afford equivalent continuity of operations.
- Power outages will be considered upon 7 days written request to OWNER and ENGINEER. Provide temporary provisions for continuous power supply to critical existing facility components if requested by OWNER'S and ENGINEER.
- Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of OWNER'S operations.

1.5 CONTRACTOR'S USE OF SITE

A. CONTRACTOR'S use of the Site shall be confined to the areas shown.

B. CONTRACTOR shall:

1. Assume full responsibility for protection and safekeeping of products stored on or off the Site.
2. Move stored products that interfere with the operations of OWNER, or local traffic.
3. Obtain and pay for all additional storage or work areas required for its operations.

END OF SECTION

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SECTION 01046
CONTROL OF WORK

PART 1 GENERAL

1.1 FACILITY

- A. Furnish equipment, material and labor which will be efficient, appropriate and large enough to secure a satisfactory quality of work and a rate of progress which will ensure the completion of the work within the Contract Time. If at any time such construction appears to be inefficient, inappropriate or insufficient for securing the quality of work required or for producing the rate of progress aforesaid, Engineer may order the Contractor to increase the efficiency, change the character or increase personnel and/or equipment and the Contractor shall conform to such order. Failure of the Engineer to give such order shall in no way relieve the Contractor of his obligations to secure the quality of the work and rate of progress required.

1.2 PRIVATE LAND

- A. Do not enter or occupy private land outside of easements, except by permission of the land owner.

1.3 PIPE LOCATIONS

- A. Locate pipelines substantially as indicated on the Drawings. The Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve him from laying and jointing different or additional items where required.

1.4 OPEN EXCAVATIONS

- A. Adequately safeguard all open excavations by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons and damage to property. Provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Remove bridges provided for access during construction when no longer required. The length or size of excavation will be controlled by the particular surrounding conditions but shall always be confined to the limits prescribed by the Engineer. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the Engineer may require special construction procedures such as limiting the length of the open trench, prohibiting stacking excavated material in the street and requiring that the trench shall not remain open overnight.
- B. Take precautions to prevent injury to the public and Owner personnel due to open

trenches. Provide adequate light at all trenches, excavated material, equipment, or other obstacles which could be dangerous to the public and Owner personnel at night.

- C. All excavation, trenching and related sheeting, bracing, etc., shall conform to the requirements of the Florida "State Safety Act" (CS/SB 2626) which incorporates, by reference, OSHA's excavation safety standards, 292 CFR 1926.650 Subpart P.

1.5 TEST PITS

- A. Excavate test pits, at the direction of the Engineer, to locate underground pipelines or structures in advance of the construction. Backfill test pits immediately after their purpose has been satisfied and restore and maintain the surface in a manner satisfactory to the Engineer.

1.6 CARE AND PROTECTION OF PROPERTY

- A. Be responsible for the preservation of all public and private property and use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, restore such property to a condition similar or equal to that existing before the damage was done, or make good the damage in other manner acceptable to the Engineer.

1.7 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES

- A. Assume full responsibility for the protection of all buildings, structures, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains and electric and telephone cables, whether or not they are shown on the Drawings. Carefully support and protect all such structures and utilities from injury of any kind. Immediately repair any damage resulting from the construction operations.
- B. Assistance will be given the Contractor in determining the location of existing services. The Contractor, however, shall bear full responsibility for obtaining all locations of underground structures and utilities (including existing water services, drain lines and sewers). Maintain services to buildings and pay costs or charges resulting from damage thereto.

1.8 MAINTENANCE OF FLOW

- A. Provide for the flow of sewers, drains and water courses interrupted during the progress of the work, and immediately cart away and remove all offensive matter. Discuss the entire procedure of maintaining existing flow with the Engineer well in advance of the interruption of any flow.

1.9 COOPERATION WITHIN THIS CONTRACT

- A. All firms or persons authorized to perform any work under this Contract shall cooperate with Engineer and Contractors or trades and assist in incorporating the work of other trades where necessary or required.
- B. Cutting and patching, drilling and fitting shall be carried out where required by the trade or Contractor having jurisdiction, unless otherwise indicated herein or directed by the Engineer.

1.10 PROTECTION OF CONSTRUCTION AND EQUIPMENT

- A. All newly constructed work shall be carefully protected from damage. All damage shall be repaired/reconstructed by the Contractor at his own expense.
- B. All structures shall be protected in a suitable manner. Proposed methods of protection shall be submitted to the Engineer. Should any floors or other parts of any structures become heaved, cracked or otherwise damaged, such damaged portions of work shall be completely repaired and made good by the Contractor at his own expense, to the satisfaction of the Engineer. If, in the final inspection of the work, defects, faults or omissions are found, the Contractor shall cause the same to be repaired or removed and replaced by proper materials and workmanship without extra compensation.

1.11 CLEANUP AND DISPOSAL OF EXCESS MATERIAL

- A. During the course of the work, keep the site of operations as clean and neat as possible. Dispose of all residue resulting from the construction work and, at the conclusion of the work, remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures and any other refuse remaining from the construction operations and leave the entire site of the work in a neat and orderly condition.
- B. In order to prevent environmental pollution arising from the construction activities related to the performance of this Contract, comply with all applicable Federal, State and local laws and regulations concerning waste material disposal, as well as the specific requirements stated in this Section and in other related sections.
- C. Disposal of excess excavated material in wetlands, stream corridors and plains are strictly prohibited even if the permission of the property owner is obtained. Any violation of this restriction by offending parties will be brought to the immediate attention of the responsible regulatory agencies, with a request that appropriate action be taken against the offending parties. The offending parties will be required to remove the fill and restore the area impacted at no increase in the Contract Price.

END OF SECTION

SECTION 01050

PROJECT CONTROLS (SURVEYING)

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Provide field engineering services required for project; including but not limited to:
 - 1. Survey work required for project controls and layout.
 - 2. Certified as-built surveys specified herein.
- B. Retain the services of a registered land surveyor licensed in the state of the project location to:
 - 1. Identify existing control points and property line corners indicated on the Drawings.
 - 2. Verify and record all existing structure locations in the vicinity of, or adjacent to, the proposed Work; and, the locations of all proposed structures and facilities.
 - 3. Maintain an accurate record of locations of all new buried piping and existing buried piping and other buried existing facilities (piping, conduits, and structures) encountered and/or relocated during construction of the new Work.
 - 4. Provide redline drawing(s) showing all constructed above ground features and underground piping four inches (4") and larger.

1.2 RELATED WORK

- A. Contract Closeout (Section 01700).
- B. Record Drawings (Section 01720).

1.3 SUBMITTALS

- A. Submit, to the Engineer, the name, address and current proof of valid state registration and license number of proposed registered land surveyor.
- B. On request of the Engineer, submit documentation to verify accuracy of field

engineering work.

- C. At the end of the project submit certified drawing(s) (with the Surveyor's title block) of the items listed below. All surveys shall be tied to the applicable Grid System and shall indicate all pre-existing and new project benchmarks. Vertical Control shall conform to the project elevation datum designated on the drawings.
 - 1. Certified site survey at 1-in = 50-ft scale or larger, but not greater than 1-in = 20-ft scale, on 22-in by 34-in sheet(s), indicating the building corners, sidewalks, paved areas and location of all above ground structures within the project site or limits of construction.

1.4 QUALIFICATIONS OF SURVEYOR

- A. Registered land surveyor licensed in the state of Florida.

1.5 SURVEY REFERENCE POINTS

- A. Existing basic horizontal and vertical control points for the project are those designated on Drawings.
- B. Locate and protect control points prior to starting site work and preserve all permanent reference points during construction.
 - 1. Make no changes or relocations without prior written notice to and approval by the Engineer.
 - 2. Report to the Engineer when any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations.
 - 3. Require the surveyor to correctly replace project control points which may be lost or destroyed. Establish replacements based on original survey control.

1.6 PROJECT SURVEY REQUIREMENTS

- A. Establish a minimum of two permanent bench marks on site, referenced to data established by survey control points.
 - 1. Record locations, with horizontal and vertical data, on the as-built Survey.
 - 2. Permanent benchmarks shall be installed and spaced for convenient reference and use at locations along the pipeline route and/or on the plant site.
 - 3. Benchmarks shall be installed to National Geodetic Survey standards and

shall include horizontal and vertical data, as well as the installation date.

- B. Establish lines and levels; locate and lay out:
 - 1. Site improvements.
 - a. Stakes for grading, fill and topsoil placement.
 - b. Utility slopes and invert elevations.
 - c. Sidewalks, pavement, fencing, storm drainage facilities, and other finish surface work.
 - 2. Batter boards for structures.
 - 3. Building foundation, column locations and floor levels.
 - 4. Controlling lines and levels required for mechanical and electrical trades.
- C. If lines, levels or layouts are lost or destroyed, or if required by the Engineer, verify layouts by same methods.
- D. Establish all lines and grades prior to construction of line work for all force mains, transmission mains, storm drainage piping, gravity sewers, duct banks and other new utility lines at 100-ft increments, at defined breaks in grade, and at manholes.

PART 2 PRODUCTS (NOT
USED) PART 3 EXECUTION

3.1 RECORDS

- A. Maintain a complete, accurate log of all control and survey work as it progresses.
- B. Update the project as-built survey on a monthly basis, based on the work performed during the month.
- C. Maintain an accurate record of new and existing piping, conduit and structure changes, revisions, relocations, and modifications.
- D. At the end of the project, submit the following:
 - 1. Four signed and sealed prints of all required as-built survey information
 - 2. Copy of all AutoCAD files of documents specified in Article 1.03.C, above on a CD or media storage device.

END OF SECTION

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SECTION 01100

SPECIAL PROJECT PROCEDURES

PART 1 GENERAL

- A. Any modifications to the design or design intent shall require the prior written approval of the Engineer. Request for Information relating to the design intent shall be submitted to the Engineer for its response. Shop Drawings and Submittals shall be submitted to the Engineer for review and approval in accordance with Section 01300. All testing required shall be performed with the full knowledge of and in the presence of the Engineer unless such observations of testing are waived by the Engineer.

1.2 SERVICES OF MANUFACTURERS' FIELD SERVICE TECHNICIAN

- A. Bid prices for equipment furnished under Divisions 11, 13, 14, 15 and 16 shall include the cost of a competent field service technician of the manufacturers of all equipment to supervise the installation, adjustment and testing of the equipment and to instruct the Owner's operating personnel on operation and maintenance. The approved manufacturer's operation and maintenance data as specified in Section 01730 shall be delivered to the Engineer prior to instructing the Owner's personnel. This supervision may be divided into two or more time periods as required by the installation program or as directed by the Engineer.
- B. After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the manufacturer's field service technician shall inspect, operate, test and adjust the equipment. The inspection shall include at least the following points where applicable.
 - 1. Soundness (without cracked or otherwise damaged parts)
 - 2. Completeness in all details, as specified and required
 - 3. Correctness of setting, alignment and relative arrangement of various parts
- C. Upon completion of this work, the manufacturer's field service technician shall submit, in triplicate, to the Engineer a complete, signed report of the results of his/her inspection, operation, adjustments and tests. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified and suggestions for precautions to be taken to ensure proper maintenance.
- D. A certificate from the manufacturer stating that the installation of the equipment is

satisfactory, that the unit has been satisfactorily tested, is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of the unit shall be submitted prior to the startup and performance demonstration hereinafter specified. The certificate shall indicate date and time instruction was given and names of operating personnel in attendance. This certification shall be submitted on the certification sheet, a sample of which is included in Section 01730.

- E. See the detailed Specifications for additional requirements for furnishing the services of the manufacturer's field service technician. For equipment furnished under other Divisions, unless otherwise specified, furnish the services of accredited field services technicians of the manufacturer only when some evident malfunction or over-heating makes such services necessary in the opinion of the Engineer.

1.3 OPERATING AND MAINTENANCE DATA

- A. Operating and maintenance data covering all equipment furnished under Division 11, 13, 14, 15 and 16 shall be submitted. Data shall be prepared and submitted in full conformance with Section 01730. Final approved copies of operating and maintenance data shall have been delivered to the Engineer prior to scheduling the instruction period with the Owner.

1.4 INSTALLATION OF EQUIPMENT

- A. Special care shall be taken to ensure proper alignment of all equipment with particular reference to mechanical equipment such as pumps, blowers and electric drives. The units shall be carefully aligned on their foundations by qualified millwrights after their sole plates have been shimmed to true alignment at the anchor bolts. The anchor bolts shall be set in place and the nuts tightened against the shims. After the foundation alignments have been approved by the manufacturer, the bedplates or wing feet of the equipment shall be securely bolted in place. The alignment of equipment shall be further checked after securing to the foundations and after confirmation of all alignments the sole plates shall be finally grouted in place. The Contractor shall be responsible for the exact alignment of equipment with associated piping, and under no circumstances, will "pipe springing" be allowed.
- B. All wedges, shims, filling pieces, keys, packing, red on white lead grout, or other materials necessary to properly align, level and secure apparatus in place shall be furnished by the Contractor. All parts intended to be plumb or level must be proven exactly so. Any grinding necessary to bring parts to proper bearing after erection shall be done at the expense of the Contractor.

1.5 SLEEVES AND OPENINGS

- A. Provide all openings, channels, chases, etc. and install anchor bolts and other items

to be embedded in concrete, as required to complete the work, together with those required by Contractors and shall do all cutting and patching, excepting cutting and patching of materials of a specified trade.

- B. Coordinate with the Contractors to provide all sleeves, inserts, hangers, anchor bolts, etc. of the proper size and material for the execution of the work. Be responsible for any corrective cutting and refinishing required to make the necessary openings, chases, etc. In no case shall beams, lintels or other structural members be cut without the written approval of the Engineer.

1.6 UNEXPLODED ORDINANCE

- A. There is a possibility that unexploded ordinance (UXO) may be encountered at the construction site. The following procedure is to be followed in the event that ordinance or unidentified objects are encountered:

**Unexploded Ordnance (UXO)
Safety and Reporting Procedures**

From: Unexploded Ordnance (UXO): An Overview 1996, prepared by the Federal Advisory Committee for the Development of Innovative Technologies*

Introduction

Unexploded Ordnance (UXO), whether present in an area by design or by accident, poses the risk of injury or death to anyone in the vicinity. To lessen the danger of UXO hazards and to help prevent placing others at future risk, certain precautions and steps should be taken by anyone who encounters UXO.

Examples of UXO include:

- Small Arms Munitions
- Hand Grenades
- Rockets
- Guided Missiles
- Projectiles
- Mortars
- Project Grenades
- Rifle Grenades
- Submunitions
- Bombs

Encountering UXO

Unexploded Ordnance (UXO) is found in the environment in many different ways depending in part on the specific type of ordnance, when and where it was deployed, how it was deployed, and activities that may take place at the location since deployment. For example, UXO can be at the ground surface, can be partially buried, or can be fully buried. In fact, UXO may be found at depths in excess of 30 feet below the ground surface. Ordnance stabilized by parachute may be completely buried, but the parachute may appear at the surface. UXO may also be found fully intact or in parts or fragments. All UXO whether intact or in parts, presents a potential hazard and should be treated as such. In addition, the UXO casing may have deteriorated depending on the type of material used, the length of time since deployment, and the elements to which it was exposed. UXO that has deteriorated presents a particular hazard because it may contain chemical agents that could become exposed. UXO may be encountered as an isolated munition or as one of many in a given area. The density and type of UXO in an area depends on the intensity and proximity of troop training and weapons testing activities, the degree of UXO cleanup already conducted, and the types of ordnance used. For example, UXO such as dispensers, missiles, rockets, or projectiles may still contain submunitions or those submunitions may have been scattered across a large area. If any UXO is found, one should assume that other UXO are in the area.

Safety Procedures

A person can lessen the danger of UXO dangers by being able to recognize the hazard and by adhering to the following basic safety guidelines:

1. After identifying potential UXO, do not move any closer to it. Some types of ordnance have magnetic or motion-sensitive proximity fusing that may detonate when they sense a target. Others may have self-destruct timers built in.
2. Do not transmit any radio frequencies in the vicinity of suspected UXO hazard. Signals transmitted from items such as walkie-talkies, short-wave radios, citizens' band (CB) radios, or other communication and navigation devices may detonate the UXO.
3. Do not attempt to remove any object on, attached to, or near a UXO. Some fuses are motion-sensitive, and the UXO may explode.
4. DO not move or disturb a UXO because the motion could activate the fuse, causing the UXO to explode.
5. If possible, mark the UXO hazard with a standard UXO marker or with other suitable materials, such as engineer tape, colored cloth, or colored ribbon. Attach the marker to an object so that it is about 3 feet off the ground and visible from all approaches. Place the marker no closer than the point where you first recognized the UXO hazard.
6. Leave the UXO hazard area.
7. Report the UXO to the proper authorities (see Reporting Procedures Section)

8. Stay away from areas of known or suspected UXO. This is the best way to prevent accidental injury or death.

UXO SAFETY WARNINGS

- When you see UXO, stop. Do not move closer
- Never transmit radio frequencies (walkie-talkies, citizens' band radios).
- Never attempt to remove anything near a UXO.
- Never attempt to touch, move, or disturb a UXO.
- Clearly mark the UXO area.
- Avoid any area where UXO is located.

"IF YOU DID NOT DROP IT, DO NOT PICK IT UP!"

Reporting Procedures

Any UXO discovered in the field should be immediately reported to the site Explosive Ordnance Disposal (EOD) personnel. IF EOD personnel are not present at the site, the military provost marshal or local law enforcement agency should be notified. The appropriate authority should initially be notified by telephone, with a written report submitted later to document UXO hazard. Ideally, the exact location should be noted along with type, condition, estimated size, and distinctive features of the ordnance.

* The Federal Advisory Committee for the Development of Innovative Technologies is Comprised of representatives from the Western Governors' Association, Department of Defense, Environmental Protection Agency, and Department of Interior.

1.7 OBSTRUCTIONS

- A. The attention of the CONTRACTOR is drawn to the fact that other work may be performed concurrently onsite. Work shall be planned to avoid obstructions.
- B. The attention of the Contractor is drawn to the fact that during excavation at the Project site, the possibility exists of the Contractor encountering various water, chemical, electrical, or other lines not shown on the Drawings. Exercise extreme care before and during excavation to locate and flag these lines so as to avoid damage to the existing lines. Should damage occur to an existing line, repair the line at no cost to the Owner.
- C. It is the responsibility of the Contractor to ensure that all utility or other poles, the stability of which may be endangered by the close proximity of excavation, are temporarily stayed in position while work proceeds in the vicinity of the pole and

that the utility or other companies concerned be given reasonable advance notice of any such excavation by the Contractor.

1.8 PROVISIONS FOR CONTROL OF EROSION

- A. Sufficient precautions in accordance with Section 02270 shall be taken during construction to minimize the run-off of polluting substances such as silt, clay, fuels, oils, bitumen, calcium chloride, or other polluting materials harmful to humans, fish, or other life, into the supplies and surface waters of the State. Control measures must be adequate to assure that turbidity in the receiving water will not be increased more than 10 nephelometric turbidity units (NTU), or as otherwise required by the State or other controlling body, in water used for public water supply or fish unless limits have been established for the particular water. In surface water used for other purposes, the turbidity must not exceed 25 NTU unless otherwise permitted. Special precautions shall be taken in the use of construction equipment to prevent operations which promote erosion.
- B. Erosion and sedimentation control shall conform to the requirements of the Manual for Erosion and Sediment Control in Florida published by the Florida Soil and Water Conservation Commission.

1.9 PROVISIONS FOR THE CONTROL OF DUST

- A. Sufficient precautions shall be taken during construction to minimize the amount of dust created. Wetting down the site may be required or as directed by the Engineer to prevent dust as a result of vehicular traffic.

1.10 ARCHITECTURAL COATINGS

- A. Maintain coordination among all Sections (windows, window walls, louvers, doors and frames, etc) requiring PVC and PVF coatings. All coatings shall match to the satisfaction of the Engineer with regard to color and texture. Items rejected by the Engineer shall promptly be removed from the job site.

1.11 ON SITE STORAGE

- A. Attention is invited to special storage requirements and possible charges for noncompliance of on-site storage requirements for materials and equipment as specified in Section 01600.

1.12 VALVE INDICES

- A. Furnish and install tags for all valve's gates required on the work. Tags on above ground valves shall be non-corrosive metal or plastic, 2-in in diameter, 19 gauge thick. Buried valve tags shall be secured to a concrete base as shown on the Drawings. Submit to the Engineer for review, two samples of each type of tag

proposed and the manufacturer's standard color chart and letter styles. Tags shall have stamped or engraved on them the information shown on the Drawings and the data described herein. Submit to the Engineer for approval no less than 120 days before start-up, a valve schedule containing all valves required for his/her work. The schedule shall contain a list of abbreviations used for each valve, the location, type, a number, words or abbreviations to identify the valve's function and the normal operating position. The information contained in the valve schedules shall be coded on the tags in a system provided by the Owner. Above ground valve tags shall be furnished with non-corrosive metal wire for attachment thereof. The tag shall not be attached to handwheel or crank operators or any part of the valve which would inhibit operation of the valve.

1.13 DISINFECTION

- A. Clean, disinfect and bacteriologically test and clear in accordance with applicable Florida Department of Health regulations all water supply facilities affected by this project which shall come into contact with raw water, water being treated or treated water prior to placing the facility in operation. The above statement shall apply to both new facilities installed and existing facilities which are to be modified.
- B. Employ a disinfection method approved by the Engineer and Owner and shall fully satisfy the Owner that adequate disinfection has been achieved prior to placing a facility on-line.
- C. Disinfection shall be performed in accordance with AWWA C651 and the Florida Waterworks Regulations. Disinfection is required for both new facilities installed, and existing facilities which are modified.
- D. Bacteriological tests shall be performed by the Owner in accordance with Section 02616.

1.14 CONNECTIONS TO EXISTING SYSTEMS

- A. Perform all work necessary to locate, excavate and prepare for connections to the terminus of the existing systems all as shown on the Drawings or where directed by the Engineer.

1.15 UTILITY CROSSINGS

- A. It is intended that wherever existing utilities such as water, chemical, electrical or other service lines must be crossed, deflection of the pipe within recommended limits and cover shall be used to satisfactorily clear the obstruction unless otherwise indicated on the Drawings. However, when in the opinion of the Owner or Engineer this procedure is not feasible, he/she may direct the use of fittings for a utility crossing as detailed on the Drawings.

1.16 EXISTING UTILITY PROTECTION

- A. Existing utilities are shown in their approximate locations. Locate and protect all utilities whether shown on Drawings or not.
- B. Contact utility companies at least 48 hours before starting construction so maintenance personnel can locate and protect facilities, if required by the utility company.

1.17 ARCHEOLOGICAL FINDS

- A. Notwithstanding anything to the contrary herein, in the event any archeological artifacts within the project are discovered during the course of the work, the Owner shall have and retain all right, title, and interest to such artifacts and shall have the further right, during the course of the Contract, to examine or cause to have examined, the site of the work for any such artifacts and to perform or have performed archeological excavations and all other related work to explore for, discover, recover and remove such artifacts from the site of the work. In the event the work or archeological examination and related work delays the Contractor's work, he/she shall be entitled to an extension of time to complete the work equal to the number of days he/she is thus delayed. Such delay shall be considered an excusable delay as defined in the supplementary conditions.

1.18 PROTECTION AGAINST ELECTROLYSIS

- A. Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces so as to eliminate direct contact and any resulting electrolysis. The insulating material shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other approved materials.

1.19 DAMAGE ON ACCOUNT OF HIGH WATER

- A. Contractor will hold himself responsible for all damage done to his/her work by heavy rains or floods and he/she shall take all reasonable precautions to provide against damages by building such temporary dikes, channels, or shoring to carry off storm water as the nature of the work may require.

1.20 TOOLS

- A. Any special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation and maintenance of any equipment shall be furnished with the respective equipment.

1.21 GREASE, OIL, FUEL, ELECTRICAL POWER AND TESTING EQUIPMENT

- A. All grease, oil and fuel required for testing of equipment shall be furnished with the

respective equipment. Electric power and all equipment and tools required for testing of equipment shall be furnished by the Contractor. The Owner shall be furnished with a year's supply of required lubricants including grease and oil of the type recommended by the manufacturer with each item of equipment supplied under Divisions 11, 13, 14, 15 and 16.

1.22 EMERGENCY PHONE NUMBERS AND ACCIDENT REPORTS

- A. Emergency phone numbers (fire, medical, police) shall be posted at the Contractor's phone and its location known to all.
- B. Accidents shall be reported immediately to the Engineer by messenger or phone.
- C. All accidents shall be documented, and a fully detailed written report submitted to the Engineer after each accident.

1.23 RIGHT TO KNOW LAW

- A. The Contractor shall submit to the Engineer Material Safety Data Sheets for all substances or mixture of substances used on the Project by him or his subcontractors prior to commencing any work in accordance with the requirements.

1.24 HURRICANE PREPAREDNESS PLAN

- A. Within 30 days of the date of Effective Date of the Notice to Proceed, submit a Hurricane Preparedness Plan to the Engineer for approval. The Plan shall describe in detail the necessary measures which the Contractor will perform to secure his equipment and materials at no additional costs to the Engineer, when a hurricane warning is issued. Revise Plan as required by the Engineer.

1.25 WEATHER PROTECTION

- A. In the event of inclement weather protect the Work and materials from damage or injury from the weather. If, in the opinion of the Engineer, any portion of the Work or materials has been damaged by reason of failure to protect the Work, such Work and materials shall be removed and replaced with new materials and Work to the satisfaction of the Engineer, at no additional cost.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01110
ENVIRONMENTAL PROTECTION PROCEDURES

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials and equipment and perform all work required for the prevention of environmental pollution in conformance with applicable laws and regulations, during and as the result of construction operations. For the purpose of this Section, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and/or recreational purposes.
- B. The control of environmental pollution requires consideration of air, water and land, and involves management of noise and solid waste, as well as other pollutants.
- C. Schedule and conduct all work in a manner that will minimize the erosion of soils in the area of the work. Provide erosion control measures such as diversion channels, sedimentation or filtration systems, berms, staked hay bales, seeding, mulching or other special surface treatments as are required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc. All erosion control measures shall be in place in an area prior to construction activity in that area. Specific requirements for erosion and sedimentation controls are specified in Section 02270.
- D. This Section is intended to ensure that construction is achieved with a minimum of disturbance to the existing ecological balance between a water resource and its surroundings. These are general guidelines.
- E. All phases of sedimentation and erosion control shall comply with and be subject to the approval of the Florida Department of Environmental Protection. Prepare sedimentation and erosion control drawings meeting the requirements for approval by that agency. Upon approval, furnish two copies of the approved Drawing to the Engineer.

1.2 APPLICABLE REGULATIONS

- A. Comply with all applicable Federal, State and local laws and regulations concerning environmental pollution control and abatement.

1.3 NOTIFICATIONS

- A. The Engineer will notify the Contractor in writing of any non-compliance with the

ENVIRONMENTAL PROTECTION PROCEDURES

foregoing provisions or of any environmentally objectionable acts and corrective action to be taken. State or local agencies responsible for verification of certain aspects of the environmental protection requirements shall notify the Contractor in writing, through the Engineer, of any non-compliance with State or local requirements. After receipt of such notice from the Engineer or from the regulatory agency through the Engineer, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Engineer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is later determined that the Contractor was in compliance.

1.4 IMPLEMENTATION

- A. Prior to commencement of the Work, meet with the Engineer to develop mutual understandings relative to compliance with these provisions and administration of the environmental pollution control program.
- B. Remove temporary environmental control features, when approved by the Engineer and incorporate permanent control features into the project at the earliest practicable time.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EROSION CONTROL

- A. Provide positive means of erosion control such as shallow ditches around construction to carry off surface water. Erosion control measures, such as siltation basins, hay check dams, mulching, jute netting and other equivalent techniques, shall be used as appropriate. Flow of surface water into excavated areas shall be prevented. Ditches around construction area shall also be used to carry away water resulting from dewatering of excavated areas. At the completion of the work, ditches shall be backfilled, and the ground surface restored to original condition.

3.2 PROTECTION OF STREAMS AND SURFACE WATERS

- A. Take all precautions to prevent, or reduce to a minimum, any damage to any stream or surface water from pollution by debris, sediment or other material, or from the manipulation of equipment and/or materials in or near such streams. Water that has been used for washing or processing, that contains oils or sediments that will reduce the quality of the water in the stream, shall not be directly returned to the stream. Divert such waters through a settling basin or filter before being directed into streams or surface waters.

ENVIRONMENTAL PROTECTION PROCEDURES

- B. Do not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water or any storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels.
- C. Take all preventative measures to avoid spillage of petroleum products and other pollutants. In the event of any spillage, prompt remedial action shall be taken in accordance with a contingency action plan approved by the Florida Department of Environmental Protection and the U.S. EPA. The Contractor shall submit two copies of approved contingency plans to the Engineer.
- D. Water being flushed from structures or pipelines after disinfection, with a Chlorine residue of 2.0 mg/L or greater shall be treated with a dechlorination solution, in a method approved by the Engineer, prior to discharge.

3.3 PROTECTION OF LAND RESOURCES

- A. Restore land resources within the project boundaries and outside the limits of permanent work to a condition, after completion of construction that will appear to be natural and not detract from the appearance of the project. Confine all construction activities to areas shown on the Drawings.
- B. Outside of areas requiring earthwork for the construction of the new facilities, do not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall in any event be responsible for any damage resulting from such use.
- C. Before beginning operations near them, protect trees that may possibly be defaced, bruised, injured, or otherwise damaged by the construction equipment, dumping or other operations, by placing boards, planks, or poles around them. Monuments and markers shall be protected similarly.
- D. Any trees or other landscape features scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to their original condition. The Engineer will decide the method of restoration to be used and whether damaged trees shall be treated and healed or removed and disposed of.
 - 1. All scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1-in in diameter shall be coated as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed in an

ENVIRONMENTAL PROTECTION PROCEDURES

approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.

2. Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the Contractor and are beyond saving in the opinion of the Engineer, shall be immediately removed and replaced.
- E. The locations of the Contractor's storage and other construction buildings required temporarily in the performance of the work, shall be cleared portions of the job site or areas to be cleared as shown on the Drawings and approved by the Engineer and shall not be within wetlands or floodplains. The preservation of the landscape shall be an imperative consideration in the selection of all sites and in the construction of buildings. Drawings showing storage facilities shall be submitted for approval of the Engineer.
- F. If the Contractor proposes to construct temporary roads or embankments and excavations for plant and/or work areas, he shall submit the following for approval at least ten days prior to scheduled start of such temporary work.
1. A layout of all temporary roads, excavations, embankments and drainage to be constructed within the work area.
 2. Details of temporary road construction.
 3. Drawings and cross sections of proposed embankments and their foundations, including a description of proposed materials.
 4. A landscaping drawing showing the proposed restoration of the area. Indicate the proposed removal of any trees and shrubs outside the limits of existing clearing area. Indicate locations of guard posts or barriers required to control vehicular traffic and protect trees and shrubs to be maintained undamaged. The Drawing shall provide for the obliteration of construction scars as such and shall provide for a natural appearing final condition of the area. Modification of the Contractor's approved drawings shall be made only with the written approval of the Engineer. No unauthorized road construction, excavation or embankment construction including disposal areas will be permitted.
- G. Remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess of waste materials, or any other vestiges of construction as directed by the Engineer. It is anticipated that excavation, filling and plowing of roadways will be required to restore the area to near natural conditions which will permit the growth of vegetation thereon. The disturbed areas shall be restored as specified elsewhere.
- H. All debris and excess material will be disposed of outside wetland or floodplain areas

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in an environmentally sound manner.

3.4 PROTECTION OF AIR QUALITY

- A. Burning - The use of burning at the project site for the disposal of refuse and debris will not be permitted.
- B. Dust Control - Maintain all excavations, embankment, stockpiles, access roads, plant sites, waste areas, borrow areas and all other work areas within or without the project boundaries free from dust which could cause the standards for air pollution to be exceeded and which would cause a hazard or nuisance to others.
- C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. The use of petroleum products is prohibited. The use of chlorides may be permitted with approval from the Engineer.
- D. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor shall have sufficient competent equipment on the job to accomplish this. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs, as determined by the Engineer.

3.5 NOISE CONTROL

- A. Make every effort to minimize noises caused by the construction operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with Federal and State regulations.

3.6 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

- A. Maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

END OF SECTION

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SECTION 01180
PIPE PENETRATIONS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install pipe penetration assemblies at all floor and wall penetrations as shown on the Drawings. This Section covers materials for the various pipe penetration configurations. Generally, penetration details are called out on the Drawings and referenced on the detail sheets. Where penetrations are required and not called out, it shall be assumed the most conservative penetration detail shown on the detail sheets shall be utilized as appropriate for the piping type, the wall or floor construction and the rating of the wall or floor penetrated.

1.2 SUBMITTALS

- A. Submit manufacturers' literature, installation instructions, and where applicable, fire rating and certified test results to the Engineer of the various components on all items to be furnished in accordance with Section 01300.

PART 2 PRODUCTS

2.1 PIPE SLEEVES

- A. Unless otherwise shown all pipe, sleeves shall be Schedule 40 galvanized steel pipe conforming to ASTM A53. Where indicated, provide a 2-in minimum circumferential water stop welded to exterior of sleeve at its midpoint. Unless otherwise indicated ends of sleeves shall be cut and ground smooth and shall be flush with the wall or ceiling and extend 2-in above finished floors. Sleeves to be sealed with mechanical seals shall be sized in accordance with the seal manufacturer's recommendations. Sleeves to be sealed by caulking and sleeves for insulated piping shall be sized as required.
- B. External wall penetrations 36-in diameter and less may be made by means of a ductile iron sleeve capable of being bolted directly to the formwork. Seal of the annular space between the carrier pipe and the sleeve shall be made by means of a confined rubber gasket and be capable of withstanding 350 psi. Sleeve shall have an integrally cast waterstop of 1/2-in minimum thickness, 2-1/2-in minimum height. Sleeves shall be by Omni-Sleeve, Malden, MA or equal.

2.2 WALL CASTINGS

- A. Unless otherwise shown, wall castings shall be ductile iron conforming to

ANSI/AWWA A21.51/C151, thickness Class 53, diameter as required. Flanges and/or mechanical joint bells shall be drilled and tapped for studs where flush with the wall. Castings shall be provided with a 2-in minimum circumferential flange/waterstop integrally cast with or welded to the casting, located as follows: for castings set flush with walls located at the center of the overall length of the casting; for castings which extend through wall located within the middle third of the wall.

2.3 SEALING MATERIALS

- A. Mechanical seals shall consist of rubber links shaped to continuously fill the annular space between the pipe and the wall opening or sleeve. Link pressure plates shall be molded of glass reinforced nylon. Hardware shall be mild steel with a 60,000-psi minimum tensile strength and 2-part Zinc Dichromate coating per ASTM B-633 and Organic Coating, tested in accordance with ASTM B-117 to pass a 1,500-hour salt spray test. Type 316 Stainless Steel hardware shall be used in chemical areas, for submerged service and for penetrations in tanks containing sludge or wastewater. Links shall be colored throughout elastomer for positive material identification. Each link shall have permanent identification of the size and manufacturer's name molded into the pressure plate and sealing element. Completed sealing system shall be duty pressure rated for 20 psig differential pressure. Link material shall be EPDM for all services except fire rated assemblies, fire rated seals shall use silicone link material. Mechanical seals shall be PSI-Thunderline/ Link-Seal as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or pre-approved equal.
- B. Sealant shall be a two-part foamed silicone elastomer by Dow Corning Co., Product No. 3-6548 silicone R.T.V.; 3M brand fire barrier products caulk C.P. 25 and 3M brand moldable putty MP+; or Flame-Safe fire stop systems FS-900 by Rectorseal. Sealant bead configuration, depth and width shall be in accordance with manufacturer's recommendations.

2.4 MISCELLANEOUS MATERIALS

- A. Bonding compound shall be Sikadur Hi-Mod epoxy by Sika Corp.; Euco 452 by Euclid Chemical Corp.; Master Builders Company or equal.
- B. Non-shrink grout shall be Masterflow 713 by Master Builders Co.; Euco NS by Euclid Chemical Co.; Five Star Grout by U.S. Grout Corp. or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Assemble and install components of pipe penetration assemblies as detailed on the Drawings.

END OF SECTION

SECTION 01300
SUBMITTALS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. This Section includes the requirements for compiling, processing and transmitting submittals required for execution of the Work.
- B. Submittals are categorized into two types: Action Submittals and Informational Submittals, as follows:
 - 1. Action Submittal: Written and graphic information submitted that requires the Engineer's approval. The following are examples of action submittals:
 - a. Shop drawings (including working drawings and product data)
 - b. Samples
 - c. Operation & Maintenance (O&M) manuals
 - 2. Informational Submittal: Information submitted that does not require the Engineer's approval. The following are examples of informational submittals:
 - a. Shop Drawing Schedule
 - b. Health and Safety Plans
 - c. Work Plans
 - d. Test Records and Reports
 - e. Vendor Training Outlines/Plans
 - f. Test and Start-Up Reports
 - g. Certifications
 - h. Submittals required by laws, regulations and governing agencies
 - i. Submittals required by funding agencies
 - j. Other requirements found within the technical specifications
 - k. Warranties and Bonds
 - l. As-Built Surveys
 - m. Contract Close-out Documents

1.2 RELATED WORK

- A. Additional requirements may be specified in the General Conditions for the Contract.
- B. Additional submittal requirements may be specified in the respective Technical Specification Sections.
- C. Operation and Maintenance (O&M) manuals are included in Section 01730.
- D. Contract closeout submittals are included in Section 01700.

- E. Warranties and Bonds are included in Section 01740.
- F. Project Controls (Surveying) 01050.
- G. Project Record Documents are included in Section 01720

1.3 CONTRACTOR'S RESPONSIBILITIES

- A. All submittals shall be clearly identified as follows:
 - 1. Date of Submission.
 - 2. Project Number.
 - 3. Project Name.
 - 4. Contractor Identification.
 - a. Subcontractor.
 - b. Supplier.
 - c. Manufacturer.
 - d. Manufacturer or supplier representative.
 - 5. Identification of the Product.
 - 6. Reference to Contract Drawing.
 - 7. Reference to specification section number, page and paragraph(s).
 - 8. Reference to applicable standards, such as ASTM or Federal Standards numbers.
 - 9. Indication of Contractor's approval.
 - 10. Contractor's Certification statement.
 - 11. Identification of deviations from the Contract Documents, if any.
 - 12. Reference to previous submittal (for resubmittals).
 - 13. Made in America (when required by the Contract).
- B. Submittals shall be clear and legible, and of sufficient size for legibility and clarity of the presented data.
- C. Submittal Log. Maintain a log of all submittals. The submittal log shall be kept

accurate and up to date. This log should include the following items (as applicable):

1. Description.
2. Submittal Number.
3. Date transmitted to the Engineer.
4. Date returned to Contractor (from Engineer).
5. Status of Submittal (Approved/Not Approved/etc.).
6. Date of Resubmittal to Engineer and Return from Engineer (if applicable and repeat as necessary).
7. Date material released for fabrication.
8. Projected (or actual) delivery date.

D. Numbering System. Utilize the following submittal identification numbering system:

1. The first character shall be a D, S, M or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.
2. The next five digits shall be the applicable Technical Specification Section Number.
3. The next three digits shall be the sequential number of each separate item or drawing submitted under each Specification Section, in the chronological order submitted, starting at 001.
4. The last character shall be a letter, A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc. A typical submittal number would be as follows:
 - a. D-03300-008-B.
 - b. D = Shop Drawing
 - c. 03300 = Section for Concrete.
 - d. 008 = the eighth different submittal under this Section.
 - e. B = the second submission (first resubmission) of that particular shop drawing.

E. Variances

1. Notify the Engineer in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.

2. Notify the Engineer in writing, at the time of re-submittal (resubmission), of all deviations from previous submissions of that particular shop drawing, except those deviations which are the specific result of prior comments from the Engineer.

F. Action Submittals

1. Shop Drawings, Working Drawings, Product Data and Samples.
 - a. Shop Drawings.
 - 1) Shop drawings as defined in the General Conditions, and as specified in individual Sections may include, but are not necessarily limited to, custom prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, valve schedules, wiring diagrams, coordination drawings, equipment inspection and test reports, and performance curves and certifications, as applicable to the work.
 - 2) Contractor shall verify all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and coordinate each item with other related shop drawings and the Contract requirements.
 - 3) All details on shop drawings shall clearly show the relation of the various parts to the main members and lines of the structure and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted.
 - 4) All shop drawings submitted by Contractors and vendors shall be reviewed by the Contractor. Contractor shall confirm, materials, dimensions, catalog numbers, technical data and performance criteria; and shall coordinate with other related shop drawings and the Contract requirements. In addition, Contractor shall confirm existing field conditions and dimensions and assure that the submittal is coordinated and compatible with existing conditions. Submittals directly from Contractors or vendors will not be accepted by the Engineer.
 - 5) The Contractor shall be responsible the accuracy of the Contractor's or vendor's submittal; and, for their submission in a timely manner to support the requirements of the Contractor's construction schedule. Shop drawings found to be inaccurate or otherwise in error shall be returned to the Contractor or vendor to correct. All shop Drawings shall be approved by the Contractor before submission to the Engineer.
 - 6) Delays to construction due to the untimely submission of submittals will constitute inexcusable delays, for which Subcontractor shall not be eligible for additional cost nor additional contract time. Inexcusable delays consist of any delay within the Subcontractor's control.
 - 7) Submittals for equipment specified under Divisions 11, 13, 14, 15 and 16 shall include a listing of installations where identical or similar

- equipment manufactured by that manufacturer has been installed and in operation for a period of at least five years.
- b. Working Drawings
 - 1) Detailed installation drawings (sewers, equipment, piping, electrical conduits and controls, HVAC work, and plumbing, etc.) shall be prepared and submitted for review and approval by the Engineer prior to installing such work. Installation drawings shall be to-scale and shall be fully dimensioned.
 - 2) Piping working drawings shall show the laying dimensions of all pipes, fittings, valves, as well as the equipment to which it is being connected. In addition, all pipe supports shall be shown.
 - 3) Equipment working drawings shall show all equipment dimensions, anchor bolts, support pads, piping connections and electrical connections. In addition, show clearances required around such equipment for maintenance of the equipment.
 - 4) Electrical working drawings shall show conduits, junction boxes, disconnects, control devices, lighting fixtures, support details, control panels, lighting and power panels, and Motor Control Centers. Coordinate all locations with the Contract Documents and the Contractor's other working drawings.
 - c. Product Data
 - 1) Product data, as specified in individual Specification Sections, include, but are not limited to, the manufacturer's standard prepared data for manufactured products (catalog data), such as the product specifications, installation instructions, availability of colors and patterns, rough-in diagrams and templates, product photographs (or diagrams), wiring diagrams, performance curves, quality control inspection and reports, certifications of compliance (as specified or otherwise required), mill reports, product operating and maintenance instructions, recommended spare parts and product warranties, as applicable.
 - d. Samples
 - 1) Furnish, samples required by the Contract Documents for the Engineer's approval. Samples shall be delivered to the Engineer as specified or directed. Unless specified otherwise, provide at least two samples of each required item. Materials or equipment for which samples are required shall not be used in the work unless and until approved by the Engineer.
 - 2) Samples specified in individual Specification Sections, include, but are not limited to physical examples of the work (such as sections of manufactured or fabricated work), small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols, and other specified units of work.
 - 3) Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify and Contract Requirements.

- 4) Approved samples not destroyed in testing shall be sent to the Engineer or stored at the site of the work. Approved samples of the hardware in good condition will be marked for identification and may be used in the work. Materials and equipment incorporated in work shall match the approved samples. Samples which fail testing or are not approved will be returned to the Contractor at his expense, if so, requested at time of submission.
- e. Professional Engineer (P.E.) Certification Form
 - 1) If specifically required in any of the Technical Specification Sections, submit a Professional Engineer (P.E.) Certification for each item required, using the form appended to this Section.
2. Contractor's Certification
 - a. Each shop drawing, working drawings, product data, and sample shall have affixed to it the following Certification Statement:
 - 1) "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements."
 - b. Shop drawings, working drawings, and product data sheets 11-in x 17-in and smaller shall be bound together in an orderly fashion and bear the above Certification Statement on the cover sheet. The transmittal cover sheet for each identified shop drawing shall fully describe the packaged data and include a listing of all items within the package.
3. The review and approval of shop drawings, working drawings, product data, or samples by the Engineer shall not relieve the Contractor from the responsibility for the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the Engineer will have no responsibility therefor.
4. Project work, materials, fabrication, and installation shall conform to approved shop drawings (including working drawings and product data) and applicable samples.
5. No portion of the work requiring a shop drawing (including working drawings and product data) or sample shall be started, nor shall any materials be fabricated or installed before approval of such item. Procurement, fabrication, delivery or installation of products or materials that do not conform to approved shop drawings shall be at the Contractor's risk. Furthermore, such products or materials delivered or installed without approved shop drawings, or in non-conformance with the approved shop drawings will not be eligible for progress payment until such time as the product or material is approved or brought into compliance with approved shop drawings. The Engineer will be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

6. Operation and Maintenance Data
 - a. Operation and maintenance data shall be submitted in assembled manuals as specified in Section 01730. Such manuals shall include detailed instructions for Owner personnel on safe operation procedures, controls, start-up, shut-down, emergency procedures, storage, protection, lubrication, testing, trouble-shooting, adjustments, repair procedures, and other maintenance requirements.

G. Informational Submittals

1. Shop Drawing Schedule
 - a. Prepare and submit a schedule indicating when shop drawings are required to be submitted to support the as-planned construction schedule. The submittal schedule shall allow sufficient time for preparation and submittal, review and approval, and fabrication and delivery to support the construction schedule.
2. Construction Schedule
 - a. Prepare and submit construction schedules and monthly status reports as specified.
3. Statements of Qualifications
 - a. Provide evidence of qualification, certification, or registration, as required in the Contract Documents, to verify qualifications of licensed land surveyor, professional Engineer, materials testing laboratory, specialty subcontractors, technical specialist, consultant, specialty installer, and other professionals.
 - b. Health and Safety Plans
 - 1) When specified, prepare and submit a general company Health and Safety Plan (HSP), modified or supplemented to include job-specific considerations.
4. Outage Requests
 - a. Provide sufficient notification of any outages required (electrical, flow processes, etc.) as may be required to tie-in new work into existing facilities.
5. Test Records and Reports
 - a. Provide copies of all test records and reports as specified in the various technical specifications.
6. Vendor Training Outlines/Plans
 - a. At least two weeks before scheduled training of Owner's personnel, provide lesson plans for vendor training in accordance with the specification for O&M manuals.
7. Test and Start-up Reports
 - a. Manufacture shall perform all pre-start-up installation inspection,

calibrations, alignments, and performance testing as specified in the respective Specification Section. Provide copies of all such test and start-up reports.

8. Certifications
 - a. Provide various certifications as required by the technical specifications. Such certifications shall be signed by an officer (of the firm) or other individual authorized to sign documents on behalf of that entity.
 - b. Certifications may include, but are not limited to:
 - 1) Welding certifications and welders' qualifications
 - 2) Certifications of Installation, Testing and Training for all equipment
 - 3) Material Testing reports furnished by an independent testing firm
 - 4) Certifications from manufacturer(s) for specified factory testing
 - 5) Certifications required to indicate compliance with any sustainability or LEEDS accreditation requirements indicated in the Contract Documents

9. As-Built Drawings
 - a. No later than Substantial Completion, submit a record of all changes during construction not already incorporated into drawings – in accordance with specification on Project Record Documents.

10. Other requirements of the Technical Specification Sections
 - a. Comply with all other requirements of the Technical Specifications.

11. As-Built Surveys
 - a. Engage the services of a licensed land surveyor in accordance with the Section 01050. Prior to Final Completion, provide an as-built survey of the constructed facility, as specified.

12. Contract Close-Out Documents
 - a. Submit Contract documentation as indicated in the specification for Contract Close-out.

PART 2 PRODUCTS (NOT USED) PART 3 EXECUTION

3.1 TRANSMITTALS

- A. Prepare separate transmittal sheets for each submittal. Each transmittal sheet shall include at least the following: the Contractor's name and address, Owner's name, project name, project number, submittal number, description of submittal and number of copies submitted.
- B. Submittals shall be transmitted or delivered directly to the office of the Engineer, as indicated in the Contract Documents or as otherwise directed by the Engineer.

3.2 PROCEDURES

A. Action Submittals

1. Contractor's Responsibilities

- a. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work of other related Sections, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required). Coordinate with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. Extensions to the Contract Time will not be approved for the Contractor's failure to transmit submittals sufficiently in advance of the Work.
- b. The submittals of all shop drawings (including working drawings and product data) shall be sufficiently in advance of construction requirements to allow for possible need of re-submittals, including the specified review time for the Engineer.
- c. No less than 30 calendar days will be required for Engineer's review time for shop drawings and O&M manuals involving only one Engineer discipline. No less than 45 calendar days will be required for Engineer's review time for shop drawings and O&M manuals that require review by more than one Engineer discipline. Resubmittals will be subject to the same review time.
- d. Submittals of operation and maintenance data shall be provided within 30 days of approval of the related shop drawing(s).
- e. Before submission to the Engineer, review shop drawings as follows:
 - 1) make corrections and add field measurements, as required
 - 2) use any color for its notations except red (reserved for the Engineer's notations) and black (to be able to distinguish notations on black and white documents)
 - 3) identify and describe each and every deviation or variation from Contract Documents or from previous submissions, except those specifically resulting from a comment from the Engineer on a previous submission
 - 4) include the required Contractor's Certification statement
 - 5) provide field measurements (as needed)
 - 6) coordinate with other submittals
 - 7) indicate relationships to other features of the Work
 - 8) highlight information applicable to the Work and/or delete information not applicable to the Work
- f. Submit the following number of copies:
 - 1) Shop drawings (including working drawings and product data) - six copies; five of which will be retained by the Engineer.
 - 2) Product Data: six copies
 - 3) Samples - submit the number stated in the respective Sections, two minimum for each submittal.
- g. If Contractor considers any correction indicated on the shop drawings to constitute a change to the contract Documents, provide written notice thereof to the Engineer immediately; and do not release for manufacture before such notice has been received by the Engineer.

- h. When the shop drawings have been completed to the satisfaction of the Engineer, carry out the construction in accordance therewith; and make no further changes therein except upon written instructions from the Engineer.
2. Engineer's Responsibilities
- a. Engineer will not review shop drawings (including working drawings and product data) that do not include the Contractor's approval stamp and required certification statement. Such submittals will be returned to the Contractor, without action, for correction.
 - b. Partial shop drawings (including working drawings and product data) will not be reviewed. If, in the opinion of the Engineer, a submittal is incomplete, that submittal will be returned to the Contractor for completion. Such submittals may be returned with comments from Engineer indicating the deficiencies requiring correction.
 - c. If shop drawings (including working drawings and product data) meet the submittal requirements, Engineer will forward copies to appropriate reviewer(s). Otherwise, noncompliant submittals will be returned to the Contractor without action - with the Engineer retaining one copy.
 - d. Submittals which are transmitted in accordance with the specified requirements will be reviewed by the Engineer within the time specified herein. The time for review will commence upon receipt of submittal by Engineer.
3. Review of Shop Drawings (Including Working Drawings and Product Data) and Samples
- a. The review of shop drawings, working drawings, data and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:
 - 1) as permitting any departure from the Contract requirements
 - 2) as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials
 - 3) as approving departures from details furnished by the Engineer, except as otherwise provided herein
 - b. The Contractor remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.
 - c. If the shop drawings (including working drawings and product data) or samples as submitted describe variations and indicate a deviation from the Contract requirements that, in the opinion of the Engineer are in the interest of the Owner and are so minor as not to involve a change in Contract Price or Contract Time, the Engineer may return the reviewed drawings without noting an exception.
 - d. Only the Engineer will utilize the color "RED" in marking submittals.
 - e. Shop drawings will be returned to the Contractor with one of the following codes.
 - 1) "APPROVED" - This code is assigned when there are no notations or

- comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.
- 2) "APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.
 - 3) "APPROVED AS NOTED/CONFIRM" - This combination of codes is assigned when a confirmation of the notations and comments is required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the confirmation.
 - 4) "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the entire package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the Engineer within 30 calendar days of the date of the Engineer's transmittal requiring the resubmittal.
 - 5) "NOT APPROVED" - This code is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the Contract Documents.
 - 6) "COMMENTS ATTACHED" - This code is assigned where there are comments attached to the returned submittal, which provide additional data to aid the Contractor.
 - 7) "RECEIPT ACKNOWLEDGED (Not subject to Engineer's Review or Approval)" - This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer's review and approval and is being filed for informational purposes only. This code is generally used in acknowledging receipt of means and methods of construction work plans, field conformance test reports, and health and safety plans.
- f. Repetitive Reviews: Shop drawings, O&M manuals and other submittals will be reviewed no more than twice at the Owner's expense. All subsequent reviews will be performed at the Contractor's expense. Reimburse the Owner for all costs invoiced by Engineer for the third and subsequent reviews.
4. Electronic Transmission
- a. Action Submittals may be transmitted by electronic means provided the following conditions are met:
 - 1) The above-specified transmittal form is included.
 - 2) All other requirements specified above have been met including, but not limited to, coordination by the Contractor, review and approval by the

Contractor, and the Contractor's Certification.

- 3) The submittal contains no pages or sheets large than 11 x 17 inches.
- 4) With the exception of the transmittal sheet, the entire submittal is included in a single file.
- 5) The electronic files are PDF format (with printing enabled).
- 6) In addition, transmit three hard-copy (paper) originals to the Engineer.
- 7) The Engineer's review time will commence upon receipt of the hard copies of the submittal.
- 8) For Submittals that require certification, corporate seal, or professional embossment (i.e., P.E.s, Surveyors, etc.) transmit at least two hard-copy originals to the Engineer. In addition, provide additional photocopied or scanned copies, as specified above, showing the required certification, corporate seal, or professional seal.

B. Informational Submittals

1. Contractor's Responsibilities

- a. Number of copies: Submit three copies, unless otherwise indicated in individual Specification sections
- b. Refer to individual technical Specification Sections for specific submittal requirements.

2. Engineer's Responsibilities

- a. The Engineer will review each informational submittal within 15 business days. If the informational submittal complies with the Contract requirements, Engineer will file for the project record and transmit a copy to the Owner. Design Builder may elect not to respond to Contractor regarding informational submittals meeting the Contract requirements.
- b. If an informational submittal does not comply with the Contract requirements, Engineer will respond accordingly to the Contractor within 15 business days. Thereafter, the Contractor shall perform the required corrective action, including retesting, if needed, until the submittal, in the opinion of the Engineer, is in conformance with the Contract Documents.

3. Electronic Transmission

- a. Informational submittals may be transmitted by electronic means providing all of the following conditions are met:
 - 1) The above-specified transmittal form is included.
 - 2) The submittal contains no pages or sheets large than 11 x 17 inches.
 - 3) With the exception of the transmittal sheet, the entire submittal is included in a single file.
 - 4) The electronic files are PDF format (with printing enabled).
 - 5) For Submittals that require certification, corporate seal, or professional embossment (i.e., P.E.s, Surveyors, etc.) transmit two hard-copy originals to the Engineer.

END OF SECTION

P.E. CERTIFICATION FORM

The undersigned hereby certifies that he/she is a professional engineer registered in the State of _____ and that he/she has been employed by

_____ to
design (Company Name)

(Insert P.E. Responsibilities)

In accordance with Specification Section _____ for the

_____. (Name
of Project)

The undersigned further certifies that he/she has performed the said design in conformance with all applicable local, state and federal codes, rules and regulations; and, that his/her signature and P.E. stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the

(Insert Name of Owner)

or Owner's representative within seven days following written request therefor by the Owner.

P.E. Name

Company Name

Signature

Signature

P.E. Registration Number

Title

Address

Address

SECTION 01410
TESTING AND TESTING LABORATORY SERVICES

PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

- A. The Contractor will employ and pay for the services of an Independent Testing Laboratory to perform testing specifically indicated in the Contract Documents and may at any other time elect to have materials and equipment tested for conformity with the Contract Documents. Failed tests shall be back-charged to the Contractor at the time of final payment. All required soil, concrete and bacteriological water testing shall be coordinated with and scheduled by the Engineer.
 - 1. The Contractor shall cooperate with the laboratory to facilitate the execution of its required services.
 - 2. Employment of the laboratory shall in no way relieve Contractor's obligations to perform the work of the Contract.

1.2 RELATED REQUIREMENTS

- A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities.
- B. Respective Sections: Certification of products.
- C. Each Section listed: Laboratory tests required and standards for testing.
- D. Testing Laboratory inspection, sampling and testing is required for but not limited to the following:
 - 1. Site Preparation is included in Section 02100.
 - 2. Earthwork is included in Section 02200.
 - 3. Trenching, Backfilling and Compaction is included in Section 02221.
 - 4. Asphaltic Concrete Paving is included in Section 02542.
 - 5. Concrete Reinforcement is included in Section 03301.
 - 6. Cast-in-Place Concrete is included in Section 03301.
 - 7. Masonry is included in Section 04200.

1.3 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

- A. Laboratory is not authorized to:
 - 1. Release, revoke, alter or enlarge on requirements of Contract Documents.

TESTING AND TESTING LABORATORY SERVICES

2. Approve or accept any portion of the Work.
3. Perform any duties of the Contractor or Engineer.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with laboratory personnel, provide access to Work, to manufacturer's operations.
- B. Secure and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.
- C. Provide to the laboratory the preliminary design mix proposed to be used for concrete and other materials mixes which require control by the testing laboratory.
- D. Furnish incidental labor and facilities:
 1. To provide access to work to be tested.
 2. To obtain and handle samples at the project site or at the source of the product to be tested.
 3. To facilitate inspections and tests.
 4. For storage and curing of test samples.
- E. Notify laboratory sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.
 1. When tests or inspections cannot be performed after such notice, reimburse Engineer for laboratory personnel and travel expenses incurred due to Contractor's negligence.
- F. Employ and pay for the services of the same or a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required for the Equipment Supplier or Contractor's convenience.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01480
TIGHTNESS TESTING OF LIQUID RETAINING STRUCTURES

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and perform tightness testing of all concrete liquid retaining structures listed herein and all retesting until the structures meet the requirements specified herein.

1.2 RELATED WORK

- A. Concrete joints and joint accessories are included in Section 03250.
- B. Concrete and Reinforcing Steel is included in Section 03301.
- C. Waterproofing and dampproofing are included in Division 7.
- D. Slide gates and weir gates are included in Section 11282.
- E. Valves are included in Section 15100.

1.3 SUBMITTALS

- A. Submit to the Engineer for each structure, in accordance with Section 01300, a detailed plan and schedule which shows the method of filling and disposal of water.
- B. Submit to the Engineer, in accordance with Section 01300, a completed Tightness Test Report (Figure A, appended at the end of this Section) of each test for each structure.

1.4 REFERENCE STANDARDS

- A. American Concrete Institute (ACI)
 - 1. ACI 350.1-01 - Tightness Testing of Environmental Engineering Concrete Structures and Commentary.

1.5 PROJECT/SITE REQUIREMENTS

- A. Coordinate timing and procedures for obtaining water for testing, structure testing, and water disposal with the Engineer.
- B. Water Source and Disposal

TIGHTNESS TESTING OF LIQUID RETAINING STRUCTURES

1. Water for testing shall be provided by the Owner.
2. Water for testing shall be plant process water. All labor, materials, equipment, incidentals and power required to convey the water to the structure shall be provided by the Contractor.
3. Test water shall be disposed of by the Contractor in an approved manner. Water shall not be disposed of by discharging it onto the ground surface of public or private land.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

- A. The testing of prestressed concrete and reinforced concrete tanks or water containment structures shall conform to the following standards and as modified herein:
 1. Wire wound prestressed tanks - AWWA D110 or ACI344R-W
 2. Prestressed tendon tanks - ACI-344R-T
 3. Reinforced concrete water retaining structures - ACI 350.1R and as specified herein.
- B. The tightness testing of cast in place reinforced concrete liquid retaining structures shall conform to ACI 350.1-01 and as specified herein.
- C. Perform tightness tests prior to waterproofing and dampproofing and prior to placing backfill around the structure to permit observation and detection of leakage points. Walls may be backfilled prior to testing only when approved in writing by the Engineer. The request to backfill prior to testing shall include a description of the method proposed to detect leakage points after the backfill is in place. Approval to place backfill prior to testing shall not relieve the Contractor of the responsibility for conducting watertightness tests.

3.2 PREPARATION

- A. Remove all dirt, mud and debris from the structure prior to initiating tightness tests. The floor and sumps shall be flushed with water to provide a clean surface, ready for testing.
- B. Inlet and outlet pipes not required to be operational for the tests shall be temporarily sealed or bulkheaded prior to testing.

TIGHTNESS TESTING OF LIQUID RETAINING STRUCTURES

- C. Confirm that all valves and slide gates are completely closed. Repair and reset seals if necessary. All valves and slide gates shall be tested for leakage in accordance with the requirements of the respective Sections as part of the preparation for final tightness testing under this Section. Estimates of gate or valve leakage will not be allowed as adjustments to the measured structure leakage.

3.3 EXAMINATION

- A. Inspect the structure to be tested for potential leakage paths including cracks, voids, honeycombs, and unsealed joints and repair such paths as directed by the Engineer.

3.4 TESTING PROCEDURES

A. Conditions of Testing

1. Do not begin filling of concrete structure until all concrete elements of the structure have attained the specified design strength, but not less than 14 days after all concrete elements have been placed.
2. Filling of concrete structure shall not exceed a rate of 4-ft in 24 hours.
3. Fill concrete structure to the maximum operating water surface level and maintain the water at that level for at least 72 hours prior to beginning tightness tests to minimize water absorption by the concrete during testing.
4. Test only a single structure at a time. Concurrent testing of contiguous or adjacent structures will not be allowed. For the purpose of tightness testing a single structure is any tank, wet well, basin, cell, compartment, filter, channel or similar construction which may be isolated by gates, valves, or the like such that it may be full of liquid when adjacent construction is empty.

B. Testing Procedures

1. Duration of the test shall not be less than the time required to produce a drop in the water surface of 1/2-in based on the calculated maximum allowable leakage rate or 3 days, whichever is greater.
2. Measure water surface elevations at 24-hour intervals. Measure water surface elevations at the same four locations 90 degrees apart. Record water temperature 18-in below the water surface when taking the first and last sets of measurements. The methods used to determine the amount of precipitation or evaporation shall be approved by the Engineer.
3. The percentage of water volume loss shall be computed based on the measured change in water surface elevation, the area of the horizontal water

TIGHTNESS TESTING OF LIQUID RETAINING STRUCTURES

surface, the initial water volume and any correction for precipitation or evaporation where applicable.

C. Reports

1. Notify the Engineer of the scheduling of tests 3 working days prior to the tests. The Engineer may monitor any tightness testing performed on the structures.
2. Submit a completed Tightness Test Report on the form appended to this Section for each structure tested.

3.5 ACCEPTANCE

- A. The following conditions shall be considered as NOT meeting the criteria for acceptance regardless of the actual loss of water volume from the structure.
1. Groundwater seeping or flowing into the structure through floors, walls, or wall-floor joints.
 2. Structures which exhibit seeping or flowing water from joints, cracks, voids, honeycombs, or from beneath the foundation (except underdrain systems).
 3. Increased flow from underdrain system during tightness testing.
 4. Damp spots on concrete surfaces.
 5. Lined concrete structures or prestressed concrete structures on which moisture can be deposited on a dry hand held against the exterior surface of the structure.
- B. The tightness of concrete tanks and structures shall be considered acceptable when the conditions of Paragraph 3.05 A are not present and when loss of water volume is within the criteria listed below:
1. For unlined (or partially lined) concrete tanks, loss of volume not exceeding 0.10 percent in 24 hours (HST-100).
 2. For concrete tanks with fully lined walls, loss of volume not exceeding 0.05 percent in 24 hours (HST-050).
 3. For completely lined tanks, loss of volume not exceeding 0.025 percent in 24 hours (HST- NML).

3.6 REPAIRS AND RETESTING

- A. Structures failing the tightness test and not exhibiting visible leakage may be retested after an additional stabilization period of 7 days. Structures failing this

TIGHTNESS TESTING OF LIQUID RETAINING STRUCTURES

second test shall be repaired prior to further testing.

- B. Repaired structures shall be retested. Repairs and retesting shall be conducted and shall be continued and repeated until the structure meets all requirements specified herein.

3.7 SCHEDULE

- A. The following structures shall be tested for tightness:
 - 1. Chlorine Contact Basin (CCB)
 - 2. Reuse Pump Station

TIGHTNESS TESTING OF LIQUID RETAINING STRUCTURES

FIGURE A
TIGHTNESS TEST REPORT

PROJECT _____ SUBMITTED BY _____
STRUCTURE* _____ TEST DATES _____

Allowable loss of water volume _____ percent in 24 hrs.
Measured loss of water volume _____ percent in 24 hrs. (From D below)

TEST READINGS

Water temperature at start _____ degrees F
Water temperature at end _____ degrees F

Water Surface Elevation

	Date	Time	Location 1	Location 2	Location 3	Location 4	Initials
1.	_____	_____	_____	_____	_____	_____	_____
2.	_____	_____	_____	_____	_____	_____	_____
3.	_____	_____	_____	_____	_____	_____	_____
4.	_____	_____	_____	_____	_____	_____	_____
5.	_____	_____	_____	_____	_____	_____	_____
Change in level		_____	_____	_____	_____	_____	_____
A.	Average change in level			_____			
B.	Correction for precipitation/evaporation			_____			
C.	Corrected change in level = CL =			_____			
D.	Measured percent water loss in 24 hrs. =			$\frac{(CL) \times (\text{surface area}) \times (100)}{(\text{initial water volume}) (\text{number of test days})}$			

Notes and field observations**

- * Attach a sketch showing a plan of the structure and measurement locations.
- ** Place date and initials at the beginning of each entry.

SECTION 01500
TEMPORARY FACILITIES

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, equipment, materials, and incidentals necessary and provide separate temporary facilities for the Contractor's use and the Engineer's use, as specified herein and as shown on the drawings.
- B. Operate and maintain temporary facilities for the duration of the project and as directed by the Engineer.

1.2 RELATED WORK

- A. Control of Work is included in Section 01046.
- B. Special Project Procedures is included in Section 01100.

1.3 QUALITY ASSURANCE

- A. Temporary facilities shall comply with all applicable state and local ordinances, codes and regulations.
- B. Coordinate with authorities having jurisdiction to inspect (and test if required) temporary facilities.
- C. Obtain all required permits for temporary facilities.

1.4 DEFINITIONS

- A. Duration of the project: The period of time from the date of the Notice to Proceed to the date of Final Completion, inclusive.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Fire Extinguishers: Provide portable, UL-rated with class and extinguishing agent required by locations and classes of fire exposure. Provide at least one for each trailer/office.

PART 3 EXECUTION

3.1 CONTRACTOR'S TEMPORARY FIELD OFFICE

- A. Temporary offices shall be established on the job site where approved or directed by the Engineer, adequately furnished, and maintained in a clean, orderly condition by the Contractor. The Contractor or an authorized representative shall be present in the field office at all times while work is in progress. Instructions received there from the Engineer shall be considered as delivered to the Contractor.
- B. The temporary office shall be weathertight, have a tight floor at least 8-in off the ground and shall be insulated all around with rigid insulation board not less than 1/2-in thick and suitably ventilated. The office shall have at least three screened windows capable of being opened, a screen door and a solid door provided with cylinder lock and three keys. The office shall be provided with janitor service, heating equipment, electrical wiring, outlets and fixtures suitable to light the tables and desk adequately as directed.
- C. The CONTRACTOR shall supply all fuel for heating and pay all electrical bills.

3.2 TEMPORARY POWER AND LIGHT

- A. Contractor shall furnish temporary light and power, including 220 Volt service for welding, complete with wiring, lamps and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the project needs. Make all necessary arrangements with the local electric company for temporary electric service and pay all expenses in connection therewith.
- B. Provide connections to existing facilities sized to provide service required for power and lighting.
- C. Install circuit and branch wiring with area distribution boxes located so that power and lighting is available throughout the site by use of construction type power cords.
- D. Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 Volt plugs into higher voltage outlets. For connection of power tools and equipment, provide outlets equipped with ground-fault circuit interrupters, reset button and pilotlight.
- E. Provide grounded extension cords. Use "hard service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if more than one length is required.
- F. Provide general service incandescent lamps as required for adequate illumination. Provide guard cages or tempered glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture.

3.3 WEATHER PROTECTION

TEMPORARY FACILITIES

- A. Contractor shall furnish, install and maintain temporary heat and enclosures to provide adequate working areas for personnel during the months of November through March.
- B. The Contractor shall furnish temporary heating units (UL or FM listed) to maintain reasonable temperatures within temporary enclosures.

3.4 TEMPORARY AIR AND WATER

- A. The Contractor shall provide all air and water piping and appurtenances required for testing pipelines and equipment installed by them. Remove temporary piping and appurtenance on completion of testing.

3.5 SANITARY FACILITIES

- A. Contractor shall provide self-contained, single occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed in a fiberglass or other approved non-absorbent shell for their use.

3.6 VEHICLE ACCESS AND PARKING

- A. Provide temporary access roads, parking areas, traffic control devices and staging areas as approved by the Engineer.

3.7 REMOVAL AND RESTORATION

- A. Remove each temporary facility complete when need for its service has ended and as approved by the Engineer. Coordinate removal of temporary facilities with authorities having jurisdiction.
- B. Restore all improvements damaged by the installation, operation, and removal of the temporary facilities. Obtain prior approval from Engineer for restoration work. Comply with the restoration requirements of Section 01046.

END OF SECTION

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SECTION 01600
DELIVERY, STORAGE, AND HANDLING

PART 1 GENERAL

1.1 SCOPE OF WORK

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

1.2 TRANSPORTATION AND DELIVERY

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

1.3 STORAGE AND PROTECTION

- A. Store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instruction shall be studied by the Contractor and reviewed by the Engineer. Instruction shall be carefully followed and a written record of this kept by the Contractor. Arrange storage to permit access for

inspection.

- B. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- C. Cement and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural, miscellaneous and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products shall be handled and stored in a manner to reduce breakage, cracking and spalling to a minimum.
- D. All mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) shall be stored in a weathertight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the Engineer. Building shall be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer.
 - 1. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer.
 - 2. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.
 - 3. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.
 - 4. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

DELIVERY, STORAGE, AND HANDLING

- E. All paint and other coating products shall be stored in areas protected from the weather. Follow all storage requirements set forth by the paint and coating manufacturers.

END OF SECTION

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**SECTION 01601
CONTROL OF MATERIALS**

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Material and equipment incorporated into the work:
 - 1. Conform to applicable specifications and standards.
 - 2. Comply with size, make, type and quality specified, or as specifically approved in writing by the Engineer.
 - 3. Manufactured and Fabricated Products
 - a. Design, fabricate and assemble in accord with the best engineering and shop practices.
 - b. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
 - c. Two or more items of the same kind shall be identical, by the same manufacturer.
 - d. Products shall be suitable for service conditions.
 - e. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing by the Engineer.
 - 4. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

1.2 RELATED WORK

- A. Special Project Procedures are included in Section 01100.
- B. Submittals are included in Section 01300.
- C. Substitutions and Product Options are included in Section 01630.
- D. Cleaning is included in Section 01710.
- E. Operating and Maintenance Data is included in Section 01730.
- F. Warranties and Bonds are included in Section 01740.

1.3 APPROVAL OF MATERIALS

- A. Unless otherwise specified, only new materials and equipment shall be

incorporated in the work. All materials and equipment furnished shall be subject to the inspection and approval of the Engineer.

- B. Within 15 days of notice to proceed, submit, in accordance with Section 01300, data relating to materials and equipment proposed to be furnished for the work. Such data shall be in sufficient detail to enable the Engineer to identify the particular product and to form an opinion as to its conformity to the specifications.
- C. Facilities and labor for handling and inspection of all materials and equipment shall be furnished by the Contractor. If the Engineer requires, either prior to beginning or during the progress of the work, submit additional samples or materials for such special tests as may be necessary to demonstrate that they conform to the requirements specified herein. Such samples shall be furnished, stored, packed and shipped as directed at the Contractor's expense.
- D. To demonstrate the proficiency of workmen or to facilitate the choice among several textures, types, finishes and surfaces, provide such samples of workmanship or finish as may be required.
- E. The materials and equipment used on the work shall correspond to the approved samples or other data.

1.4 MANUFACTURER'S INSTRUCTIONS FOR INSTALLATION

- A. When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including five copies to the Engineer.
 - 1. Maintain one set of complete instructions at the job site during installation and until completion.
- B. Handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements.
 - 1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.
 - 2. Do not proceed with work without clear instructions.
- C. Perform work in accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

1.5 TRANSPORTATION AND HANDLING

- A. Arrange deliveries of products in accord with construction schedules, coordinate to avoid conflict with work and conditions at the site.
 - 1. Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
 - 2. Immediately upon delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and that products are properly protected and undamaged.
- B. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

1.6 HANDLING AND STORAGE OF MATERIALS

- A. If not, storage is available on site, the Contractor shall furnish a covered, weather-protected storage structure providing a clean, dry, non-corrosive environment for all mechanical equipment, valves, architectural items, electrical, instrumentation equipment, and special equipment to be incorporated into this project. Storage of equipment shall be in strict accordance with the "instructions for storage" of each equipment supplier and manufacturer including connection of heaters, placing of storage lubricants for equipment, etc. Furnish a copy of the manufacturer's instructions for storage to the Engineer prior to storage of all equipment and materials. Corroded, damaged or deteriorated equipment and parts shall be replaced before acceptance of the project. Equipment and materials not properly stored will not be included in a payment estimate.
- B. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible.
 - 1. Store products subject to damage by the elements in weathertight enclosures.
 - 2. Maintain temperature and humidity within the ranges required by manufacturer's instructions.
 - 3. Store fabricated products above the ground, on blocking or skids to prevent soiling or staining. Cover products which are subject to deterioration with impervious sheet coverings, provide adequate ventilation to avoid condensation.
 - 4. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
- C. All materials and equipment to be incorporated in the work shall be handled and stored by the manufacturer, fabricator, supplier and Contractor before, during and

after shipment in a manner to prevent warping, twisting, bending, breaking, chipping, rusting and any injury, theft or damage of any kind whatsoever to the material or equipment.

- D. Cement and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural, miscellaneous, reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products shall be handled and stored in a manner to reduce breakage, chipping, cracking and spalling to a minimum.
- E. All mechanical equipment subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) shall be stored in a building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the Engineer.
- F. All materials which, in the opinion of the Engineer, have become so damaged as to be unfit for the use intended or specified shall be promptly removed from the site of the work and no compensation shall be given for the damaged material or its removal.
- G. All pipe and other materials delivered to the job shall be unloaded and placed in a manner which will not hamper the normal operation of the existing plant or interfere with the flow of necessary traffic.
- H. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions and free from damage or deterioration.
- I. Protection After Installation
 - 1. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove covering when no longer needed.

1.7 SPECIAL TOOLS

- A. Manufacturers of equipment and machinery shall furnish special tools (including grease guns or other lubricating devices) required for normal adjustment, operations and maintenance, together with instructions for their use. Preserve and deliver to the Owner these tools and instructions in good order no later than 7 days prior to plant start-up.

1.8 HANDLING AND STORAGE OF EQUIPMENT ON SITE

- A. Special attention shall be given to the storage and handling of equipment on site. As a minimum, the procedure outlined below shall be followed.
1. Equipment shall not be shipped until approved by the Engineer. The intent of this requirement is to reduce on-site storage time prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the Engineer. Operation and maintenance data as described in Section 01730 shall be submitted to the Engineer for review prior to shipment of equipment.
 2. All equipment having moving parts such as gears, electric motors, etc, and/or instruments shall be stored in a temperature and humidity-controlled building approved by the Engineer, until such time as the equipment is to be installed.
 3. All equipment shall be stored fully lubricated with oil, grease, etc, unless otherwise instructed by the manufacturer.
 4. A copy of the manufacturer's storage instructions shall be given to the Engineer and shall be carefully studied by the Contractor and reviewed with the Engineer by him. These instructions shall be carefully followed and a written record of his kept by the Contractor.
 5. Moving parts shall be rotated a minimum of once weekly to insure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment, start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.
 6. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. Mechanical equipment to be used in the work, if stored for longer than ninety days, shall have the bearings cleaned, flushed and lubricated prior to testing and startup, at no extra cost to the Owner or Engineer.
 7. Prior to acceptance of the equipment, have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guarantee the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

1.9 WARRANTY

- A. For all major pieces of equipment, submit a warranty from the equipment manufacturer as specified in Section 01740.

1.10 SPARE PARTS

- A. Spare parts for certain equipment provided under Divisions 11, 12, 13, 15 and 16 have been specified in the pertinent Sections. Collect and store all spare parts as required by the manufacturer in accordance with Paragraph 1.08 above. In addition, Equipment Supplier or Contractor (as applicable) shall furnish to the Engineer an inventory listing all spare parts, the equipment they are associated with, the name and address of the supplier and the delivered cost of each item. Copies of actual invoices for each item shall be furnished with the inventory to substantiate the delivered cost. Deliver the spare parts to the Owner not later than 7 days prior to plant start-up.

1.11 GREASE, OIL, AND FUEL

- A. All grease, oil and fuel required for testing of equipment shall be furnished with the respective equipment. The Owner shall be furnished with a one year's supply of required lubricants including grease and oil of the type recommended by the manufacturer with each item of equipment supplied under Divisions 11, 12, 13, 15 and 16.
- B. The Contractor shall be responsible for changing the oil in all drives and intermediate drives of each piece mechanical equipment after initial break-in of the equipment, which shall be in accordance with manufacturer's recommendations.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01630
SUBSTITUTIONS AND PRODUCT OPTIONS**

PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Furnish and install products specified, under options and conditions for substitutions stated in this Section.
- B. Whenever a product, material or item of equipment is specified or described by using the name of a proprietary product or the name of a particular manufacturer or vendor, followed by the phase "or equal," the specific item mentioned shall be the basis upon which bids are to be prepared, and shall be understood as establishing the type, function, dimension, appearance and quality desired. Other manufacturer's or vendor's products not named will be considered as substitutions, provided the required information is submitted in the manner set forth in this Section and provided the substitution will not require substantial revision to the Contract Documents.

1.2 RELATED WORK

- A. Delivery Storage and Handling is included in Section 01600.

1.3 SUBMITTAL OF LIST OF PROPOSED SUBSTITUTIONS

- A. The Contractor shall submit their list of proposed substitutions and the proposed monetary changes associated therewith to the Owner & Engineer.

1.4 CONTRACTOR'S OPTIONS

- A. For Products specified only by reference standard, select product meeting that standard, by any manufacturer.
- B. For Products specified by naming several products or manufacturers, select any one of products and manufacturers named which complies with Specifications.
- C. For Products specified by naming one or more products or manufacturers and stating "or equal," submit a request as for substitutions, for any product or manufacturer which is not specifically named.
- D. For Products specified by naming only one product and manufacturer, there is no option and no substitution will be allowed.

1.5 SUBSTITUTIONS

- A. For substitutions to be considered, the Contractor shall submit, within 7 days of issuance of Notice of Award, complete data as set forth herein to permit complete analysis of all proposed substitutions noted on his substitutions list. No substitution shall be considered unless the Contractor provides the required data in accordance with the requirements of this Section within the 7-day period.

- B. Submit separate request for each substitution. Support each request with:
 - 1. Complete data substantiating compliance of proposed substitution with requirements stated in Contract Documents:
 - a. Product identification, including manufacturer's name and address.
 - b. manufacturer's literature; identify:
 - 1) Product description.
 - 2) Reference standards.
 - 3) Performance and test data.
 - 4) Operation and maintenance data.
 - c. Samples, as applicable.
 - d. Name and address of similar projects on which product has been used, and date of each installation.
 - 2. Itemized comparison of the proposed substitution with product specified; List significant variations. Substitution shall not change design intent and shall perform equal to that specified.
 - 3. Data relating to impact on construction schedule occasioned by the proposed substitution.
 - 4. List of changes required in other work or products.
 - 5. Accurate cost data comparing proposed substitution with product specified.
 - a. Amount of any net change to Contract Sum.
 - 6. Designation of required license fees or royalties.
 - 7. Designation of availability of maintenance services, sources of replacement materials.

- C. Substitutions will not be considered for acceptance when:
 - 1. They are indicated or implied on shop drawings or product data submittals without a formal request from the Engineer.
 - 2. They are requested directly by a Contractor or supplier.

3. Acceptance will require substantial revision of Contract Documents.
- D. Requests for substitutions submitted after Notice of Award will not be considered unless evidence is submitted to the Engineer that all of the following circumstances exist:
1. The specified product is unavailable for reasons beyond the control of the Equipment Supplier or Contractor as applicable. Such reasons shall consist of strikes, bankruptcy, discontinuance of manufacturer, or acts of God.
 2. The Contractor placed, or attempted to place, orders for the specified products within 7 days after Notice of Award.
 3. Request for substitution is made in writing to the Engineer within 7 days of the date on which the Contractor ascertains that he cannot obtain the item specified.
 4. Complete data as set forth herein to permit complete analysis of the proposed substitution is submitted with the request.
- E. The Engineer's decision regarding evaluation of substitutions shall be considered final and binding. Requests for time extensions and additional costs based on submission of, acceptance of, or rejection of substitutions will not be allowed. All approved substitutions will be incorporated into the Contract by Change Order.
- 1.6 EQUIPMENT SUPPLIER OR CONTRACTOR'S (AS APPLICABLE) REPRESENTATION
- A. In making formal request for substitution, Equipment Supplier or Contractor (as applicable) represents that:
1. It has investigated proposed product and has determined that it is equal to or superior in all respects to that specified.
 2. It will provide same warranties or bonds for substitution as for products specified.
 3. It will coordinate installation of accepted substitution into the Work and will make such changes as may be required for the Work to be complete in all respects.
 4. It waives claims for additional costs caused by substitution which may subsequently become apparent.
 5. Cost data is complete and includes related costs under his Contract, but not:

SUBSTITUTIONS AND PRODUCT OPTIONS

- a. Costs under separate contracts.
- b. Engineer's costs for redesign or revision of Contract Documents.

1.7 ENGINEER DUTIES

- A. Review Equipment Supplier or Contractor's (as applicable) requests for substitutions with reasonable promptness.
- B. Notify Equipment Supplier or Contractor (as applicable), in writing, of decision to accept or reject requested substitution.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01700
CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. This Section specifies administrative, verification and procedural requirements for project closeout, including but not limited to:
 - 1. Final Cleaning (Section 01710).
 - 2. Project Record Documents (Section 01720).
 - 3. Spare parts and maintenance materials (spare paint, lubricants, and special tools) (applicable Sections in Divisions 09 through 16).
 - 4. Warranties, guarantees, and bonds (Section 01740) and applicable Sections in Technical Divisions 10 through 16.
 - 5. Permit close-outs including Certificate of Occupancy or Certificate of Completion.

1.2 RELATED WORK

- A. Operation and Maintenance (O&M) data and manuals (Section 01730) and applicable Sections in Technical Divisions.
- B. Warranties and Bonds (Section 01740)
- C. Certified Surveyor documentation submittals and As-Built Survey (Section 01050).

1.3 PROJECT RECORD DOCUMENTS

- A. Maintain on site, one set of the following documents; actual revisions to the Work shall be recorded in these documents:
 - 1. Contract Drawings
 - 2. Specifications
 - 3. Addenda
 - 4. Change orders and other Modifications to the Contract
 - 5. Reviewed shop drawings, product data, samples, and other submittals

- B. Store As-Built Documents separate from documents used for construction.
- C. Record information concurrent with construction progress.
- D. Specifications: 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.
- E. Contract Drawings and Shop Drawings: 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.
- F. Submit documents to Engineer with Application for Final Payment.

1.4 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, work has been inspected and that work is complete in accordance with Contract Documents and ready for Engineer's inspection.
- B. Provide all deliverables as specified, prior to submitting the final payment application.
- C. Provide submittals to Engineer that are required by governing or other authorities having applicable jurisdiction including but not limited to permit close out information, certificates of occupancy, etc.
- D. Submit Application for Final Payment identifying total adjusted Contract Sum, previous payments and sum remaining due, following submittal and approval of Record Documents and Record Drawings.

- E. Submit Contractor's Final Release and Release of Liens with final payment application.

1.5 FINAL CLEANING

- A. Contractor to complete final cleaning prior to submittal of the final application for payment.

1. Remove labels that are not permanent labels.
2. The installing Contractor shall clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
3. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean.
4. The installing Contractor shall wipe the surface of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
5. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.

- B. Contractor to comply with requirements as specified in Section 01710.

1.6 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

PART 2 PRODUCTS (NOT
USED) PART 3 EXECUTION
(NOT USED)

END OF SECTION

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SECTION 01710
CLEANING

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Execute cleaning, during progress of the Work, and at completion of the Work, as required by Contract terms.

1.2 RELATED WORK

- A. Each Section: Cleaning for specific products or work.

1.3 DISPOSAL AND CLEANING

- A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations and anti-pollution laws.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Use only those cleaning materials which will not create hazards to health or property, and which will not damage surfaces.
- B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.
- C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 EXECUTION

3.1 DURING CONSTRUCTION

- A. Execute periodic cleaning to keep the Work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.
- B. Provide on-site containers for the collection of waste materials, debris and rubbish.
- C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

3.2 DUST CONTROL

- A. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
- B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.3 FINAL CLEANING

- A. Employ skilled workmen for final cleaning.
- B. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels and other foreign materials from sight-exposed interior and exterior surfaces.
- C. Ventilating Systems:
 - 1. Clean permanent filters and replace disposable filters if units were operated during construction.
 - 2. Clean ducts, blowers and coils if units were operated without filters during construction.
- D. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.
- E. Prior to final completion, or Owner occupancy, conduct an inspection of sight-exposed interior and exterior surfaces and all work areas, to verify that the entire Work is clean.

END OF SECTION

SECTION 01720
PROJECT RECORD
DOCUMENTS

PART 1 GENERAL

1.1 SCOPE

- A. Contractor shall keep and maintain, at the job site, a copy of contract documents, marked up to indicate all changes made during the course of the Work, as specified herein.

1.2 RELATED REQUIREMENTS

- A. As-built surveys are included in Section 01050.
- B. Contract close-out submittals are included in Section 01700.
- C. Warranties and Bonds are included in Section 01740.

1.3 REQUIREMENTS INCLUDED

- A. Contractor shall maintain a record copy of the following documents, marked up to indicate all changes made during the course of a project:
 - 1. Contract Drawings
 - 2. Specifications
- B. Contractor shall assemble copies of the following documents for turnover to the Engineer at the end of the project, as specified.
 - 1. Field Orders, Change Orders, Design Modifications, and RFIs
 - 2. Field Test records
 - 3. Permits and permit close-outs (final approvals)
 - 4. Certificate of Occupancy or Certificate of Completion, as applicable
 - 5. Laboratory test reports (e.g., water quality, concrete, backfill, etc.)
 - 6. Certificates of Compliance for materials and equipment

7. Samples

C. RECORD DRAWINGS

1. Contractor shall annotate (mark-up) the Contract Drawings to indicate all project conditions, locations, configurations, and any other changes or deviations that vary from the original Contract Drawings. This requirement includes, but is not limited to, buried or concealed construction, and utility features that are revealed during the course of construction. Special attention shall be given to recording the locations (horizontal and vertical) and material of all buried utilities that are encountered during construction - whether or not they were indicated on the Contract Drawings. The record information added to the drawings may be supplemented by detailed sketches, if necessary, clearly indicating, the Work, as constructed.
2. These annotated Contract Drawings constitute Contractor's Record Drawings and are actual representations of as-built conditions, including all revisions made necessary by change orders, design modifications, requests for information and field orders.
3. Record drawings shall be accessible to the Owner and Engineer at all times during the construction period.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 MAINTENANCE OF RECORD DOCUMENTS AND SAMPLES

- A. Store documents and samples in Contractor's field office apart from documents used for construction.
 1. Provide files and racks for storage of the record documents.
 2. Provide locked cabinet(s) or secure storage space for storage of samples.
- B. File documents and samples in accordance with Construction Specifications Institute(CSI) format.
- C. Maintain documents in a clean, dry, legible, condition and in good order. Do not use record documents for construction purposes.
- D. Make documents and sample available for inspection by the Engineer at all times.
- E. Up-to-date Record Drawings are a pre-requisite of processing periodic monthly pay applications, if so, specified under the section for progress payments.

3.2 MARKING METHOD

- A. Use the color Red (indelible ink) to record information on the Drawings and Specifications,
- B. Label each document "PROJECT RECORD" in neat large printed letters.
- C. Unless otherwise specified elsewhere, notations shall be affixed to hardcopies of documents.
- D. Record information contemporaneously with construction progress.
- E. Legibly mark drawings with as-built information:
 - 1. Elevations and dimensions of structures and structural elements.
 - 2. All underground utilities (piping and electrical), structures, and appurtenances
 - a. Changes to existing structure, piping and appurtenance locations.
 - b. Record horizontal and vertical locations of underground structures, piping, utilities and appurtenances, referenced to permanent surface improvements.
 - c. Record actual installed pipe material, class, size, joint type, etc.

3.3 RECORD INFORMATION COMPILATION

- A. Do not conceal any work until the required information is acquired.
- B. Items to be recorded include, but are not limited to:
 - 1. Location of internal utilities and appurtenances concealed in the construction – referenced to visible and accessible features.
 - 2. Field changes of dimensions and/or details;
 - a. Interior equipment and piping relocations.
 - b. Architectural and structural changes, including relocation of doors, windows, etc.
 - c. Architectural schedule changes.
- C. Changes made by Field Order, Change Order, design modification, and RFI.
- D. Details not indicated on the original Contract Drawings.
- E. Major architectural schedule changes according to second tier Contractor's records and shop drawings.

- F. Architectural schedule changes according to Contractor's records and shop drawings.
- G. All underground duct banks with elevations and dimensions, horizontal and vertical locations of underground duct banks, and manholes along duct banks.
- H. All underground cable elevations and horizontal locations of underground cables.
- I. Specifications and Addenda - legibly mark each Section to record:
 - 1. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually installed.
 - 2. Changes made by Field Order, Change Order, RFI, and approved shop drawing.

3.4 SUBMITTAL

- A. Upon substantial completion of the Work and prior to Final Acceptance, Contractor shall finalize and deliver a complete set of Record Drawings to the Engineer conforming to the construction records of the Contractor. The set of drawings shall consist of corrected and annotated drawings showing the recorded location(s) of the Work. Unless specified otherwise elsewhere, Record Drawings shall be in the form of a set of prints with annotations carefully and neatly superimposed on the drawings in red.
- B. Accompany submittal with transmittal letter in duplicate, containing:
 - 1. Date
 - 2. Project Title and Number
 - 3. Contractor's name and address
 - 4. Title and number of each Record Document
 - 5. Signature of Contractor or their authorized representative.
- C. The information submitted by the Contractor into the Record Drawings and Record Documents will be assumed to be correct, and the Contractor shall be responsible for the accuracy of such information and shall bear the costs resulting from the correction of incorrect data.
- D. Delivery of Record Drawings and Record Documents to the Engineer will be a prerequisite to Final Payment.
- E. Contractor shall maintain a copy of all books, records, and documents pertinent to the performance under this Contract for a period of five years following completion of the contract.

END OF SECTION

SECTION 01730
OPERATION AND MAINTENANCE
DATA

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. This Section includes procedural requirements for compiling and submitting Operation and Maintenance data required to complete the project.

1.2 RELATED WORK

- A. Submittals are included in Section 01300.
- B. Contract closeout is included in Section 01700.
- C. Warranties and Bonds are included in Section 01740.

1.3 SERVICES OF MANUFACTURERS' REPRESENTATIVE

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

1.4 OPERATING MANUALS

- A. Four complete final hard copy sets of operation and maintenance instructions and four electronic copies covering all equipment furnished under Divisions 11, 13, 15 and 16 shall be delivered at least 30 days prior to scheduled start-up directly to the Engineer. One set of originals must be part of the six sets of operation and maintenance instructions required, including original manuals covering components manufactured by others.

- B. Provide specific operation and maintenance instructions for all electrical, mechanical, and instrumentation & controls equipment furnished under various technical specifications sections.

- C. Separate manuals shall be provided for each type of equipment, or each Section number. Each manual shall contain the following:
 1. Format and Materials
 - a. Binders:
 - 1) Commercial quality three ring binders with durable and cleanable plastic covers
 - 2) Maximum ring width capacity: 3 inches
 - 3) When multiple binders are used, correlate the data into related consistent groupings/volumes.

 - b. Identification: Identify each volume on the cover and spine with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". Include the following:
 - 1) Title of Project.
 - 2) Identify the general subject matter covered in the manual.
 - 3) Identify structure(s) and/or location(s), of the equipment provided.
 - 4) Specification Section number.
 - c. 20 lb loose leaf paper, with hole reinforcement
 - d. Page size: 8-1/2 inch by 11 inch
 - e. Provide heavy-duty fly leaves (section separators), matching the table of contents, for each separate product, each piece of operating equipment, and organizational sections of the manual.
 - 1) Provide typed description of product, and major component parts of equipment.
 - 2) Provide indexed tabs.
 - f. Provide reinforced punched binder tab; bind in with text.
 - g. Reduce larger drawings and fold to the size of text pages - but not larger than 11 inches x 17 inches - or provide a suitable clear plastic pocket (with drawing identification) for such folded drawings/diagrams.

 2. Contents:
 - a. A table of contents/Index divided into section reflective of the major components provided.
 - b. Specific description of each system and components
 - c. Equipment Attribute sheets for submittal of name plate data

- d. Name, address, telephone number(s) and e-mail address(es) of vendor(s) and local service representative(s)
 - e. Specific on-site operating instructions (including starting and stopping procedures)
 - f. Safety considerations
 - g. Project specific operational procedures and recommended log sheet(s).
 - h. Project specific routine maintenance procedures
 - i. Manufacturer's operating and maintenance instructions – specific to the project
 - j. Copy of each wiring diagram
 - k. Copy of approved shop drawing(s) and each Engineer/Contractor's coordination/layout drawing(s)
 - l. List of spare parts, manufacturer's price, and recommended quantities
 - m. Product Data: Mark each sheet to clearly identify specific products and component parts and data applicable to installation. Delete inapplicable information.
 - n. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams
 - o. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.
 - p. Warranties and Bonds, as specified in the General Conditions
3. Transmittals
- a. Prepare separate transmittal sheets for each manual. Each transmittal sheet shall include at least the following: the Contractor's name and address, Owner's name, project name, project number, submittal number, description of submittal and number of copies submitted.
 - b. Submittals shall be transmitted or delivered directly to the office of the Engineer, as indicated in the Contract Documents or as otherwise directed by the Engineer.
- D. Manuals for Equipment and Systems - In addition to the requirements listed above, for each System, provide the following:
- 1. Overview of system and description of unit or system and component parts. Identify function, normal operating characteristics and limiting conditions. Include legible performance curves, with engineering data and tests and complete nomenclature and commercial number of replaceable parts.
 - 2. Panelboard circuit directories including electrical service characteristics, controls and communications and color-coded wiring diagrams as installed.
 - 3. Operating procedures: include start-up, break-in and routine normal operating instructions and sequences; regulation, control, stopping, shut-down and emergency instructions; and summer, winter and any special operating instructions.

4. Maintenance Requirements
 - a. Procedures and guides for trouble-shooting; disassembly, repair, and reassembly instructions
 - b. Alignment, adjusting, balancing and checking instructions
 - c. Servicing and lubrication schedule and list of recommended lubricants
 - d. Manufacturer's printed operation and maintenance instructions
 - e. Sequence of operation by instrumentation and controls manufacturer
 - f. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance
 5. Control diagrams by controls manufacturer as installed (as-built)
 6. Contractor's coordination drawings, with color coded piping diagrams, as installed (as-built)
 7. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams. Include equipment and instrument tag numbers on diagrams.
 8. List of original manufacturer's spare parts and recommended quantities to be maintained in storage
 9. Test and balancing reports, as required
 10. Additional Requirements as specified in individual products specification
 11. Design data for systems engineered by the Contractor or its Suppliers
- E. Electronic Transmission of O&M Manuals
1. Unless otherwise approved by the Engineer, O&M manuals may not be transmitted by electronic means other than by CD-ROM or USB flash drive. Electronic O&M manuals shall meet the following conditions:
 - a. The above-specified transmittal form is included.
 - b. All other requirements specified above have been met, including, but not limited to, coordination by the Contractor, review and approval by the Engineer.
 - c. The submittal contains no pages or sheets large than 11 x 17 inches.
 - d. With the exception of the transmittal sheet, the entire submittal is included in a single file.
 - e. Files are Portable Document Format (PDF) - with the printing function enabled.
 - f. All scanned manufacturer's O&M manuals must be quality checked after scanning to ensure the page are not crooked and all information is legible.
 2. When electronic copies are provided, transmit two hard copy (paper)

originals to the Engineer with an electronic copy on CD-ROM.

3. The electronic copy of the O&M Manual shall be identical in organization, format and content to the hard copies of the manual.
4. The electronic O&M Manual shall be bookmarked identically to the paper manual table of contents to allow quick access to information. Electronic submittals that require extensive scrolling will not be accepted. The document shall be indexed and searchable.

PART 2 PRODUCTS (NOT
USED) PART 3 EXECUTION

3.1 SUBMITTAL SCHEDULE

- A. Operation and Maintenance Manuals shall be delivered directly to the office of the Engineer, as follows:
 1. Provide preliminary copies of each manual to the office of the Engineer, no later than 30 days following approval of the respective shop drawings.
 2. Provide final copies of each completed manual prior to testing.
 3. Provide a letter that grants the Engineer and Owner to the limited right to use and reproduce each manual (in its entirety or any portion thereof) from the respective equipment manufacturer(s). Such limited right shall allow the Engineer and Owner to use each manual or any portion thereof for:
 - a. The potential assembly of a comprehensive facility operation and maintenance manual for the sole benefit of the Owner; and,
 - b. Supplemental training of the Owner's personnel and operators, over and above the required vendor's training, regarding operation of the facility as a system.
- B. The Engineer will review Operation and Maintenance Manuals submittals for operating equipment for conformance with the requirements of the applicable specification Section. The review will generally be based on the O&M Manual Review Checklist appended to this Section.
- C. If during test and start-up of equipment, any changes were made to the equipment, provide two hard copies of as-built drawings or any other amendments for insertion, by the Contractor, in the previously transmitted final manuals. In addition, provide one revised electronic version including the as-built drawings and any other amendments. The manuals shall be completed, including updates, if any, within 30 days of start-up and testing of the facility.

3.2 VENDOR TRAINING/INSTRUCTIONS (TO OWNER'S PERSONNEL)

- A. Before final initiation of operation, manufacturers shall train/instruct Owner's designated personnel in the operation, adjustment, and maintenance of products, equipment and systems at times convenient to the Owner. The Engineer may video tape instructions while they are being given to the Owner's personnel.
- B. Use Operation and Maintenance Manuals as basis for instruction. Train/instruct the Owner's personnel, in detail, based on the contents of manual explaining all aspects of operation and maintenance of the equipment. If the respective equipment is inter-related to the operation of other equipment, all interlock, constraints, and permissives shall be explained.
- C. Prepare and insert additional data in each Operation and Maintenance Manual when the need for such data becomes apparent during training/instruction.
- D. Vendor's training/instruction will be considered acceptable based on the completed Owner's Acknowledgement of Manufacturer's Instruction as indicated on the Equipment Manufacturer's Certification of Installation, Testing, and Instruction appended to this Section.

3.3 ENGINEER'S O&M REVIEW CHECKLIST

- A. The Engineer will review Operation and Maintenance Manuals on operating equipment for conformance with the requirement of this Section.

END OF SECTION

EQUIPMENT MANUFACTURER'S CERTIFICATE OF INSTALLATION
TESTING AND INSTRUCTION

Client _____

Project _____

Contract No. _____

OCWS Project No. _____

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of (Print Name)

(Print manufacturer's name)

hereby CERTIFY that _____
(Print equipment name & model w/ serial No.)

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

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

OWNER'S ACKNOWLEDGEMENT OF MANUFACTURER'S INSTRUCTION

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

DATE: _____

OPERATION AND MAINTENANCE DATA

_____ DATE: _____

_____ DATE: _____

_____ DATE: _____

OPERATION AND MAINTENANCE DATA

O&M Manual Review Checklist

Submittal No.: _____ Project No.: _____ Manufacturer: _____

Equipment Submitted: _____

Specification Section: _____

Date of Submittal: _____

General Data		
1.	Are the area representative's name, address, e-mail address and telephone number included?	
2.	Is the nameplate data for each component included?	
3.	Are all associated components related to the specific equipment included?	
4.	Is non-pertinent data crossed out or deleted?	
5.	Are drawings neatly folded and/or inserted into packets?	
6.	Are all pages properly aligned and scanned legibly?	
7.	Is the .PDF document bookmarked according to the table of contents?	
Operations and Maintenance Data		
8.	Is an overview description of the equipment and/or process included?	
9.	Does the description include the practical theory of operation?	
10.	Does each equipment component include specific details (design characteristics, operating parameters, control descriptions, and selector switch positions and functions)?	
11.	Are alarm and shutdown conditions specific to the equipment provided on this project clearly identified? Does it describe possible causes and recommended remedies?	
12.	Are step procedures for starting, stopping, and troubleshooting specific to the equipment provided included?	
13.	Is a list of operational parameters to monitor and record specific to the equipment provided included?	
14.	Is a proposed operating log sheet specific to the equipment provided	
15.	Is a spare parts inventory list included for each component?	
16.	Is a lubrication schedule for each component specific to the equipment provided included - or does it clearly state "No Lubrication Required"?	
17.	Is a maintenance schedule for each component specific to the equipment provided included?	
18..	Is a copy of the warranty information included?	

Review Comments

Is the submittal fully approved (yes/no)? _____

If not, the following points of rejection must be addressed and require resubmittal by the Contractor:

Item No.

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____
- 6. _____
- 7. _____
- 8. _____
- 9. _____
- 10. _____
- 11. _____
- 12. _____
- 13. _____
- 14. _____
- 15. _____

Reviewed By: _____ Date: _____

Legend

- 1 = OK
- 2 = Not Adequate
- 3 = Not Included

Note: This submittal has been reviewed for compliance with the Contract Documents.

SECTION 01740
WARRANTIES AND
BONDS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

1.2 RELATED WORK

- A. Refer to Conditions of Contract for the general requirements relating to warranties and bonds.
- B. General closeout requirements are included in Section 01700 Project Closeout.
- C. Specific requirements for warranties for the work and products and installations that are specified to be warranted are included in the individual Sections.
- D. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

1.3 SUBMITTALS

- A. Submit written warranties to the Engineer prior to the date fixed for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the work, or a designated portion of the work, submit written warranties upon request of the Owner.
- B. When a designated portion of the work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Engineer within 15 days of completion of that designated portion of the Work.
- C. When a special warranty is required to be executed by the Contractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Engineer for approval prior to final execution.
- D. Refer to individual Sections for specific content requirements, and particular

requirements for submittal of special warranties.

- E. At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the supplier or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the ProjectManual.
- F. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents and sized to receive 8-1/2- in by 11-in paper.
- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Specification, with each item identified with the number and title of the Section in which specified and the name of the product or work item.
- H. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address and telephone number of the installer, supplier and manufacturer.
- I. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS", the project title or name and the name, address and telephone number of the Contractor, equipment supplier, responsible principal, etc.
- J. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.4 WARRANTY REQUIREMENT

- A. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.
- B. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has

benefited from use of the work through a portion of its anticipated useful service life.

- D. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the contract Documents.
- E. The Owner reserves the right to refuse to accept work for the project where a special warranty, certification, or similar commitment is required on such work or part of the work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- F. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers and subcontractors required to countersign special warranties with the Contractor.

1.5 MANUFACTURERS CERTIFICATIONS

- A. Where required, the Contractor shall supply evidence, satisfactory to the Engineer, that the Contractor can obtain manufacturers' certifications as to the Contractor's installation of equipment.

1.6 DEFINITIONS

- A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
- B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT
USED)

END OF SECTION

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SECTION 02050
DEMOLITION AND
MODIFICATIONS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and demolish, modify, remove and dispose of work shown on the Drawings and as specified herein.
- B. Included, but not limited to, are demolition, modifications and removal of existing materials, equipment or work necessary to install the new work as shown on the Drawings and as specified herein and to connect with existing work in approved manner.
- C. Demolition, modifications and removals which may be specified under other Sections shall conform to requirements of this Section.
- D. Demolition and modifications include:
 - 1. Remove and salvage all sprayheads from the construction site. The salvaged sprayheads are to be delivered to the Owner.
 - 2. Remove and dispose of underground irrigation piping within the limits shown on the drawings to accommodate new construction. Otherwise, abandon existing irrigation piping in the project site, and leave in place.
- E. Blasting and/or the use of explosives will not be permitted for sprayhead removal or any other demolition work.

1.2 RELATED WORK

- A. Submittals are included in Section 01300.
- B. Clearing is included in Section 02100.
- C. Excavation and Backfill is included in Section 02200.
- D. Environmental Protection is included in Section 01110.

1.3 SUBMITTALS

DEMOLITION AND MODIFICATIONS

- A. Submit, in accordance with Section 01300, six copies of proposed methods and operations of demolition of the structures and modifications prior to the start of work. Include in the schedule the coordination of shutoff, capping and continuation of utility service as required.
- B. Furnish a detailed sequence of demolition and removal work to ensure the uninterrupted progress of the Owner's operations. Sequence shall be compatible with sequence of construction and shutdown coordination requirements as required by the Engineer.

1.4 JOB CONDITIONS

A. Protection

- 1. Closing or obstructing of roadways, sidewalks and passageways adjacent to the work by the placement or storage of materials will not be permitted and all operations shall be conducted with a minimum interference to traffic on these ways.
- 2. Erect and maintain barriers, lights, sidewalk sheds and other required protective devices.

B. Scheduling

- 1. Carry out operations so as to avoid interference with operations and work in the existing facilities.

C. Notification

- 1. At least 48 hours prior to commencement of a demolition or removal, notify the Engineer in writing of proposed schedule. The Engineer shall inspect the existing equipment and to identify and mark those items which are to remain the property of the Owner. No removals shall be started without the permission of the Engineer.

D. Conditions of Structures

- 1. The Owner assumes no responsibility for the actual condition of the objects to be demolished.
- 2. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable. However, variations may occur prior to the start of demolition work.

E. Traffic Access

DEMOLITION AND MODIFICATIONS

1. Conduct demolition operations and the removal of equipment and debris to ensure minimum interference with access road onsite and offsite and to ensure minimum interference.
2. Special attention is directed towards maintaining safe and convenient access to the construction site.

1.5 RULES AND REGULATIONS

- A. The Building Code of the State of Florida shall control the demolition, modification or alteration of the existing buildings or structures.

1.6 DISPOSAL OF MATERIAL

- A. Salvageable material and equipment listed herein shall become the property of the Owner. Dismantle all such items to a size that can be readily handled and deliver them to a designated storage area.
- B. The following materials and items of equipment shall remain the property of the Owner and stored where directed on the site. Any such material damaged due to improper handling will not be accepted and the replacement value of the material deducted from the payment to the Contractor.
 1. All existing sprayheads within the limits shown on the drawings, including access roads.
 2. All valves greater than 8-in diameter.
- C. All other material and items of equipment shall become the Contractor's property and must be removed from the site.
- D. The storage or sale of removed items on the site will not be allowed.

PART 2 PRODUCTS (NOT USED) PART 3 EXECUTION

3.1 GENERAL

- A. All materials and equipment removed from existing work shall become the property of the Contractor, except for those which the Owner has identified herein or marked for his/her use. All materials and equipment marked by the Owner to remain shall be carefully removed, so as not to be damaged, cleaned and stored on or adjacent to the site in a protected place specified by the Engineer or loaded onto trucks provided by the Owner.

- B. Dispose of all demolition materials, equipment, debris and all other items not marked by the Owner to remain, off the site and in conformance with all existing applicable laws and regulations.
- C. Pollution Controls
 - 1. Use water sprinkling, temporary enclosures and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.
 - a. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding and pollution.
 - b. Clean adjacent structures, facilities, and improvements of dust, dirt and debris caused by demolition operations. Return adjacent areas to conditions existing prior to the start of the work.

3.2 MECHANICAL REMOVALS

- A. Mechanical removals shall consist of those items shown on the Contract drawings and dismantling and removing the existing irrigation system as specified, shown, or required for the completion of the work. It shall include cutting, capping, and plugging as required.
- B. When underground piping is to be removed, the remaining piping shall be properly capped. Abandoned underground piping may be left in place unless it interferes with new work or is shown or specified to be removed.
- C. Any changes to potable water piping and other plumbing and heating system work shall be made in conformance with all applicable codes and under the same requirements as other underground piping. All portions of the potable water system that have been altered or opened shall be pressure tested and disinfected in accordance with Section 01100 and local codes. Other plumbing piping and heating piping shall be pressure tested only.

3.3 CLEAN-UP

- A. Remove from the site all debris resulting from the demolition operations as it accumulates. Upon completion of the work, all materials, equipment, waste and debris of every sort shall be removed, and premises shall be left, clean, neat and orderly.

END OF SECTION

SECTION 02100
SITE
PREPARATION

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and perform all clearing, grubbing and stripping of topsoil complete as shown on the Drawings and as specified herein.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 CLEARING AND GRUBBING

- A. All trees, stumps, brush, shrubs, roots and other objectionable material shall be cut, grubbed, removed and disposed of from areas needed to construct buildings, structures, roads, pipelines and any other areas to be stripped.
- B. Protect trees or groups of trees, designated by the Engineer to remain, from damage by all construction operations by erecting suitable barriers, or by other approved means. Clearing operations shall be conducted in a manner to prevent falling trees from damaging trees designated to remain.
- C. Areas outside the easements or limits of clearing shall be protected from damage and no equipment or materials shall be stored in these areas.
- D. No stumps, trees, limbs, or brush shall be buried in any fills or embankments.

3.2 STRIPPING

- A. Strip topsoil from all areas to be excavated or filled. Avoid mixing topsoil with subsoil and stockpile topsoil in areas on the site as approved by the Engineer. Topsoil shall be free from brush, trash, large stones and other extraneous material and protected until it is placed as specified under Section 02930. Dispose of any remaining topsoil as directed by the Engineer.

END OF SECTION

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SECTION 02140
DEWATERING AND DRAINAGE

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Design, furnish, install, operate, monitor, maintain and remove a temporary dewatering system as required and lower and control water levels below subgrades of excavations to permit construction in the dry.
- B. Furnish, maintain and remove temporary surface water control measures adequate to drain and remove surface water entering excavations.
- C. Collect and properly dispose of all discharge water from the dewatering and drainage systems in accordance with the provisions of Section 01110.

1.2 DESIGN AND PERFORMANCE RESPONSIBILITY

- A. Design and execution of methods for controlling surface water and groundwater.
- B. For damage to properties, buildings or structures, sewers and other utility installations, pavements and work that may result from dewatering or surface water control operations.
- C. Design review and field monitoring activities by the Owner or of the Engineer shall not relieve the Contractor of his/her responsibilities for the work.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 01300, detailed plans of the proposed dewatering method, as specified in Paragraph 3.03 below.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Pipe for observation wells, if required, shall consist of minimum 1-in I.D., Schedule 80 PVC pipe and machine slotted PVC wellpoints, maximum slot size 0.020-in.

PART 3 EXECUTION

3.1 GENERAL

- A. Control surface water and groundwater such that excavation to final grade is made in-the-dry, the bearing soils are maintained undisturbed and softening and/or instability or disturbance due to the presence or seepage of water does not occur. All construction and backfilling shall proceed in-the-dry and flotation of completed portions of work shall be prohibited.

3.2 SURFACE WATER CONTROL

- A. Construct surface water control measures, including dikes, ditches, sumps and other methods to prevent, as necessary, flow of surface water into excavations.

3.3 EXCAVATION DEWATERING

- A. All times during construction furnish and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavations. Excavations shall be kept dry, so as to obtain a satisfactory undisturbed subgrade foundation condition until the fill, structure or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.
- B. Pipe and masonry shall not be laid in water or submerged within 24 hours after being placed. Water shall not flow over new masonry within 4 days after placement.
- C. In no event shall water rise to cause unbalanced pressure on structures until the concrete or mortar has set at least 24 hours. Prevent flotation of the pipe by promptly placing backfill.
- D. Dewatering shall at all times be conducted in such a manner as to preserve the natural undisturbed capacity of the subgrade soils at proposed bottom of excavation. If the subgrade of the trench bottom or excavation becomes disturbed due to inadequate drainage, excavate below normal grade as directed by the Engineer and refill with screened gravel at the Contractor's expense.
- E. Evaluate the impact of the anticipated subsurface soil/water conditions on the proposed method of excavation and removal of water.
- F. Where groundwater level is above the proposed bottom of excavation level, it is expected that some type of pumped dewatering system will be required for pre-drainage of the soils prior to final excavation and for maintaining the lowered groundwater level until construction has been completed to such an extent that the structure, pipeline or fill will not be floated or otherwise damaged. It is further expected that the type of system, spacing of dewatering units and other details of the work will have to be varied depending on soil/water conditions at a particular location.

DEWATERING AND DRAINAGE

- G. At least 2 weeks prior to the start of construction in any areas of anticipated dewatering submit to the Engineer for review, a proposed initial plan for removal of water, method of excavation and support of the excavation. Do not proceed with construction in any of these areas until the initial plan has been reviewed and commented upon by the Engineer. It is expected that the initial plan may have to be modified to suit the variable soil/water conditions to be encountered along the route. Dewater and excavate, at all times, in a manner which does not cause loss of ground or disturbance to the pipe bearing soil or soil which supports overlying or adjacent structures.
- H. If the method of dewatering does not properly dewater the trench as specified, install groundwater observation wells as directed by the Engineer and do not place any pipe or structure until the readings obtained from the observation wells indicate that the groundwater has been lowered a minimum of 6-in below the bottom of the final excavation within the trench limits.
- I. Dewatering units used in the work shall be surrounded by suitable filter sand and no fines shall be removed by pumping. Pumping from the dewatering system shall be continuous until pipe or structure is adequately backfilled. Stand-by pumps shall be provided.
- J. Water entering the excavation from precipitation or surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sump and pumped from the excavation to maintain a bottom free from standing water.
- K. Drainage and discharge from temporary dewatering shall be disposed of in accordance with the Section 02270, Sedimentation. New or existing sewer lines shall not be used to dispose of drainage or temporary dewatering discharge, unless approved by the Engineer.

END OF SECTION

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SECTION 02200
EARTHWORK

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and perform all excavation, backfill, fill and grading required to complete the work as shown on the Drawings and as specified herein. The work shall include, but not necessarily be limited to; excavation for structures, footings, manholes, vaults, electrical manholes, handholes, conduits, cables, raceways and ducts, pipes and paving; all backfilling and fill; embankment and grading; disposal of waste and surplus materials; and all related work such as sheeting, bracing and pumping.
- B. All excavation, trenching and related sheeting, bracing, etc, shall conform to the requirements of the Florida "State Safety Act" (CS/SB 2626) which incorporates, by reference, OSHA's excavation safety standards, 29 CFR 1926.650 Subpart P.
- C. Loam, if any, excavated under this Section may be salvaged by the Contractor for his/her own convenience for use as specified under Section 02930.
- D. This location is (was) in the glide path of an Eglin Air Force Base runway. It is possible, though not probable, that unexploded ordinance may be encountered during excavation. If a suspicious or unidentifiable object is uncovered, work is to stop immediately, and the Engineer notified. No activities shall be permitted that would disturb the object until it is identified as other than unexploded ordinance or confirmed as unexploded ordinance and removed by Air Force ordinance experts. See also Section 01100, 1.06 for additional information.

1.2 RELATED WORK

- A. Site preparation is included in Section 02100.
- B. Dewatering is included in Section 02140.
- C. Trenching, Backfilling and Compaction is included in Section 02221.
- D. Loaming and hydro-seeding is included in Section 02930.

1.3 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C33 - Specification for Concrete Aggregates.

2. ASTM D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu ft (2,700kN-m/cu m)).
 3. ASTM D2487 - Standard Classification of Soils for Design Building Purposes.
 4. ASTM D4751 - Standard Test Method for Determining the Apparent Opening Size of a Geotextile.
 5. ASTM D5034 - Standard Test Methods for Breaking Strength and Elongation of Textile Fabrics.
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.4 PROTECTION

A. Sheeting and Bracing

1. Furnish, put in place and maintain such sheeting and bracing as may be required: by Federal, State and local safety requirements; to support the sides of excavations; to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction; and to protect adjacent structures from undermining or other damage. If the Engineer is of the opinion that at any points sufficient or proper supports have not been provided, he/she may order additional supports put in, and compliance with such order shall not relieve or release the Contractor from his/her responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed. Where soil cannot be properly compacted to fill a void, lean concrete shall be used as backfill.
2. Construct the sheeting outside the neat lines of the foundation, unless indicated otherwise, to the extent deemed desirable for the method of operation. Sheeting shall be plumb and securely braced and tied in position. Sheeting and bracing shall be adequate to withstand all pressures to which the structure or trench will be subjected. Any movement or bulging which may occur shall be corrected to provide the necessary clearances and dimensions.
3. Where sheeting and bracing is required to support the sides of excavations for structures, engage a Professional Engineer, licensed by the State of Florida to design the sheeting and bracing. The sheeting and bracing installed shall be in conformity with the design and certification of this shall be provided. Submit P.E. Certification Form contained in Section 01300 to show compliance with this requirement.

4. Leave in place to be embedded in the backfill all sheeting and bracing not shown on the Drawings but which the Engineer may direct in writing to leave in place at any time during the progress of the work for the purpose of preventing injury to structures, utilities, or property, whether public or private. The Engineer may direct that timber used for sheeting and bracing be cut off at any specified elevation. Payment for sheeting shown on the Drawings to be left in place will be included in the Base Bid. All timber sheeting to be left in place within the limits of the structure shall be treated.
5. All sheeting and bracing not left in place shall be carefully removed in such manner as not to endanger the construction or other structures, utilities, or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, or otherwise as may be directed.
6. The right of the Owner to order sheeting and bracing left in place shall not be construed as creating any obligation on his/her part to issue such orders and his/her failure to exercise his/her right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.
7. No sheeting is to be withdrawn if driven below mid-diameter of any pipe and under no circumstances shall any sheeting be cut off at a level lower than 1-ft above the top of any pipe.

1.5 SOIL TESTING

- A. Previous to the general placement of the fill and during such placement, the Engineer may select areas within the limits of the fill for testing the degree of compaction obtained. Cooperate fully in obtaining the information desired.
- B. Payment for testing will be made by the Contractor. If test results are unsatisfactory, all costs involved in correcting deficiencies in compacted materials to the satisfaction of the Engineer, will be borne by the Contractor.

PART 2 PRODUCTS

2.1 MATERIALS

A. Structural Fill

1. Structural Fill (bank run gravel) shall be gravel, sandy gravel, or gravelly sand free of organic material, loam, wood, trash, snow, ice, frozen soil and other objectionable material and shall be well graded within the following limits:

<u>Sieve Size</u>	<u>Percent Finer by</u>
<u>Weight 3-in</u>	100
No. 4	20 to 70
No. 40	5 to 75
No. 200	0 to 12

2. Submit to the Engineer a representative sample of proposed structural fill, weighing approximately 50 lbs, at least 5 days prior to the date of anticipated use of such material.
- B. Common Fill shall consist of mineral soil substantially free from organic materials, loam, wood, trash and other objectionable materials which may be compressible or which cannot be properly compacted. Common fill shall not contain stones larger than 6-in in largest diameter and shall have a maximum of 75 percent passing the No. 40 sieve and a maximum of 20 percent passing No. 200 Sieve. Common fill shall not contain granite blocks, broken concrete, masonry rubble or other similar materials. It shall have physical properties such that it can be readily spread and compacted during filling. Soil excavated from the structure areas and which meets the above requirements may be used in embankments.
- C. Select Common Fill shall be as specified above for Common Fill except that the material shall contain no stones larger than 2-in in largest dimension.
- D. Screened Gravel
1. Screened gravel shall be used for pipe bedding as detailed and at other locations indicated on the Drawings.
 2. Screened gravel shall consist of hard, durable, rounded or sub-angular particles of proper size and gradation and shall be free from sand, loam, clay, excess fines and deleterious materials. The gravel shall be graded within the following limits:

<u>Sieve Size</u>	<u>Percent Finer by</u>
<u>Weight 5/8-in</u>	100
1/2-in	40 to 100
3/8-in	15 to 45
No. 10	0 to 5

- E. Sand
1. Sand shall conform to ASTM C33 for fine aggregate.
- F. Field Stone
1. Construct field stone walls where shown on the Drawings to the dimensions

detailed. Use field stones salvaged from old stone walls and stockpiled on site for the purpose. Furnish additional stone of a weathered type similar to stockpiled material if such material is insufficient to complete the work.

G. Erosion Control Blanket

1. Erosion control blanket shall be used where indicated on the Drawings and shall conform to the following requirements:
 - a. Minimum grab strength of 120 lbs per ASTM D5034.
 - b. Apparent opening size to be equal to or greater than the U.S. Standard Sieve No. 100 (0.210 mm) per ASTM D4751.
 - c. Percent open area not to exceed about 25 percent. The percent open area is defined as the ratio of the sum of 20 or more individual open areas (times 100) to the sum of the corresponding 20 or more individual total areas.
 - d. Coefficient of permeability shall not be less than 0.01 cm/sec.
 - e. Erosion control blanket shall be Mirafi, Type 140N; Dupont, Type PAR, Style 3401 or equal product by Amoco.

PART 3 EXECUTION

3.1 EXCAVATION BELOW GRADE

- A. If the bottom of any excavation is taken out below the limits shown on the Drawings, specified, or directed by the Engineer, it shall be refilled at the Contractor's expense with concrete, 8-inch layers of compacted structural fill, or other material satisfactory to the Engineer. The type of material to be used shall be at the Engineer's option.
- B. If, in the opinion of the Engineer, the material in its undisturbed natural condition, at or below the normal grade of the excavation as indicated on the Drawings, is unsuitable for foundations, it shall be removed to such depth and width as he/she may direct and be replaced with suitable material as directed by the Engineer for which compensation will be made in accordance with the Prime Contract.

3.2 STRUCTURE EXCAVATION

- A. Excavation shall be made to the grades shown on the Drawings and to such widths as will give suitable room for construction of the structures, for bracing and supporting, pumping and draining. The bottom of the excavations shall be rendered firm and dry and, in all respects, acceptable to the Engineer.
- B. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. Exposed subgrades shall be proofrolled with at least two coverages of the specified equipment. The Engineer shall waive this requirement if, in his/her opinion, the subgrade will be rendered unsuitable by

such compaction. Subgrade soils which become soft, loose, "quick", or otherwise unsatisfactory for support of structures as a result of inadequate excavation, dewatering, proofrolling, or other construction methods shall be removed and replaced by structural fill as required by the Engineer at the Contractor's expense.

- C. Dewatering shall be such as to prevent boiling or detrimental underseepage at the base of the excavation as specified herein.
- D. Excavation equipment shall be satisfactory for carrying out the work in accordance with the requirements specified. In no case shall the earth be ploughed, scraped, or dug with machinery so near to the finished subgrade as to result in excavation of, or disturbance of material below grade, the last of the excavated material being removed with pick and shovel just before placing of concrete or working mat thereon.
- E. When excavation for foundations has reached prescribed depths, the Engineer shall be notified and will inspect conditions. If materials and conditions are not satisfactory to the Engineer, the Engineer will issue instructions as to the procedures and if additional costs are involved, adjustments of the Contract Price will be made on the basis of unit prices agreed upon by the Owner and the Contractor in accordance with the provisions of the Contract Documents.
- F. During final excavation to subgrade level, take whatever precautions are required to prevent disturbance and remolding. Material which has become softened and mixed with water shall be removed. Hand excavation of the final 3 to 6-in will be required as necessary to obtain a satisfactory undisturbed bottom. The Engineer will be the sole judge as to whether the work has been accomplished satisfactorily.

3.3 EXCAVATION AND BACKFILLING FOR FOOTINGS AND UNDERSLAB TRENCHES

- A. Excavation for all pipe lines beneath structures and excavation for all footings shall be carried out with the excavating equipment operating from the subgrade for the structure. The excavation shall be carried out "in-the-dry" and in a manner which will preserve the undisturbed state of the subgrade soils. The excavations may be completed with shoring and bracing of open cuts.
- B. All excavation beneath structures shall be backfilled with structural fill. Where it is impractical to use large equipment for compaction or when such methods, in the opinion of the Engineer, are disturbing the surrounding natural subgrade, the fill shall be compacted using hand-operated mechanical compactors. The lift thickness shall not exceed 6-in measured before compaction when hand-operated equipment is used.

3.4 TRENCH EXCAVATION AND BACKFILLING

- A. Excavation for all trenches required for the installation of pipes and ducts shall be made to the depths indicated on the Drawings and in such a manner and to such widths as will give suitable room for laying the pipe or installing the ducts within the trenches, for bracing and supporting and for pumping and drainage facilities. Render the bottom of the excavations firm and dry and in all respects acceptable to the Engineer. Pavement, when encountered, shall be cut with pneumatic chisels along straight lines before excavating.
- B. Rock shall be removed to a minimum eight [8]-inch clearance around the bottom and sides of all the pipe being laid.
- C. Where pipe or ducts are to be laid in gravel bedding or encased in concrete, the trench may be excavated by machinery to, or just below the designated subgrade provided that the material remaining in the bottom of the trench is no more than slightly disturbed.
- D. Where pipe or ducts are to be laid directly on the trench bottom, the lower part of the trenches in each shall not be excavated to grade by machinery, the last of the material being excavated manually in such a manner that will give a flat bottom true to grade so that pipe or duct can be evenly supported on undisturbed material. Bell holes shall be made as required.
- E. Meet the following criteria when installation method includes the use of a steel box:
 - 1. When installing rigid pipe (R.C., V.C., A.C., D.I., etc), any portion of the box extending below mid diameter shall be raised above this point prior to moving the box ahead to install the next pipe. This is to prevent the separation of installed pipe joints due to movement of the box.
 - 2. When installing flexible pipe (PVC, ABS solid wall, ABS truss, etc), the bottom of the box shall not extend below mid diameter. This is to prevent loss of soil between the box and the pipe bedding which could result in excessive deflection of the installed pipe.
- F. Backfilling over ducts shall begin not less than 3 days after placing concrete encasement.
- G. Where pipe is to be installed in fill of any type, fill shall be placed and compacted to the total depth required (rough grade elevation) and then re-excavated for pipe installation.
- H. As soon as practicable after the pipe has been laid and jointed, backfilling shall begin and thereafter be prosecuted expeditiously. If required, as shown on the Drawings, screened gravel shall be placed around the pipe to mid-diameter. As the screened gravel is placed, it shall be compacted by suitable tools.
- I. After the screened gravel bedding (if required) has been placed to the mid-diameter

of the pipe, selected common fill as shown on the drawings, shall be placed to a depth of one [1]-foot over the top of the pipe. Material shall be thoroughly compacted by hand-tamping as placed with at least one man tamping for each man shoveling material into the trench.

- J. Where the pipes are laid in unpaved areas, the remainder of the trench shall be filled with common fill in layers not to exceed 3-ft and thoroughly compacted by rolling ramming or puddling, as the Engineer may direct, sufficiently to prevent subsequent settling. The backfill shall be mounded six [6]-inch above the existing grade or as directed. Wherever a loam or gravel surface exists prior to excavations, it shall be removed, conserved and replaced to the full original depth as part of the work under the pipe items. In some areas it may be necessary to remove excess material during the clean-up process, so that the ground may be restored to its original level and condition. If storage of loam, gravel, or topsoil is not preferred, replace it with material of equal quality and in equal quantity.
- K. Where the pipes are laid in streets, or other paved areas, the remainder of the trench above the bedding shall be backfilled with common fill in one [1]-foot layers, thoroughly compacted by rolling, or ramming as the Engineer may direct. The one [1]-foot layer below the bottom of the specified paving shall be compacted in six [6]-inch layers.
- L. Along the length of all pipeline and duct trenches, construct impervious dams or bulkheads of clay or concrete in the trench bottom at 300-foot intervals or at manholes and structures, whichever is less, to obstruct the free flow of groundwater after construction is completed. Install impervious dams at all points where a pipe trench enters an excavated area where a permanent underdrain system is installed.
- M. The method and degree of compacting backfill as directed by the Engineer will be governed by the type of material and the extent to which any subsequent settlement can be permitted.

3.5 MISCELLANEOUS EXCAVATION

- A. Perform all miscellaneous excavation. Make all excavations necessary to permit the placing of loam and plants, for constructing roadways and any other miscellaneous earth excavation required under this Contract.

3.6 BACKFILLING - COMMON FILL

- A. Common Fill may be used as trench backfill; fill against exterior walls of structures (except water and retention structures) as indicated on the Drawings; as embankment fill; or in other areas as designated by the Engineer. Material conforming to the requirements of common fill shall be placed in layers having a maximum thickness of 1-ft measured before compaction.

- B. Common Fill shall be compacted to at least 95 percent of maximum dry density beneath roadways and at least 90 percent of maximum dry density in all other areas. Maximum dry density shall be as determined by ASTM D1557, Method D.
- C. Materials placed in fill areas shall be deposited to the lines and grades shown on the Drawings making do allowance for settlement of the material and for the placing of loam thereon.
- D. The surfaces of filled areas shall be graded to smooth true lines, strictly conforming to grades indicated on the grading plan and no soft spots or un-compacted areas will be allowed in the work.
- E. No compacting shall be done when the material is too wet either from rain or from excess application of water. At such times, work shall be suspended until the previously placed and new materials have dried sufficiently to permit proper compaction.

3.7 BACKFILLING - STRUCTURAL FILL

- A. Structural fill shall be placed in layers having a maximum thickness of eight [8]-inches in open areas and six [6]-inches in confined areas including points where conduit and piping join structures, measured before compaction. Each layer of fill shall be compacted to at least 95 percent of maximum dry density determined by the ASTM D1557, Method D by methods approved by the Engineer. The limits of structural fill adjacent to structures shall extend as shown on the Drawings.
- B. Compaction of structural fill in open areas shall consist of fully loaded ten-wheel trucks, a tractor dozer weighing at least 30,000 lbs and operated at full speed, a heavy vibratory roller, or any method approved by the Engineer. Compaction of structural fill in confined areas shall be accomplished by hand operated vibratory equipment or mechanical tampers approved by the Engineer. As a minimum, compaction of structural fill shall consist of four passes of approved equipment.
- C. Working mat is required below all structures, as indicated on the Drawings, it shall consist of structural fill (12-inch minimum).

3.8 EARTH EMBANKMENTS-COMMON FILL

- A. All organic materials, including peat and loam, and loose inorganic silt material (loess) shall be removed from areas beneath new embankments. If the subgrade slopes are excessive, the subgrade shall be stepped to produce a stable surface for the placement of the embankments. The natural subgrade shall then be compacted by at least two passes of a loaded six-wheel or ten-wheel truck. The Engineer will waive this requirement, if, in his/her opinion, the subgrade will be rendered unstable by such compaction. The prepared subgrade shall be inspected and approved by the Engineer prior to the placement of fill.

3.9 DISPOSAL OF SURPLUS MATERIAL

- A. No excavated materials shall be removed from the site of the work or disposed of, except as specified by the Engineer. Materials shall be neatly piled until used or otherwise disposed of as specified below.
- B. Suitable excavated material shall be used for fill embankments or backfill on the different parts of the work as required.
- C. Surplus fill shall become the property of the Contractor and shall be removed and disposed off site.

3.10 GRADING

- A. Grading in preparation for placing of loam, planting areas, paved walks and drives and appurtenances shall be performed at all places that are indicated on the Drawings, to the lines, grades and elevations shown and otherwise as directed by the Engineer and shall be performed in such a manner that the requirements for formation of embankments can be followed. All material encountered, of whatever nature, within the limits indicated, shall be removed and disposed of as directed. During the process of grading, the subgrade shall be maintained in such condition that it will be well drained at all times. When directed, temporary drains and drainage ditches shall be installed to intercept or divert surface water which may affect the prosecution or condition of the work.
- B. If at the time of grading it is not possible to place any material in its final location, it shall be stockpiled in approved areas for later use. No extra payment will be made for the stockpiling or double handling of excavated material.
- C. The right is reserved to make minor adjustments or revisions in lines or grades if found necessary as the work progresses, in order to obtain satisfactory construction.
- D. Stones or rock fragments larger than 4-inches in their greatest dimensions will not be permitted in the top 6-inches of the finished subgrade of all fills or embankments.
- E. In cuts, all loose or protruding rocks on the back slopes shall be barred loose or otherwise removed to line or finished grade of slope. All cut and fill slopes shall be uniformly dressed to the slope, cross-section and alignment shown on the Drawings or as directed by the Engineer.

3.11 EROSION CONTROL BLANKET

- A. Erosion control blankets shall be installed on slopes prior to the installing of riprap

as directed by the Engineer in accordance with manufacturer's instructions. The area to be covered shall be properly prepared, before the blanket is applied. When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area. The blankets shall be butted snugly at the ends and side and stapled. Blankets shall be placed a minimum of three rows (of four feet) wide (total 12-ft width) and stapled together in accordance with manufacturer's instructions. The staples shall be made of wire, 0.091-in in diameter or greater, "U" shaped with legs 6-inches in length and a 1-inch crown. The staples shall be driven vertically into the ground, spaced approximately six [6]-feet apart on each side; and one row in the center alternately spaced between each side. Adjoining blankets shall not be overlapped and shall utilize a common row of staples to attach.

3.12 RIPRAP FOR SLOPE PROTECTION

- A. Unless otherwise authorized by the Engineer, the riprap protection shall be placed in conjunction with the construction of the embankment with only sufficient lag in the construction of the riprap protection as may be necessary to allow for proper construction of the portion of the embankment protected and to prevent mixture of embankment and riprap material. Bank run gravel shall be placed and graded to a depth of 6-inches to obtain a continuous uninterrupted bed of the required thickness within the required limits. It shall be compacted by a minimum of one pass by a crawler-type tractor with a total weight, including blade and equipment, of not less than 30,000 lbs.
- B. Riprap shall be hand-placed on the prepared bed of compacted gravel. Stones shall be laid so that the maximum dimension is perpendicular to the prepared bed. The stones shall be placed so that the weight of the stone is carried by the underlying material and not by the adjacent stones. Large stones shall be placed at the bottom of the slope. Spaces between stones shall be filled with spalls of suitable size to construct a solid, stable slope, free from large voids and defects.

END OF SECTION

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TRENCHING, BACKFILLING, AND COMPACTION

SECTION 02221 TRENCHING, BACKFILLING, AND COMPACTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and perform all trenching for pipelines and appurtenances, including drainage, filling, backfilling, disposal of surplus material and restoration of trench surfaces and easements.
- B. Excavation shall extend to the width and depth shown on the Drawings or as specified herein and shall provide suitable room for installing pipe, structures and appurtenances.
- C. Furnish and place all sheeting, bracing and supports and remove from the excavation all materials which the Engineer may deem unsuitable for backfilling. The bottom of the excavation shall be firm, dry and in all respects, acceptable. If conditions warrant, deposit gravel for pipe bedding, or gravel refill for excavation below grade, directly on the bottom of the trench immediately after excavation has reached the proper depth and before the bottom of the trench has become softened or disturbed by any cause whatever. The length of open trench shall be related closely to the rate of pipe laying. All excavation shall be made in open trenches.
- D. All excavation, trenching and related sheeting, bracing, etc, shall conform to the requirements of the Florida "State Safety Act" (CS/SB 2626) which incorporates, by reference, OSHA's excavation safety standards, 29 CFR 1926.650 Subpart P.
- E. Wherever the requirement for 92 percent compaction is referred to herein it shall mean "at least 92 percent of maximum density as determined by ASTM D1557, Method D".
- F. Prior to the start of work submit the proposed method of backfilling and compaction to the Engineer for review.

1.2 RELATED WORK

- A. Dewatering is included in Section 02140.
- B. Granular fill material is included in Section 02230.
- C. Loaming and Hydroseeding is included in Section 02930.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 TRENCH EXCAVATION

- A. Trench excavation shall include material of every description and of whatever substance encountered, except rock and boulders. Pavement shall be cut with a saw, wheel or pneumatic chisel along straight lines before excavating.
- B. Strip and stockpile topsoil from grassed areas crossed by trenches. At the Contractor's option, topsoil may be otherwise disposed of and replaced, when required, with approved topsoil of equal quality.
- C. While excavating and backfilling is in progress, traffic shall be maintained, and all utilities and other property protected as provided in the General Conditions and General Requirements.
- D. Trenches shall be excavated to the depth indicated on the Drawings and in widths sufficient for laying the pipe, bracing and for pumping and drainage facilities. The bottom of the excavations shall be firm and dry and in all respects acceptable to the Engineer. Trench width shall be practical minimum.
- E. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. The trench may be excavated by machinery to, or just below the designated subgrade, provided that material remaining in the bottom of the trench is no more than slightly disturbed. Subgrade soils which become soft, loose, "quick", or otherwise unsatisfactory as a result of inadequate excavation, dewatering or other construction methods shall be removed and replaced by screened gravel fill as required by the Engineer at the Contractor's expense.
- F. Clay and organic silt soils are particularly susceptible to disturbance due to construction operations. When excavation is to end in such soils, use a smooth-edge bucket to excavate the last 1-ft of depth.
- G. Where pipe is to be laid in screened gravel bedding, the trench may be excavated by machinery to the normal depth of the pipe provided that the material remaining in the bottom of the trench is no more than slightly disturbed.
- H. Where pipe is to be laid directly on the trench bottom, final excavation at the bottom of the trench shall be performed manually, providing a flat-bottom true to grade upon undisturbed material. Bell holes shall be made as required.

3.2 DISPOSAL OF MATERIALS

- A. Excavated material shall be stacked without excessive surcharge on the trench bank. Excavated material shall be segregated for use in backfilling as specified below.
- B. It is expressly understood that no excavated material shall be removed from the site of the work or disposed of, except as directed by the Engineer. When removal of

TRENCHING, BACKFILLING, AND COMPACTION

surplus materials has been approved by the Engineer, dispose of such surplus material in approved designated areas.

- C. Should conditions make it impracticable or unsafe to stack material adjacent to the trench, the material shall be hauled and stored at a location provided. When required, it shall be re-handled and used in backfilling the trench.

3.3 SHEETING AND BRACING

- A. Furnish, put in place and maintain sheeting and bracing required by Federal, State or local safety requirements to support the sides of the excavation and prevent loss of ground which could endanger personnel, damage or delay the work or endanger adjacent structures. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he/she may order additional supports placed at the expense of the Contractor. Compliance with such order shall not relieve the Contractor from his/her responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.
- B. Where sheeting and bracing are required to support the sides of trenches, engage a Professional Engineer, licensed in the State of Florida, to design the sheeting and bracing. The sheeting and bracing installed shall be in conformity with the design provided by the Professional Engineer. Submit P.E. Certification Form contained in Section 01300 to show compliance with this requirement.
- C. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the screened gravel backfill.
 - 1. When installing rigid pipe (R.C., V.C., A.C., etc), any portion of the box extending below mid diameter shall be raised above this point prior to moving the box ahead to install the next pipe. This is to prevent the separation of installed pipe joints due to movement of the box.
 - 2. When installing flexible pipe (PVC, etc), trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below mid-diameter of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, screened gravel shall be placed to fill any voids created and the screened gravel and backfill shall be recompacted to provide uniform side support for the pipe.
- D. Permission will be given to use steel sheeting in lieu of wood sheeting for the entire job wherever the use of sheeting is necessary. The cost for use of sheeting will be included in the bid items for pipe and shall include full compensation for driving, bracing and later removal of sheeting.

TRENCHING, BACKFILLING, AND COMPACTION

- E. All sheeting and bracing shall be carefully removed in such manner as not to endanger the construction of other structures, utilities, or property, whether public or private. All voids left after withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, by watering or otherwise as directed.
- F. No payment will be given for sheeting, bracing, etc, during the progress of the work. No payment will be given for sheeting which has actually been left in the trench for the convenience of the Contractor.
- G. Sheeting driven below mid-diameter of any pipe shall remain in place from the driven elevation to at least 1-ft above the top of the pipe.

3.4 TEST PITS

- A. Excavation of test pits may be required for the purpose of locating underground utilities or structures as an aid in establishing the precise location of new work.
- B. Test pits shall be backfilled as soon as the desired information has been obtained. The backfilled surface shall be maintained in a satisfactory condition for travel until resurfaced as specified.

3.5 EXCAVATION BELOW GRADE AND REFILL

- A. Whatever the nature of unstable material encountered or the groundwater conditions, trench drainage shall be complete and effective.
- B. If the Contractor excavates below grade through error or for the Contractor's own convenience, or through failure to properly dewater the trench, or disturbs the subgrade before dewatering is sufficiently complete, he may be directed by the Engineer to excavate below grade as set forth in the following paragraph, in which case the work of excavating below grade and furnishing and placing the refill shall be performed at his own expense.

3.6 BACKFILLING

- A. As soon as practicable after the pipe has been laid and jointed, backfilling shall begin and thereafter be prosecuted expeditiously. Select fill, as specified for the type of pipe installed, shall be placed up to one [1]-foot over the pipe.
- B. An impervious dam or bulkhead cutoff of clay or other impervious material shall be constructed in the trench as directed, to interrupt the unnatural flow of groundwater after construction is completed. The dam shall be effectively keyed into the trench bottom and sidewalls. Provide at least one clay or other impervious material dam in

TRENCHING, BACKFILLING, AND COMPACTION

the pipe bedding between each manhole where directed or every 300-ft, whichever is less.

- C. Where the pipes are laid cross-country, the remainder of the trench shall be filled with common fill material in layers not to exceed 3-ft and mounded 3-inches above the existing grade or as directed. Where a loam or gravel surface exists prior to cross-country excavations, it shall be removed, conserved and replaced to the full original depth as part of the work under the pipe items. In some areas it may be necessary to remove excess material during the clean-up process, so that the ground may be restored to its original level and condition.
- D. Where the pipes are laid in streets, the remainder of the trench up to a depth of 12-inches below the bottom of the specified permanent paving shall be backfilled with common fill material in layers not to exceed 1-foot and thoroughly compacted. The subbase layer for paving shall be of bank-run gravel thoroughly compacted in six [6]-inch layers.
- E. To prevent longitudinal movement of the pipe, dumping backfill material into the trench and then spreading will not be permitted until selected material or screened gravel has been placed and compacted to a level one [1]-foot over the pipe.
- F. Backfill shall be brought up evenly on all sides. Each layer of backfill material shall be thoroughly compacted by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping, to 92 percent compaction. If rolling is employed, it shall be by use of a suitable roller or tractor, being careful to compact the fill throughout the full width of the trench.
- G. Water jetting or puddling may be used unless the refill contains too great a proportion of clay or loam to permit satisfactory drying. Water jetting shall consist of using a suitable length of pipe at least 1-1/4-in in diameter fitted with quick acting valve and sufficient hose to connect to hydrant or pump having adequate pressure and capacity. The full depth of backfill shall be thoroughly inundated by thrusting the pipe into the fill at frequent intervals with the valve open until all slumping ceases. Where backfill is compacted by puddling, it shall be done by depositing in water. Water for jetting or puddling may be obtained from Owner hydrants wherever possible. Water may be furnished by the Owner from these hydrants if reasonable care is exercised in its use and when approved by the Water Department.
- H. If water restrictions are in force, obtain water elsewhere, or compact the backfill by other approved methods at no additional cost to this Contract.
- I. Where other methods are not practicable, compaction shall be by use of hand or pneumatic ramming with tools weighing at least 20 lbs. The material shall be spread and compacted in layers not over 6-in thick. If necessary, sprinkling shall be employed in conjunction with rolling or ramming.

TRENCHING, BACKFILLING, AND COMPACTION

- J. Backfill around structures shall be selected common fill material, may be compacted by puddling where approved by the Engineer. All backfill shall be compacted, especially under and over pipes connected to the structures.
- K. Subject to the approval of the Engineer, fragments of ledge and boulders smaller than 6-in may be used in trench backfill providing that the quantity in the opinion of the Engineer is not excessive. Rock fragments shall not be placed until the pipe has at least 2-ft of earth cover. Small stones and rocks shall be placed in thin layers alternating with earth to ensure that all voids are completely filled. Fill shall not be dropped into the trench in a manner to endanger the pipe.
- L. Bituminous paving shall not be placed in backfilling unless specifically permitted, in which case it shall be broken up as directed. Frozen material shall not be used under any circumstances.
- M. All road surfaces shall be broomed and hose-cleaned immediately after backfilling. Dust control measures shall be employed at all times.

3.7 RESTORING TRENCH SURFACE

- A. In and adjacent to streets, the 12-in layer (20-in in State Highways) of trench backfill below the specified initial pavement shall consist of compacted bank-run gravel. Should the Contractor wish to use material excavated from the trench as gravel subbase for pavement replacement, the Contractor shall, at his/her own expense, have samples of the material tested by an independent testing laboratory at intervals not to exceed 500-ft, in order to establish its compliance with the specifications. Only material which has been tested and approved by the Engineer shall be allowed to be incorporated into the work.
- B. In sections where the pipeline passes through grassed areas, and at the Contractor's own expense, remove and replace the sod, or loam and seed the surface to the satisfaction of the Engineer

END OF SECTION

SECTION 02230
GRANULAR MATERIALS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and obtain materials for filling and backfilling, grading and miscellaneous sitework, for the uses shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Site Preparation is included in Section 02100.
- B. Dewatering and Drainage is included in Section 02140.
- C. Trenching, Backfilling and Compaction is included in Section 02221.
- D. Sedimentation and Erosion Control is included in Section 02270.
- E. Loaming and Seeding is included in Section 02930.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 01300, complete product data for materials specified in this Section.

1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 2. ASTM D698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600kN-m/m)).
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. Laboratory Testing
 - 1. At least 7 days prior to the placement of any backfill or fill materials, deliver a

representative sample of the proposed materials weighing at least 50 lbs to the soils testing laboratory in accordance with Section 01410.

2. Engage the soils testing laboratory to perform:
 - a. Grain size analyses of the samples to determine their suitability for use as backfill or fill material in conformance to the materials requirements specified herein.
 - b. The appropriate Proctor analyses to determine the maximum dry densities required for compaction testing as specified elsewhere in the Contract Documents.
3. Test results and determinations of suitability shall be delivered to the resident project representative no later than 3 days prior to the placement of backfill or fill materials.

PART 2 PRODUCTS

2.1 MATERIALS

A. Backfill and Fill materials shall be suitable excavated materials, natural or processed mineral soils obtained from off-site sources, or graded crushed stone or gravel. Backfill and Fill materials shall be free of all organic material, trash, snow, ice, frozen soil, or other objectionable materials which may be compressible or which cannot be properly compacted. Soft, wet, plastic soils which may be expansive, clay soils having a natural, in-place water content in excess of 30 percent, soils containing more than 5 percent (by weight) fibrous organic materials, and soils having a plasticity index greater than 30 shall be considered unsuitable for use as backfill and fill. Backfill and fill materials shall have a maximum of 1 percent expansion when testing is performed on a sample remolded to 95 percent of maximum dry density (per ASTM D698) at 2 percent below optimum moisture content under a 100 lbs/sq ft surcharge.

B. Structural Fill shall be gravel, sandy gravel, or gravelly sand. Material shall have a plasticity index of less than 15 and shall conform to the following gradation limits:

<u>Sieve Size</u>	<u>Percent Finer By Weight</u>
3-in	100
No. 4	20 to 70
No. 40	5 to 75
No. 200	0 to 12

- C. Select Fill shall conform to the requirements of common fill except that the material shall not contain any materials larger than 2-in in largest dimension.
- D. Common Fill shall not contain granite blocks, broken concrete, masonry

rubble, asphalt pavement, or any material larger than 6-in in any dimension. Common Fill shall have a plasticity index of less than 15 and shall conform to the following gradation limits:

<u>Sieve Size</u>	<u>Percent Finer By Weight</u>
No. 40	75
No. 200	20

- E. Crushed Stone shall be sound, durable stone, angular in shape, and free of any foreign material, structural defects and chemical decay. Crushed stone shall conform to the following gradation limits:

<u>Sieve Size</u>	<u>Percent Finer By</u>
1-in	100
3/4-in	90
1/2-in	60
1/4-in	25

- F. Pea Gravel shall be screened, uniformly rounded stone, free from sand, loam, clay, excess fines and other deleterious materials. Pea Gravel shall conform to the following gradation limits:

<u>Sieve Size</u>	<u>Percent Finer By</u> <u>Weight</u>
1/2-in	100
3/8-in	90
No. 4	30
No. 8	10
No. 16	5

- G. Screened Gravel shall be hard, durable, rounded, or sub-angular particles of proper size and gradation, and shall be free from sand, loam, clay, excess fines, and other deleterious materials. Screened gravel shall be graded within the following limits:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
5/8-in	100
1/2-in	40 to 100
3/8-in	15 to 45
No. 10	0 to 5

- H. Sand for concrete, grout, and masonry shall conform to ASTM C33 for fine aggregate. General purpose sand shall be Select Common Fill.
- I. Lean Concrete shall be ready-mix, cast-in-place concrete conforming to the requirements of Section 03301. Minimum compressive strength shall be 2,000 psi after 7 days and 2,500 psi after 28 days.
- J. Riprap shall be fragmented granite or other angular rock, well graded between

6-inches and 12-inches in size, with no more than 10 percent by weight smaller than 6-inches.

- K. Filter fabric shall be Mirafi, Type 140N; Dupont, Type PAR, Style 3401, or equal product by Amoco and shall conform to the following requirements:
 - 1. Minimum grab strength of 120 lbs per ASTM D1682.
 - 2. Equivalent open size (EOS) to be equal to or greater than the U.S. Standard Sieve No. 100 (0.210 mm) per ASTM D442.
 - 3. Percent open area not to exceed about 25 percent. The percent open area is defined as the ratio of the sum of 20 or more individual open areas (times 100) to the sum of the corresponding 20 or more individual total areas.
 - 4. Coefficient of permeability shall not be less than 10^{-2} cm/sec.

- L. Staples for installing Erosion Control Blanket shall be made of wire, 0.091-in in diameter or greater, "U" shaped, with legs 6-inches in length and a 1-inch crown.

- M. Controlled Low-Strength Material (CLSM) used as backfill and fill shall be comprised of a mixture of Portland cement, coarse aggregate, fine aggregate and water. Materials, methods of preparation, and placement techniques shall comply with the requirements of Section 03301 as for concrete. Design mix shall result in a flowable material with a 28 day compressive strength of approximately 60 psi. Recommended mix shall be as follows:

Portland Cement	40 lbs/cu yd
Coarse Aggregate	1700 lbs/cu yd
Fine Aggregate	1900 lbs/cu yd
Water	325 lbs/cu yd, or as

needed PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 02270
EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and perform all installation, maintenance, removal and area cleanup related to erosion and sedimentation control work as shown on the Drawings and as specified herein. The work shall include, but not necessarily be limited to; installation of temporary access ways and staging areas, silt fences, stone filter boxes, stone filter berms, sediment removal and disposal, device maintenance, removal of temporary devices, temporary mulching, excelsior matting installation and final cleanup.

1.2 RELATED WORK

- A. Dust control is included in Section 01110.
- B. Earthwork is included in Section 02200.
- C. Granular fill materials are included in Section 02230.
- D. Loaming and Hydroseeding is included in Section 02930.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 01300, within 10 days after award of Contract, technical product literature for all commercial products, including straw mulch tackifier, to be used for erosion and sedimentation control.

1.4 QUALITY ASSURANCE

- A. Be responsible for the timely installation and maintenance of all sedimentation control devices necessary to prevent the movement of sediment from the construction site to off site areas or into the stream system via surface runoff or underground drainage systems. Measures in addition to those shown on the Drawings necessary to prevent the movement of sediment off site shall be installed, maintained, removed, and cleaned up at the expense of the Contractor. No additional charges to the Owner will be considered.

PART 2 PRODUCTS

2.1 MATERIALS

EROSION AND SEDIMENTATION CONTROL

A. Crushed stone for sediment filtration devices, access ways and staging areas shall conform to The State of Florida Highway "Standards and Specifications for Highway and Bridges"

B. Berm structural stone shall be rip-rap as follows:

1. Rip-rap shall be sound, durable rock which is roughly rectangular shape and of suitable quality to insure permanence in the condition in which it is to be used. Rounded stones, boulders, sandstone or similar soft stone will not be acceptable. Material shall be free from overburden, spoil, shale and organic material, meet the Engineer's approval and be well graded within the following limits:

<u>Weight of Stone</u>	<u>Percent Finer by Weight</u>
40 lb	100
12 lb	50
3 lb	0

C. Sediment Fence

1. Sediment fence shall be a prefabricated commercial product made of a woven, polypropylene, ultraviolet resistant material such as "Envirofence" by Mirafi Inc., Charlotte, NC or equal.

D. 1/4-in woven wire mesh for filter boxes shall be galvanized steel or hardware cloth.

E. Straw mulch shall be utilized on all newly graded areas to protect areas against washouts and erosion. Straw mulch shall be comprised of threshed straw of oats, wheat, barley, or rye that is free from noxious weeds, mold or other objectionable material. The straw mulch shall contain at least 50 percent by weight of material to be 10-inches or longer. Straw shall be in an air-dry condition and suitable for placement with blower equipment.

F. Latex acrylic copolymer or organic tackifier shall be a commercial product specifically manufactured for use as straw mulch tackifier.

G. An asphalt tackifier shall only be used when temperatures are too low to allow the use of a latex acrylic copolymer and only with prior written approval from the Engineer.

H. Erosion control blanket shall be installed in all seeded drainage swales and ditches as shown on the Drawings or as directed by the Engineer. Erosion control blanket shall be 100 percent agricultural straw matrix stitch bonded with degradable thread between two photodegradable polypropylene nettings, such as Model S150 Double Net Short-Term Blanket (10 months) by North American Green, Evansville, IN or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Sediment Fence Installation

1. Sediment fences shall be positioned as indicated on the Drawings and as necessary to prevent off site movement of sediment produced by construction activities as directed by the Engineer.
2. Dig trench approximately 6-inches wide and 6-inches deep along proposed fence lines.
3. Drive stakes, 6-ft on center (maximum) at back edge of trenches. Stakes shall be driven 2- ft (minimum) into ground.
4. Hang filter fabric on posts carrying to bottom of trench with about 4-inches of fabric laid across bottom of trench. Stretch fabric fairly taut along fence length and maintain secure both ways.
5. Backfill trench with excavated material and tamp.
6. Install pre-fabricated silt fence according to manufacturer's instructions.

B. Stone Filter Berm Installation

1. Place berm as shown on the drawings. Face upstream side of structural berm with crushed stone.

C. Staging areas and access ways shall be surfaced with a minimum depth of 4-in of crushed stone.

3.2 MAINTENANCE AND INSPECTIONS

A. Inspections

1. Make a visual inspection of all erosion and sedimentation control devices once per week and promptly after every rainstorm. If such inspection reveals that additional measures are needed to prevent movement of sediment to offsite areas, promptly install additional devices as needed. Sediment controls in need of maintenance shall be repaired promptly.

B. Device Maintenance

1. Sediment Fences

- a. Remove accumulated sediment once it builds up to 1/2 of the height of the fabric.
 - b. Replace damaged fabric, or patch with a 2-ft minimum overlap.
 - c. Make other repairs as necessary to ensure that the fence is filtering all runoff directed to the fence.
2. Stone Filter Berm
 - a. Muck out trapped silt from dewatering operations when it has built up to within 6-inches of the top of the berm.
 - b. Replace crushed stone filter when saturated with silt.
 3. Add crushed stone to access ways and staging area as necessary to maintain a firm surface free of ruts and mudholes.

3.3 TEMPORARY MULCHING

- A. Apply temporary mulch to areas where rough grading has been completed but final grading is not anticipated to begin within 30 days of the completion of rough grading.
- B. Straw mulch shall be applied at rate of 100 lbs/1000 sq ft and tackified with latex acrylic copolymer at a rate and diluted in a ratio per manufacturer's instructions.

3.4 EROSION CONTROL BLANKETS

- A. Erosion control blankets shall be installed in all seeded drainage swales and ditches as shown on the Drawings and as directed by the Engineer in accordance with manufacturer's instructions. The area to be covered shall be properly prepared, fertilized and seeded with permanent vegetation before the blanket is applied. When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area. The blankets shall be applied in the direction of water flow and stapled. Blankets shall be placed a minimum of three rows (of 4-ft) wide (total approx. 12-ft width) within the drainage swale/ditch and stapled together in accordance with manufacturer's instructions. Side overlaps shall be 4-inches minimum. The staples shall be made of wire, .091-inches in diameter or greater, "U" shaped with legs 10-inches in length and a 1-1/2-inch crown. Commercial biodegradable stakes may also be used with prior approval by the Engineer. The staples shall be driven vertically into the ground, spaced approximately two linear feet apart, on each side, and one row in the center alternately spaced between each side. Upper and lower ends of the matting shall be buried to a depth of 4-inches in a trench. Erosion stops shall be created every 25-ft by making a fold in the fabric and carrying the fold into a silt trench across the full width of the blanket. The bottom of the fold shall be 4-inches below the ground surface. Staple on both sides of fold. Where the matting must be cut or more than one roll length is required in the swale, turn down upper end of downstream roll into a slit trench to a depth of 4-inches.

EROSION AND SEDIMENTATION CONTROL

Overlap lower end of upstream roll 4-inches past edge of downstream roll and staple.

1. To ensure full contact with soil surface, roll matting with a roller weighing 100 lbs/ft of width perpendicular to flow direction after seeding, placing matting and stapling. Thoroughly inspect channel after completion. Correct any areas where matting does not present a smooth surface in full contact with the soil below.

3.5 REMOVAL AND FINAL CLEANUP

- A. Once the site has been fully stabilized against erosion, remove sediment control devices and all accumulated silt. Dispose of silt and waste materials in proper manner. Regrade all areas disturbed during this process and stabilize against erosion with surfacing materials as indicated on the Drawings.

END OF SECTION

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SECTION 02515
CONCRETE WALKWAYS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install concrete walkways, as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Earthwork is included in Section 02200.
- B. Cast-in-Place Concrete is included in section 03301.

1.3 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A185 – Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- B. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO M213 – Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete shall be as specified in Section 03301, but in no case less than 2,500 psi at 28 days.
- B. Welded wire fabric shall conform to ASTM A185 and shall be of size and gauge shown.
- C. Expansion joint filler shall be bituminous type, 1/4-in thick meeting AASHTO M-213-65.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The subgrade for walkways shall be shaped parallel to the proposed surface of the walkways and thoroughly compacted. All depressions occurring shall be filled and again compacted until the surface is smooth and hard.
- B. Forms
 - 1. Side and transverse forms shall be smooth, free from warp, of sufficient strength to resist springing out of shape, of a depth to conform to the thickness of the walkway and of a type satisfactory to the Engineer.
 - 2. All mortar or dirt shall be completely removed from forms that have been previously used. The forms shall be well staked and thoroughly braced and set to the established lines with their upper edge conforming to the grade of the finished walk which shall have sufficient pitch to provide for surface drainage, but not to exceed 1/4-in/ft.
 - 3. All forms shall be oiled as specified in Section 03301 before placing concrete.
- C. Wire Fabric Reinforcement
 - 1. All wire fabric shall be stored off the ground and shall be protected from moisture and be kept free from dirt, oil, or injurious coatings.
 - 2. Splices in welded wire fabric shall be lapped not less than 1-1/2 courses or 12-in, whichever is greater. Wire fabric splices shall be tied together with wire ties as approved spaced no more than 24-in on center. Support as approved in middle of slab.
 - 3. Before being placed in position, wire fabric shall be thoroughly cleaned of loose mill and rust scale, dirt and other coatings, including ice, that reduce or destroy bond. Where there is delay in depositing concrete after reinforcement is in place, fabric shall be reinspected and cleaned when necessary.
 - 4. In no case shall wire fabric be covered with concrete until the amount and position of the fabric has been checked by the Engineer and his/her permission given to proceed with the concreting.
- D. Placing and Finishing Concrete
 - 1. Concrete walkways shall be placed in alternate slabs not exceeding 36-ft in length, except as otherwise ordered. The slabs shall be separated by transverse, preformed expansion joint filler.

2. Preformed expansion joint filler shall be placed adjacent to structures as directed.
3. Concrete shall be of thickness as specified in the Drawings, after being thoroughly consolidated in place. Finishing operations shall be delayed until all bleed water and water sheen has left the surface and concrete has started to stiffen. After water sheen has disappeared, edging operations shall be completed. After edging and jointing operations, the surface shall be floated with an aluminum or magnesium float. Immediately following floating, the surface shall be steel troweled. If necessary, tooled joints and edges shall be rerun before and after troweling to maintain uniformity. Finish with broom at right angles to alignment of walk, then round all edges with 1/4-in radius after brooming.
4. When completed, the walkways shall be kept moist and protected from traffic and weather for at least 3 days.

3.2 CLEANUP

- A. At the completion of the work, Contractor shall clean up all scraps, rubbish, and surplus materials caused by this work and haul them away from the site and leave job in a neat, clean, and orderly condition.
- B. Contractor shall pressure clean walkways if discolored prior to final acceptance of project.

END OF SECTION

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SECTION 02605
PRECAST CONCRETE MANHOLES

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials and equipment required and install precast concrete manholes, frames and covers, manhole rungs, and appurtenances as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Earthwork is included in Section 02200.
- B. Trenching, Backfilling and Compaction are included in Section 02221.
- C. Cast-in-Place Concrete is included in Section 03301.
- D. Grout is included in Section 03600.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings, product data, materials of construction, and details of installation. Submittals shall include the following:
 - 1. Base sections, riser sections, eccentric conical top sections, including notarized certificate indicating compliance with ASTM C478.
 - 2. Pipe connections to precast concrete elements.
 - 3. Manhole rungs, including method of installation and notarized certificate indicating compliance with pull-out resistance test specified herein.
 - 4. Manhole frame and cover with certification of compliance with the specified ASTM standard and Class designation.
 - 5. Method of repair for minor damage to precast concrete sections.
- B. Design Data
 - 1. Precast concrete structures:
 - a. Sectional plan(s) and elevations showing dimensions and reinforcing steel placement.
 - b. Structural calculations including assumptions. Check for potential structure

- flotation.
- c. Concrete design mix.

C. Test Reports

1. Precast concrete structures:
 - a. Concrete test cylinder reports from an approved testing laboratory certifying conformance with this Section.
2. Results of leakage tests.

1.4 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM C32 - Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).
3. ASTM C33 - Standard Specification for Concrete Aggregates.
4. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
5. ASTM C150 - Standard Specification for Portland Cement
6. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes
7. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
8. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections
9. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealant.
10. ASTM D4101 - Standard Specification for Propylene Plastic Injection and Extrusion Materials.

B. American Concrete Institute (ACI)

1. ACI 318 - Building Code Requirements for Structural Concrete
2. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures

- C. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. Standard Specifications for Highway Bridges
- D. Occupational Safety and Health Administration (OSHA)
- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. All material shall be new and unused.
- B. Materials' quality, manufacturing process and finished sections are subject to inspection and approval by Engineer or other Owner representative. Inspection may be made at place of manufacture, at work site following delivery, or both.
- C. Materials will be examined for compliance with ASTM standards, this Section and approved manufacturer's drawings. Additional inspection criteria shall include: appearance, dimensions(s), blisters, cracks and soundness.
- D. Materials shall be rejected for failure to meet any requirements specified herein. Rejection may occur at place of manufacture, at work site, or following installation. Mark for identification rejected materials and remove from work site immediately. Rejected materials shall be replaced at no additional cost to Owner.
- E. Repair minor damage to precast concrete sections by approved method, if repair is authorized by the Engineer.

PART 2 PRODUCTS

2.1 GENERAL

- A. Reference to a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts and manufacturer's service.
- C. Provide lifting lugs or holes in each precast section for proper handling.
- D. Cement shall conform to ASTM C150, Type II cement or equal.
- E. Precast concrete sections shall be properly cured prior to shipping. Precast concrete sections shall not be shipped before concrete has attained 3,000 psi compressive strength.

- F. Mark date of manufacture, name and trademark of manufacturer on the inside of each precast section.

2.2 PRECAST CONCRETE MANHOLE SECTIONS

- A. Precast concrete base sections, riser sections, transition top sections, flat slab tops and grade rings shall conform to ASTM C478 and shall meet the following requirements:
 - 1. Design precast concrete base and flat slab top for their own weight, weight of soil at 130 pcf, and a live load equal to AASHTO H-20 truck loading applied at finished grade.
 - 2. Bottom slab thickness shall be no less than the riser wall thickness.
 - 3. Construct precast concrete bases as shown on the Drawings.
 - 4. Base, riser and transition top sections shall have tongue and groove joints.
 - 5. Top section shall be eccentric cone where cover over pipe exceeds 2-ft. Top section shall be a flat slab where cover over top of pipe is 2-ft or less. Top section shall be a plastic lined flat slab where manhole riser sections are to be plastic lined.
 - 6. Provide integrally cast knock-out panels in precast concrete manhole sections at locations, and with sizes shown on Drawings. Knock-out panels shall have no steel reinforcing.

2.3 PRECAST CONCRETE BOXES

- A. Refer to FDOT standards for required inside dimensions and minimum thickness of concrete.
- B. Manufacturer shall notify Engineer at least 5 working days prior to placing concrete during manufacturing process. Engineer may inspect reinforcing steel placement prior to placing concrete.
- C. Structural design calculations and fabrication drawings shall be prepared and stamped by a Professional Engineer licensed in the State of Florida.
- D. Design Criteria
 - 1. Precast concrete
 - a. Minimum compressive strength shall be 5000 psi at 28 days.
 - b. Maximum water-to-cement ratio shall be 0.40 by weight.
 - c. Minimum cement content shall be 600 lbs of cement per cubic yard of concrete.

2. Manufactured products
 - a. Conform to ACI 350 for liquid-containing structures and to ACI 318 for other structures.
 - b. Analyze walls and slabs using accepted Engineering principals. Design walls for internal fluid pressures and external soil pressures independently.
 - c. At liquid-containing structures, when "fy" exceeds 40,000 psi, "z" (per ACI 318) shall not exceed 95,000 psi, and "fs" shall be computed and shall not exceed 50 percent of "fy".
 - d. Design products to support their own weight, weight of soil at 120 pcf, and a live load equal to AASHTO HS-20 truck applied to top slab.
 - e. Design walls of the precast structure for the governing case from the following load conditions:
 - 1) An external lateral pressure based on an equivalent fluid with a unit weight of 90 pounds per cubic foot (pcf). Originate the pressure diagram at the finished ground surface or top of pavement surface, as applicable. When designing by the Strength Design Method, environmental durability factors, as defined in ACI 350-01, need not be included for this load condition. When designing by the Alternate Design Method (Service Loads), allowable stresses may be increased by one-third for this load condition.
 - 2) An external lateral pressure based on an equivalent fluid with a unit weight of 60 pcf. Include a live load surcharge pressure equal to 2 feet of earth above the finished ground surface or top of pavement surface, as applicable.
 - 3) An internal lateral pressure based on a fluid with a unit weight of 63 pcf. Assume internal fluid to the bottom surface of the top slab, unless otherwise noted or shown. Design of walls shall account for effects of tension due to internal fluid pressure.
 - f. Prevent flotation, with ground water level at finished ground surface, by dead weight of structure and of soil directly above structure. Do not consider skin friction, soil friction, or weight of equipment in structure.
 - g. Locate access openings, wall sleeves and pipe penetrations as shown on Drawings.
 - h. Locate horizontal wall joints 8-in minimum from edge of wall openings unless otherwise approved by the Engineer.
 - i. Consider discontinuities in structure produced by openings and joints. Provide additional reinforcing around openings. Frame openings to carry full design loads to support walls.
 - j. Design structure with a minimum number of joints. Maximum number of structure sections, including top slab, shall be four.
 - k. Cast base slab and walls together to form a monolithic base section.
 - l. Provide lifting hooks for top slab, where slab is required to be removed.
 - m. Wall sleeves shall be provided by the precast concrete manufacturer.

2.4 MANHOLE FRAME AND COVER

- A. Manhole frames and covers shall be of good quality, strong, tough, even grained cast

iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30 as a minimum.

2.5 JOINTING PRECAST MANHOLE SECTIONS AND STRUCTURES

- A. Seal tongue and groove joints of precast sections with either rubber O-ring gasket or preformed flexible joint sealant. O-ring rubber gaskets shall conform to ASTM C443. Preformed flexible joint sealant shall conform to ASTM C990 and shall be Kent Seal No. 2 by Hamilton-Kent; Ram-Nek by K.T. Snyder Company or equal.
- B. Completed joint shall withstand 15 psi internal water pressure without leakage or displacement of gasket or sealant.

2.6 MANHOLE RUNGS

- A. Manhole rungs shall conform to ASTM C478 and shall be Steel reinforced, copolymer polypropylene, 14-in wide, M.A. Industries Inc, PF Series or equal. Copolymer polypropylene shall conform to ASTM D4101 Classification PP0344 B33534 Z02. Steel reinforcing shall be 1/2-in diameter, conforming to ASTM A615, Grade 60 and shall be continuous throughout rung.
- B. Manhole rungs must be provided in manholes deeper than 4.5 feet.
- C. All steps shall be built into the walls of the pre-cast sections in straight alignment to form a continuous ladder with a maximum distance of 16 inches between steps.

2.7 PIPE CONNECTIONS

- A. Connect pipe to manholes using a flexible sleeve, which is an integrally cast sleeve in precast element or install sleeve in a formed or cored opening. Pipe shall be fastened in sleeve with stainless steel clamp(s). Coat stainless steel clamp(s) with bituminous material to protect from corrosion. Flexible sleeve shall be Lock Joint Flexible Manhole Sleeve; Kor-N-Seal connector; PSX Press-Seal Gasket or equal.

2.8 DAMPPROOFING

- A. Brush or spray applied dampproofing shall be an asphalt emulsion reinforced with fibers conforming to ASTM D1227, Type II, Class 1. The dampproofing shall be Hydrocide 700B by Sonneborn Building Products, Division of ChemRex Inc., Minneapolis, MN; Karnak 220 Asphalt Emulsion by Karnak Corporation, Clark, NJ; or polyamide coal tar epoxy, Series 46H-413 Hi-Build Tnemec-Tar (the latter per Okaloosa

County Water and Sewer standard 8.6.6.1.1); or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Manhole and Structure Installation.

1. Manholes and structure shall be constructed to the dimensions shown on the Drawings and as specified herein. Protect all work against flooding and flotation.
2. Construct cast-in-place bases in accordance with the requirements of Division 3 and the details shown on the Drawings.
3. Place base on a bed of 12-in structural fill as shown on the Drawings. Set base grade so that a maximum grade adjustment of 8-in is required to bring the structure to final grade.
 - a. Use precast concrete grade rings or brick and mortar to adjust manhole frame and cover to final grade.
4. Set precast concrete sections plumb with a 1/4-in maximum out of plumb tolerance allowed. Seal joints of precast sections with either a rubber O-ring set in a recess or preformed flexible joint sealant in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with non-shrink mortar and finish flush with the adjoining surfaces. Caulk the inside of any leaking joints with lead wool or non-shrink grout to the satisfaction of the Engineer.
5. Allow joints to set for 14 hours before backfilling, unless a shorter period is specifically approved by the Engineer.
6. Plug holes in the concrete sections required for handling with a non-shrink grout or non-shrink grout in combination with concrete plugs. Finish flush on the inside.
7. Cut holes in precast sections to accommodate pipes prior to setting precast sections in place to prevent jarring that may loosen the mortar joints.
8. Backfill carefully and evenly around manholes and precast boxes.

B. Pipe Connections

1. Construct pipe connections, including pipe stubs, as specified above. Close or seal pipe stubs for future connections with a gasketed watertight plug.

C. Rung Installation

1. Steel Reinforced Polypropylene Manholes Plastic Rungs
 - a. Preform holes for rungs during casting of the riser and cone sections, using tapered form pins specifically made for preforming rung holes.
 - b. Drive rungs into preformed holes after concrete has developed a compressive strength of 3,000 psi.
 - c. Alternatively, cast rungs into precast sections when concrete is placed.
 - d. Drilling holes for rungs may be used to accommodate field conditions when approved by the Engineer. Drill holes of diameter, spacing and depth required by rung manufacturer.
 - e. All rung installations shall withstand a pull-out resistance test of 1,500 pounds.

D. Setting Manhole Frame and Cover

1. Set manhole covers and frames in a full mortar bed. Utilize bricks or precast concrete grade rings, a maximum of 8-in thick, to assure frame and cover are set to the finished grade. Set manhole frame and cover to final grade prior to placement of permanent paving.

E. Dampproofing

1. Coat outer surfaces of manholes at the rate of 30 to 35 sq ft per gallon, in accordance with manufacturer's instructions. If leakage testing is required, complete leakage testing prior to application of dampproofing.

3.2 LEAKAGE TESTS

- A. Test each liquid-containing manhole for leakage. Engineer shall observe each test. Perform exfiltration test as described below:
- B. Assemble manhole in place; fill and point all lifting holes and exterior joints within 6-ft of the ground surface with an approved non-shrinking mortar. Test prior to placing the shelf and invert and before filling and pointing the horizontal joints below 6-ft of depth. Lower ground water table below bottom of the manhole for the duration of the test. Plug all pipes and other openings into the manhole and brace to prevent blow out.
- C. Fill manhole with water to the top of the cone section. If the excavation has not been backfilled and no water is observed moving down the surface of the manhole, the manhole is satisfactorily water-tight. If the test, as described above is unsatisfactory as determined by the Engineer, or if the manhole excavation has been backfilled, continue the test. A period of time may be permitted to allow for absorption. Following this period, refill manhole to the top of the cone, if necessary and allow at least 8 hours to pass. At the end of the test period, refill the manhole to the top of the cone again, measuring the volume of water added. Extrapolate the refill amount to a 24-hour leakage rate. The leakage for each manhole shall not exceed one gallon per

vertical foot for a 24-hour period. If the manhole fails this requirement, but the leakage does not exceed three gallons per vertical foot per day, repairs by approved methods may be made as directed by the Engineer. If leakage due to a defective section of joint exceeds three gallons per vertical foot per day, the manhole shall be rejected. Uncover the rejected manhole as necessary and to disassemble, reconstruct or replace it as directed by the Engineer. Retest the manhole and, if satisfactory, fill and point the interior joints.

- D. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorptions, etc. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete.
- E. An infiltration test may be substituted for an exfiltration test if the ground water table is above the highest joint in the manhole. If there is no leakage into the manhole as determined by the Engineer, the manhole will be considered water-tight. If the Engineer is not satisfied, testing shall be performed as previously described.
- F. Regardless of whether leakage testing is required, visible leaks which occur after backfilling shall be sealed by approved means.

3.3 CLEANING

- A. Thoroughly clean all new manholes of all silt, debris and foreign matter of any kind, prior to final inspections.

END OF SECTION

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SECTION 02616
YARD PIPING

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required, install, and test ductile iron pipe and fittings for yard piping as shown on the Drawings and as specified herein.
- B. Yard piping shall include all piping and fittings extending outward, upward and downward into the ground from five (5) feet from the outside face of all structures. Unless otherwise noted, non-buried pipe outside a structure shall be specified in Division 15. Yard piping shall begin five (5) feet from the outside face of the structures. The first joint shall be not more than 5-ft from the outside face of the building or structure unless otherwise shown on the Drawings. Yard piping shall include all piping in valve vaults, manholes, cleanouts and similar yard structures.
- C. Piping shall be located substantially as shown on the Drawings. The Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference between pipes or for other reasons. Pipe fitting notation is for the Contractor's convenience and does not relieve him/her from installing and jointing different or additional items where required to achieve a complete piping system.
- D. Where the word "pipe" is used it shall refer to ductile iron pipe, fittings, or appurtenances unless otherwise noted.

1.2 RELATED WORK

- A. Delivery, Storage and Handling is included in Section 01600.
- B. Trenching, Backfilling and Compaction is included in Section 02221.
- C. Granular Fill Material is included in Sections 02200 & 02230.
- D. Sedimentation and Erosion Control is included in Section 02270.
- E. Pipe Testing - General Requirements is included in Section 15052

1.3 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings and product data for review.
- B. Submit copies of design calculations in accordance with Paragraph 2.02 below.

- C. Submit a tabulated laying schedule which references stations and invert elevations as shown on the Drawings as well as all fittings, bends, outlets, restrained joints, tees, special deflection bells, adapters, solid sleeves and specials, along with the manufacturer's drawings and specifications indicating complete details of all items. The laying schedule shall show pipe class, class coding, station limits and transition stations for various pipe classes. The above shall be submitted to the Engineer for approval before manufacture and shipment. The location of all pipes shall conform to the locations indicated on the Drawings.
- D. Submit anticipated production and delivery schedule.
- E. Prior to shipment of pipe, submit a certified affidavit of compliance from the manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.

1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A193 – Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
 - 2. ASTM A194 – Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High- Pressure and High-Temperature Service.
- B. American Water Works Association (AWWA)
 - 1. AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - 2. AWWA C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - 3. AWWA C110 – Ductile-Iron and Gray-Iron Fittings, 3-in through 48-in (75mm Through 1219mm) for Water.
 - 4. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 5. AWWA C150 – Thickness Design of Ductile-Iron Pipe.
 - 6. AWWA C151 – Ductile-Iron Pipe, Centrifugally Cast, for Water.
 - 7. AWWA C153 – Ductile-Iron Compact Fittings, 3-in (76-mm) through 64-in (1600-mm), for Water Service.
 - 8. AWWA C550 – Protective Interior Coatings for Valves and Hydrants

9. AWWA C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances.
 10. AWWA C606 – Grooved and Shouldered Joints
 11. AWWA C651 - Disinfecting Water Mains.
- C. National Sanitation Foundation (NSF)
- D. NSF 61 – Drinking Water System Components Health Effects
- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. Each length of ductile iron pipe supplied for the project shall be hydrostatically tested at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture of the pipe wall. Certified test results shall be furnished in duplicate to the Engineer prior to time of shipment.
- B. All ductile-iron pipe and fittings to be installed under this project shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the Engineer sworn certificates of such tests and their results prior to the shipment of the pipe.
- C. All pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the Engineer at the Engineer's expense.
- D. Inspection of the pipe and fittings will also be made by the Engineer after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job.
- E. All pipe and fittings shall be permanently marked with the following information:
 1. Manufacturer, date.
 2. Size, type, class, or wall thickness.
 3. Standard produced to (AWWA, ASTM, etc.).

1.6 DELIVERY, STORAGE AND HANDLING

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe. Under no circumstances shall the pipe be dropped or skidded against each other. Slings, hooks, or pipe tongs shall be used in pipe handling.
- B. Materials, if stored, shall be kept safe from damage. The interior of all piping, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times.
- C. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations.
- D. Gaskets for mechanical and push-on joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products.

PART 2 PRODUCTS

2.1 MATERIALS

A. Pipe

- 1. Ductile iron pipe shall conform to AWWA C151. Pipe shall be supplied in standard lengths as much as possible.
- 2. Thickness design shall be per AWWA C150, except provide minimum Class 250 for piping 20 inches and smaller, provide minimum Class 200 for piping 24-in, and provide minimum Class 150 for piping 30-in and larger.
- 3. Ductile iron pipe for gravity sewer shall conform to ASTM A746 standards.
- 4. Ductile iron pipe shall be by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company; or equal.

B. Joints

- 1. Ductile iron pipe shall have rubber-gasket push-on joint or rubber-gasket mechanical joint. Rubber-gasket joints shall conform to AWWA C111. Gasket shall be of SBR. Unless otherwise specifically called out on the drawings, all buried pipe shall be restrained joint.
- 2. Restraint for push on joint pipe shall be "Locked-type" joints manufactured by the pipe and fitting manufacturer that utilize restraint independent of the joint gasket.

3. Sleeve type couplings shall be Dresser Style 38, 138 or equal.
4. Split Sleeve type flexible couplings shall be F x F (self-restrained) or equal.
5. All fittings for lines 6-in diameter and larger shall have restrained joints.

C. Fittings

1. Pipe fittings shall be ductile iron with pressure rating of 350 psi for 24-in and smaller piping and 250 psi for 30-in and larger piping. Fittings shall meet the requirements of AWWA C110 or AWWA C153 as applicable.
2. Fittings shall have the same pressure rating, as a minimum, of the connecting pipe.
3. Closures shall be made with mechanical joint ductile iron solid sleeves and shall be located in straight runs of pipe at minimum cover outside the limits of restrained joint sections. Location of closures shall be subject to approval of the Engineer.

D. Interior Lining

1. Ductile iron pipe and fittings shall have the same type of lining as specified herein.
2. The 16-inch return sludge ductile iron pipe and fittings between the RAS Pump Station and Headworks, and 42-inch raw sewage ductile iron pipe and fittings between the Headworks and BNR Process Basins shall be epoxy lined, in accordance with ASTM A746.
3. Ductile iron pipe and fittings, other than those specified in 2.01.D.2 above, shall be cement mortar lining in accordance with ANSI/AWWA C104/A21.4. The cement mortar lining shall be Type I per ASTM C150, double thickness.
4. At the option of the supplier fittings may be lined in accordance with AWWA C550. Lining shall be NSF 61 certified.

E. Exterior Coating

1. Buried Pipe shall be installed with asphaltic coating conforming to AWWA C151. The asphaltic coating shall be 1 mil thick minimum.

2.2 DUCTILE IRON PIPE DESIGN

- A. Design for the net thickness for external loading shall be taken as the greater of the following conditions:

1. 2-1/2-ft of cover with AASHTO H-20 wheel loads, with an impact factor of 1.5.
2. Depth from existing ground level of future proposed grade (whichever is greater) to top of pipe as shown on the Drawings, with truck load.
3. Soil Density: 120 lbs/cu ft
4. Laying Conditions; AWWA C150, Type 2.
5. Design for the net thickness shall be based upon the following internal pressure conditions:
 - a. Design pressure: 150 psi
 - b. Surge allowance: 100 psi
 - c. Safety factor: 2
 - d. Total internal pressure design: $2 (150 + 100) = 500$ psi

PART 3 EXECUTION

3.1 GENERAL

- A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe or coatings. Pipe and fittings shall not be dropped. All pipe and fittings shall be examined before laying and no piece shall be installed which is found to be defective. Damage to the pipe coatings shall be repaired per manufacturer's recommendations.
- B. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work and when installed or laid, shall conform to the lines and grades required.

3.2 INSTALLING DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe and fittings shall be installed in accordance with requirements of AWWA C600, except as otherwise specified herein. A firm, even bearing throughout the length of the pipe shall be provided by digging bell holes at each joint and by tamping backfill materials at the side of the pipe to the springline per details shown on the Drawings. Blocking will not be permitted.
- B. All pipe shall be sound and clean before laying. When laying is not in progress, open ends of the pipe shall be closed by a watertight plug or other approved means. Sufficient backfill shall be placed to prevent flotation. The deflection at joints shall not exceed 75 percent of allowable deflection recommended by manufacturer.
- C. All ductile iron pipe laid underground shall have a minimum of 3-ft of cover unless otherwise shown on the Drawings or as specified herein. Pipe shall be laid such that

the invert elevations shown on the Drawings are not exceeded.

- D. Fittings, in addition to those shown on the Drawings shall be provided, where required, in crossing utilities which may be encountered upon opening the trench. Solid sleeve closures shall be installed at locations approved by the Engineer.
- E. The pipe interior shall be maintained dry and broom clean throughout the construction period.
- F. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a bell shall be beveled to conform to the manufactured spigot end. Cement lining shall be undamaged. Cutting of restrained joint pipe will not be allowed, unless approved at specific joints in conjunction with the use of restrainer glands by EBAA Iron or field adaptable restrained joints.
- G. Jointing Ductile-Iron Pipe
 - 1. Push-on joints shall be made in strict accordance with manufacturer's instructions and AWWA C600. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe. The joint surfaces shall be cleaned and lubricated and the plain end of the pipe shall be aligned with the bell of the pipe to which it is to be joined and pushed home.
 - 2. Mechanical joints shall be assembled in strict accordance with the manufacturer's instructions and AWWA C600. Pipe shall be laid with bell ends looking ahead. To assemble the joints in the field, thoroughly clean and lubricate the joint surfaces and rubber gasket. Bolts shall be tightened to the specified torques. Under no condition shall extension wrenches or pipe over handle of ordinary ratchet wrench be used to secure greater leverage.
 - 3. Bolts in mechanical or restrained joints shall be tightened alternately and evenly.
 - 4. Restrained joints shall be installed according to pipe manufacturer's instructions.
- H. All blow-offs, outlets, valves, fittings, and other appurtenances required shall be set and jointed as indicated on the Drawings in accordance with the manufacturer's instructions.

3.3 CONNECTIONS TO STRUCTURES

- A. Wherever a pipe 3-in in diameter or larger passes from concrete to earth horizontally, two flexible joints spaced from 2 to 4-ft apart depending on pipe size shall be installed, within 2-ft of the exterior face of the wall, whether or not shown on the Drawings.
- B. Wall pipes shall have a thrust collar located at mid-depth of wall.

- C. Piping underneath structures shall be concrete encased.

3.4 TESTING

- A. After installation, the pipe shall be tested for compliance as specified herein and in Section 15052. Furnish all necessary equipment and labor for the pressure test and leakage test on the pipelines.
- B. Submit detailed test procedures and method for Engineer's review. In general, testing shall be conducted in accordance with AWWA C600.
- C. Pressure pipelines shall be subjected to a hydrostatic pressure of 50% above the normal operating pressure or 150 psi (whichever is greater). This test pressure shall be maintained for a minimum of 2 hours. The leakage rate shall not exceed those indicated in AWWA C600. Provide suitable restrained bulkheads as required to complete the hydrostatic testing specified.
- D. Gravity pipelines shall be subjected to either hydrostatic pressure test as specified in AWWA C600 or low pressure air test, or exfiltration test as specified in Section 306-1.4 of Standard Specifications for Public Works Construction, latest edition.
- E. All valves and valve boxes shall be properly located and installed and operable prior to testing.
- F. Bulkheads shall be provided with a sufficient number of outlets for filling and draining the line and for venting air.
- G. Hydrostatic pressure and leakage tests shall conform to Section 4 of AWWA C600. Furnish gauges, meters, pressure pumps and other equipment needed to fill the line slowly and perform the required hydrostatic pressure leakage tests.
- H. The Owner will provide a source of supply from the existing treated water distribution system for use in filling the lines. An air break shall be maintained at all times between the distribution system and the Owner's equipment to prevent cross-connection. The line shall be slowly filled with water and the specified test pressure shall be maintained in the pipe for the entire test period by means of a pump furnished by the Contractor. Provide accurate means for measuring the quantity of water required to maintain this pressure. The amount of water required is a measure of the leakage.
- I. Duration of pressure test shall not be less than 2 hours. The leakage test shall be a separate test following the pressure test and shall not be less than 2 hours duration. All leaks evident at the surface shall be repaired and leakage eliminated regardless of the total leakage as shown by test. Lines which fail to meet tests shall be repaired and retested as necessary until test requirements are complied with. Defective materials, pipes, valves and accessories shall be removed and replaced.

- J. The Owner shall supply, at no cost to the Contractor, a maximum quantity of water equal to 110 percent of the volume of the pipelines for testing.
- K. Submit plan for testing to the Engineer for review at least 10 days before starting the test.

3.5 CLEANING

- A. At the conclusion of the work, thoroughly clean all of the pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. All debris shall be removed from the pipeline. The lowest segment outlet shall be flushed last to assure debris removal

3.6 DISINFECTION

- A. Ductile iron pipe used for potable water service shall be disinfected after cleaning. Provide all necessary equipment and labor for the disinfection.
- B. Disinfection shall be in accordance with AWWA C651 standard. Discharge of chlorinated water shall comply with all Federal, State and local standards. Provide sodium bisulfite for dechlorination prior to discharge.

END OF SECTION

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SECTION 02930
 LOAMING AND HYDROSEEDING

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and provide erosion control and place topsoil, finish grade, apply lime and fertilizer, hydraulically apply seed and mulch and maintain all seeded areas as shown on the Drawings and as specified herein, including all areas disturbed.

1.2 RELATED WORK

- A. Site preparation including clearing, grubbing and stripping is included in Section 02100.
- B. Earthwork including excavation, backfill, fill and grading including the stockpiling of topsoil is included in Section 02200.
- C. Sedimentation and erosion control is included in Section 02270.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 01300, samples of all materials for inspection and acceptance.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil shall be fertile, friable, natural topsoil typical of topsoil of the locality and shall be obtained from a well drained site that is free of flooding. It shall be without admixture of subsoil or slag and free of stones, lumps, plants or their roots, sticks, clay, peat and other extraneous matter and shall not be delivered to the site or used while in a muddy condition. Topsoil as delivered to the site or stockpiled shall have pH between 6.0 and 7.0 and shall contain not less than 5 percent nor more than 8 percent organic matter as determined by loss of ignition of moisture-free samples dried at 100 degrees Celsius. The topsoil shall meet the following mechanical analysis:

	<u>Percentage Finer</u>
1-in screen opening	100
No. 10 mesh	95 to 100

No. 270 mesh	35 to 75
0.002 mm*	5 to 25

*Clay size fraction determined by pipette or hydrometer analysis.

1. At least 30 days prior to anticipated start of topsoiling operations, a one pint sample of topsoil material shall be delivered to the Engineer for testing and approval. Based on tests performed by the Engineer, the topsoil shall be identified as acceptable, acceptable with certain fertilizer and limestone applications or unacceptable. If the topsoil is found acceptable the fertilizer and lime requirements will be as specified or as recommended by the Engineer. If the topsoil is found unacceptable, identify another source of topsoil and incur all expenses associated with testing additional samples. All topsoil incorporated into the site work shall match the sample provided to the Engineer for testing. Topsoil stockpiled under other Sections of this Division may be used subject to the testing and approval outlined above. Be responsible for screening stockpiled topsoil and providing additional topsoil as required at his own expense.

- B. Fertilizer shall be commercial mixed free flowing granules or pelleted fertilizer, 10-20-10 (N-P2O5-K2O) grade for lawn and naturalized areas. Fertilizer shall be delivered to the site in original unopened containers each showing the manufacturer's guaranteed analysis conforming to applicable state fertilizer laws. At least 40 percent of the nitrogen in the fertilizer used shall be in slowly available (organic) form.

- C. Lime shall be ground limestone containing not less than 85 percent calcium and magnesium carbonates and be ground to such fineness that at least 50 percent shall pass a 100-mesh sieve and at least 90 percent shall pass a 20-mesh sieve.

- D. Seed shall be labeled in accordance with USDA Rules and Regulations under the Federal Seed Act and applicable State seed laws. Seed shall be furnished in sealed bags or containers bearing the date of the last germination, which date shall be within a period of 6 months prior to commencement of planting operations. Seed shall be from same or previous year's crop; each variety of seed shall have a purity of not less than 85 percent, a percentage of germination not less than 90 percent, shall have a weed content of not more than 1 percent and contain no noxious weeds. The seed mixtures shall consist of seed proportioned by weight as follows:
 1. Lawn Area Seed Mix (For areas as indicated on the

Drawings) "Rebel II" Tall Fescu	70 percent
"Baron" Kentucky Bluegrass	10 percent
"Palmer" Perennial Ryegrass	20 percent

 2. Natural Area Seed Mix (For all slopes and disturbed areas not otherwise

indicated) Kentucky 31 Fescue	40 percent
Palmer Perennial Ryegrass	30 percent
Birds Foot Trefoil (Empire Variety)	15
percent Red Clover	5
percent	
White Clover	5 percent
Redtop (Streaker Variety)	5 percent

- E. The seed shall be furnished and delivered premixed in the proportions specified above. A manufacturer's certificate of compliance to the specified mixes shall be submitted by the manufacturers for each seed type. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed and also the net weight and date of shipment. No seed may be sown until the certificates have been submitted.
- F. Seed shall be delivered in sealed containers bearing the dealer's guaranteed analysis.
- G. Mulch shall be specially processed 100 percent Virgin wood fiber mulch containing no growth or germination-inhibiting factors. Wood fiber mulch shall be "Second Nature Regenerated wood fiber as by Central Fiber Corporation, Wellsville, KS or equal. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the wood fiber shall be marked by the manufacturer to show the air dry weight content and not contain in excess of 10 percent moisture.
- H. Erosion control blanket is specified in Section 02270.
- I. Straw Mulch is specified in Section 02270.
- J. Tackifier is specified in Section 02270.

PART 3 EXECUTION

3.1 APPLICATION

- A. Unless otherwise shown on the Drawings, topsoil shall be placed to a minimum compacted depth of 6-in on all parts of the site not covered with structures, pavement, or existing woodland.
- B. For all areas to be seeded:
 - 1. Lime shall be applied at the rate of 150 lbs/1,000 sq ft or as determined by the soil test to bring topsoil pH to a range of 6.0 to 7.0.
 - 2. Fertilizer (10-20-10) shall be applied at the rate of 30 lbs/1,000 sq ft or as

determined by the soil test.

3. Seed shall be applied at the rate of 5 lbs/1,000 sq ft.
 4. Fiber mulch shall be applied at the rate of 45 lbs/1,000 sq ft.
 5. Straw mulch shall be applied to all slopes of 3 horizontal to 1 vertical and steeper at a rate of 75 lbs/1000 sq ft.
 6. Tackifier shall be installed per manufacturer's instructions and reapplied as necessary to insure the straw mulch is stabilized until reasonable turf growth is established as determined by the Engineer with a minimum rate of 1 gal/1000 sq ft per application.
- C. If possible, limestone shall be applied 2 to 3 months before the application of fertilizer. Limestone may not be mixed with fertilizer for application and shall be applied a minimum of 2 weeks prior to fertilizer application.
- D. After the topsoil is placed and before it is raked to true lines and rolled, limestone shall be spread evenly over the loam surface and thoroughly incorporated by heavy raking to at least one half the depth of topsoil.
- E. The application of fertilizer may be performed hydraulically in one operation with hydroseeding and fiber mulching. Clean all structures and paved areas of unwanted deposits of the hydroseeded mixture.
- F. Straw Mulch and Tackifier shall be applied immediately following seeding operations (same day) unless otherwise approved by the Engineer.

3.2 INSTALLATION

- A. Previously established grades, as shown on Drawings shall be maintained in a true and even condition.
- B. Subgrade shall be prepared by tilling prior to placement of topsoil to obtain a more satisfactory bond between the two layers. Tillage operations shall be across the slope. Tillage shall not take place on slopes steeper than 2 horizontal to 1 vertical or where tillage equipment cannot be operated. Tillage shall be accomplished by disking or harrowing to a depth of 9-in parallel to contours. Tillage shall not be performed when the subgrade is frozen, excessively wet, extremely dry or in other conditions which would not permit tillage. The subgrade shall be raked and all rubbish, sticks, roots and stones larger than 2-in shall be removed. Subgrade surfaces shall be raked or otherwise loosened immediately prior to being covered with loam.
- C. Topsoil shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling, the complete work will conform to the lines, grades and elevations indicated. No loam shall be spread in

water or while frozen or muddy.

- D. After topsoil has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking. All stiff clods, lumps, roots, litter and other foreign material shall be removed from the loamed area and disposed of. The areas shall also be free of smaller stones, in excessive quantities, as determined by the Engineer. The whole surface shall then be rolled with a hand roller weighing not more than 100 lbs/ft of width. During the rolling, all depressions caused by settlement of rolling shall be filled with additional loam and the surface shall be regraded and rolled until a smooth and even finished grade is created.
- E. Seeding, mulching and conditioning shall only be performed during those periods within the seasons which are normal for such work as determined by the weather and locally accepted practice, as approved by the Engineer. Hydroseed and straw mulch only on a calm day.
- F. Schedules for seeding and fertilizing must be submitted to the Engineer for approval prior to the work. Seeding as specified herein shall be accomplished between the period of April 1 to June 1 or August 15 to October 1. Seeding during the period from October 2 to March 31 shall only be undertaken upon approval of the Engineer. Seeding during the period from June 1 to August 14 shall only be performed if irrigation is provided.
- G. Seeding shall be done within ten days following soil preparation. Seed shall be applied hydraulically at the rates and percentages indicated. The spraying equipment and mixture shall be so designed that when the mixture is sprayed over an area, the grass seed and mulch shall be equal in quantity to the specified rates. Prior to the start of work, furnish the Engineer with a certified statement as to the number of pounds of materials to be used per 100 gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the hydroseeder. Upon completion of seeding operations, furnish the Engineer with a certified statement on the actual quantity of solution applied.
- H. In order to prevent unnecessary erosion of newly topsoiled and graded slopes and unnecessary siltation of drainage ways, carry out seeding and mulching as soon as he has satisfactorily completed a unit or portion of the project. For the purpose of this project a unit is defined as 10,000 sq ft. When protection of newly loamed and graded areas is necessary at a time which is outside of the normal seeding season, protect those areas by whatever means necessary as approved by the Engineer and shall be responsible for prevention of siltation in the areas beyond the limit of work.
- I. Erosion control blankets shall be installed in all drainage swales and ditches as shown on the Drawings and as directed by the Engineer in accordance with manufacturer's instructions. The area to be covered shall be properly prepared, fertilized and seeded before the blanket is applied. When the blanket is unrolled, the

netting shall be on top and the fibers in contact with the soil over the entire area. The blankets shall be applied in the direction of water flow, butted snugly at the ends and side and stapled. Blankets shall be placed a minimum of three rows (of 4-ft) wide (total 12-ft width) within the drainage swale/ditch and stapled together in accordance with manufacturer's instructions. The staples shall be made of wire, .091-in in diameter or greater, "U" shaped with legs 6-in in length and a 1-in crown. The staples shall be driven vertically into the ground, spaced approximately two linear yards apart, on each side and one row in the center alternately spaced between each size. Adjoining shall not be overlapped and shall utilize a common row of staples to attach.

- J. When newly graded subgrade areas cannot be topsoiled and seeded because of season or weather conditions and will remain exposed for more than 30 days, protect those areas against erosion and washouts by whatever means necessary such as straw applied with a tar tack, wood chips or by other measures as approved by the Engineer. Prior to application of topsoil, any such materials applied for erosion control shall be thoroughly incorporated into the subgrade by discing. Fertilizer shall be applied prior to spreading of topsoil.
- K. On slopes in addition to straw mulch and tackifier, provide against washouts by an approved method. Any washout which occurs shall be regraded and reseeded at the Contractor's expense until a good turf is established.

3.3 MAINTENANCE AND PROVISIONAL ACCEPTANCE

- A. Keep all seeded areas watered and mowed and in good condition, reseeding all seeded areas if and when necessary until a good, healthy, uniform growth is established over the entire area seeded and shall maintain all seeded areas in an approved condition until provisional acceptance.
- B. The Engineer will inspect all work for provisional acceptance at the end of the 10 week maintenance period, upon the written request received at least 10 days before the anticipated date of inspection. The maintenance period must occur during the growing season between March 31 and October 1 and shall include a minimum of three mowings.
- C. A satisfactory turf will be defined as:
 - 1. No bare spots larger than 3 sq ft.
 - 2. No more than 10 percent of total area with bare spots larger than 1 sq ft.
 - 3. Not more than 15 percent of total area with bare spots larger than 6-in-square.
- D. After the inspection has occurred but prior to provisional acceptance, a soil test shall be performed to determine if additional soil fertilization should occur. If necessary additional fertilizer not to exceed 30 lbs/1000 sq ft of 20-10-10 shall be

applied as directed by the Engineer.

- E. Furnish full and complete written instructions for maintenance of the seeded areas to the Owner at the time of provisional acceptance.
- F. The inspection by the Engineer will determine whether maintenance shall continue. Continue maintenance until all areas of the site meet the minimum requirements specified above.
- G. After all necessary corrective work and clean-up has been completed, and maintenance instructions have been received by the Owner, the Engineer will certify in writing the provisional acceptance of the turf areas. Maintenance of all turf areas shall cease on receipt of provisional acceptance.

3.4 GUARANTEE PERIOD AND FINAL ACCEPTANCE

- A. All seeded areas shall be guaranteed for not less than 1 full year from the time of provisional acceptance.
- B. At the end of the guarantee period, inspection will be made by the Engineer upon written request submitted at least 10 days before the anticipated date. Seeded areas not demonstrating satisfactory stands as outlined above, as determined by the Engineer, shall be renovated, reseeded and maintained meeting all requirements as specified herein.
- C. After all necessary corrective work has been completed, the Engineer shall certify in writing the final acceptance of the seeded areas.

END OF SECTION

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SECTION 02932
SODDING

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and prepare lawn bed and install sodding as specified.
- B. Area to receive sodded grass lawns shall be the following:
 - 1. Twenty feet around the perimeter of all new structures.
 - 2. Ten feet on each side of all sidewalks and pipe trenches.
 - 3. Ten feet on each side of roadways.
 - 4. All slopes steeper than 4:1.

1.2 SUBMITTALS

- A. Submit, in accordance with Section 01300, technical data on all materials or installation procedures required under this Section.
- B. Submit representative topsoil samples for analysis by a private laboratory to determine nutrient deficiencies and outline a proper fertilization program.
- C. Submit certifications for all sodding supplied.

PART 2 PRODUCTS

2.1 SOD

- A. Sod shall be Argentine Bahia of firm texture having a compacted growth and good root development as approved.
- B. Sod shall be certified to meet Florida State Plant Board specifications, absolutely true to varietal type, and free from weeds or other objectionable vegetation, fungus, insects and disease of any kind.
- C. Before being cut and lifted the sod shall have been mowed three times with the final mowing not more than a week before cutting into uniform dimensions.

2.2 SOIL CONDITIONERS

A. Fertilizer

1. Fertilizer shall be a complete fertilizer, the elements of which are derived from organic sources. Fertilizer shall be a standard product complying with State and Federal fertilizer laws.
 2. Percentages of nitrogen, phosphorus and potash shall be based on laboratory tests on soils outlined in Paragraph 1.02B and approved by the Engineer. For purpose of bidding, assume 6 percent nitrogen, 6 percent phosphorus and 6 percent potash by weight. At least 50 percent of the total nitrogen shall contain no less than 3 percent water-insoluble nitrogen.
 3. Fertilizer shall be delivered to the site, mixed as specified, in the original unopened standard size bags showing weight, analysis and name of manufacturer. Containers shall bear the manufacturer's guaranteed statement of analysis, or a manufacturer's certificate of compliance covering analysis shall be furnished to the Engineer. Store fertilizer in a weatherproof place and in such a manner that it will be kept dry and its effectiveness will not be impaired.
- B. Superphosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes containing not less than 20 percent available phosphoric acid.

PART 3 EXECUTION

3.1 LAWN BED PREPARATION

- A. Areas to be sodded shall be cleared of all rough grass, weeds, and debris, and the ground brought to an even grade as approved.
- B. The soil shall then be thoroughly tilled to a minimum 8-in depth.
- C. Superphosphate at a rate for bidding purposes of 5 pounds per 1000 square foot and complete fertilizer at a rate for bidding purposes of 16 pounds per 1000 square foot shall be evenly distributed over entire area and cross-diced in to a depth of 4 to 6-in.
- D. The areas shall then be brought to proper grade, free of sticks, stones, or other foreign matter over 1-in in diameter or dimension. The surface shall conform to finish grade, less the thickness of sod, free of water-retaining depressions, the soil friable and of uniformly firm texture.

3.2 SOD HANDLING AND INSTALLATION

- A. During delivery, prior to planting, and during the planting of the lawn areas, the sod panels shall at all times be protected from excessive drying and unnecessary exposure of the roots to the sun. All sod shall be stacked during construction and

planting so as not to be damaged by sweating or excessive heat and moisture.

- B. After completion of soil conditioning as specified above, sod panels shall be laid tightly together so as to make a solid sodded lawn area. On mounds and other slopes, the long dimension of the sod shall be laid perpendicular to the slope. Immediately following sod laying the lawn areas shall be rolled with a lawn roller customarily used for such purposes, and then thoroughly watered.
- C. Bring the sod edge in a neat, clean manner to the edge of all paving and shrub areas. Top dressing with approved, clean, weed free, sand may be required at no additional cost to the Owner if deemed necessary by the Engineer.

3.3 MAINTENANCE

- A. The Contractor shall produce a dense, well established lawn. The Contractor shall be responsible for the repair and resodding of all eroded or bare spots until project acceptance. Repair sodding shall be accomplished as in the original work except that fertilizing may be omitted.
- B. Sufficient watering shall be done by the Contractor to maintain adequate moisture for optimum development of the lawn areas. Sodded areas shall receive no less than 1.5-in of water per week.

3.4 REPAIRS TO LAWN AREAS DISTURBED BY CONTRACTOR'S OPERATIONS

- A. Lawn areas planted under this Contract and lawn areas outside the designated areas damaged by Contractor's operations shall be repaired at once by proper sod bed preparation, fertilizing and resodding, in accordance with these specifications.

END OF SECTION

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SECTION 03250
CONCRETE JOINTS AND JOINT ACCESSORIES

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install accessories for concrete joints complete as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Cast-in-place concrete and concrete reinforcement is included in Section 03301.
- B. Grout is included in Section 03600.
- C. Miscellaneous metals are included in Section 05500.
- D. Waterproofing, dampproofing and caulking are included in Division 7.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings and product data for:
 - 1. Premolded joint fillers: Product data including location of use, sample, catalogue cut, technical data, storage requirements, installation instructions, and conformity to ASTM standards.
 - 2. Preformed expansion joint material: Product data including location of use, catalogue cut, dimensions, technical data, storage requirements, installation instructions, and conformity to ASTM standards.
 - 3. Bond breaker: Product data including location of use, catalogue cut, technical data, storage requirements, and application instructions.
 - 4. Sealant: Product data including location of use, catalogue cut, technical data, storage requirements, mixing and application instructions, and conformity to ASTM standards.
- B. Certifications
 - 1. Certify that all materials used within the joint system are compatible with each other.

1.4 REFERENCE STANDARDS

A. ASTM International

1. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
2. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
3. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
4. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
5. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

B. Federal Specifications (FS)

1. FS SS-S-210A - Sealing Compound for Expansion Joints.

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. Provide services of a manufacturer's field representative of the sealant who has performed at least five projects of similar size and complexity within the last 5 years. The field representative shall be present at the work site prior to any mixing of components to instruct on mixing, application and inspection procedures and to inspect the finish of the prepared surfaces prior to application of the sealant.
- B. The manufacturer's field representative shall make at least one additional visit to the site as the work progresses and shall report on each visit to the Engineer and the Engineer, advising as to whether the application is being performed in accordance with this Section and the manufacturer's printed instructions.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in original, unopened containers displaying the manufacturer's label showing manufacturer name, product identification and batch number.
- B. Store products as recommended by the manufacturer.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials used together in a given joint shall be compatible with one another. Coordinate selection of suppliers and products to provide compatibility. Do not use asphaltic bond breakers or asphaltic joint fillers in joints receiving sealant.

2.2 MATERIALS

A. Premolded Joint Filler

- 1. Premolded Joint Filler - Structures: Self-expanding cork premolded joint filler conforming to ASTM D1752, Type III. Provide 1-in thickness unless otherwise indicated on the Drawings.

B. Bond Breaker

- 1. Bond Breaker Tape: Adhesive-backed glazed butyl or polyethylene tape which will adhere to the premolded joint filler or concrete surface. Provide tape the same width as the joint.
- 2. Bond breaker for concrete other than where tape is indicated on the Drawings or specified: Either bond breaker tape or a non-staining type bond prevention coating such as Crete- Lease Bond Breaker for Tilt-Up by Cresset Chemical Co.; Sure-Lift J-6 WB by Dayton Superior; Silcoseal Select by Nox-Crete, or equal.

C. Preformed Expansion Joint Material

- 1. A non-extrudable watertight strip material used to fill expansion joints between structures. The material shall be capable of being compressed at least 40 percent for 70 hours at 68 degrees F and subsequently recovering at least 20 percent of its original thickness in the first 1/2 hour after unloading. Preformed expansion joint material shall be Phyzite 380 by Chase Construction Products, Albany, NY or equal.

D. Sealant

- 1. Provide sealant for joints in horizontal surfaces conforming to ASTM C920, Type S or M, Grade P or NS, Class 25. Provide sealant for joints in sloping and vertical surfaces conforming to ASTM C920, Type S or M, Grade NS, Class 25. Provide Use T sealant in pedestrian and vehicular traffic areas and Use NT in non-traffic areas.

PART 3 EXECUTION

3.1 INSTALLATION

A. Construction Joints

1. Make construction joints only at locations shown on the Drawings or as approved by the Engineer. Any additional or relocation of construction joints proposed by the Contractor must be submitted to the Engineer for written approval. Do not eliminate construction joints.
2. Locate additional or relocated joints where they least impair strength of the member. In general, locate joints within the middle third of spans of slabs, beams and girders. However, if a beam intersects a girder at the joint, offset the joint a distance equal to twice the width of the member being connected. Locate joints in walls and columns at the underside of floors, slabs, beams or girders and at tops of footings or floor slabs. Do not locate joints between beams, girders, column capitals, or drop panels and the slabs above them. Do not locate joints between brackets or haunches and walls or columns supporting them.
3. Unless indicated otherwise, provide joints perpendicular to main reinforcement. Continue reinforcing steel through the joint as indicated on the Drawings.
4. At all construction joints and at concrete joints indicated on the Drawings to be "roughened", uniformly roughen the surface of the concrete to a full amplitude (distance between high and low points and side to side) of 1/4-in with chipping tools to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by waterblasting or sandblasting and prepare for bonding. At least two hours before and again shortly before the new concrete is deposited, saturate the joints with water. After glistening water disappears, coat joints with neat cement slurry mixed to the consistency of very heavy paste. The surfaces shall receive a coating at least 1/8-in thick, scrubbed-in by means of stiff bristle brushes. Deposit new concrete before the neat cement dries.
5. Do not use keyways in construction joints unless specifically shown on the Drawings or approved by the Engineer.

B. Sealant

1. Install sealants in clean dry recesses free of frost, oil, grease, form release agent, loose material, laitance, dirt, dust and other materials which will impair bond at the locations shown on the Drawings. Apply sealant conforming to the manufacturer's recommendations including concrete cure, temperature, moisture, mixing, primer, primer cure time, joint and recess preparation, tooling, and curing. Apply masking tape to each side of the joint prior to the installation of the sealant and remove afterwards along with any spillage to leave a sealant installation with neat straight edges.

CONCRETE JOINTS AND JOINT ACCESSORIES

C. Preformed Expansion Joint Material

1. Install preformed expansion joint material in conformance with the manufacturer's recommendations; including surface preparation, adhesive installation, heat welding and set time.

END OF SECTION

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SECTION 03301
CONCRETE AND REINFORCING
STEEL

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install all concrete work complete as shown on the Drawings and as specified herein.
- B. Furnish, as required to establish concrete mixes, all sampling and laboratory testing of products and materials performed by an independent testing laboratory engaged by and at the expense of the Engineer. Provide field sampling, testing, inspection and related laboratory tests.

1.2 RELATED WORK

- A. Grout is included in Section 03600.
- B. Electrical Raceway Encasement is in Section 03800.
- C. Moisture protection is included in Division 7.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings and product data for:
 - 1. Placing drawings and bar bending details in conformity with the recommendations of ACI 315.
 - 2. Technical data on all materials and components.
 - 3. Material Safety Data Sheets (MSDS) for all concrete admixtures and curing agents.
- B. Test Reports
 - 1. Sieve analysis, mechanical properties and deleterious substance content for fine and coarse aggregates.
 - 2. Cement and fly ash: Conformance to ASTM standards, including chemical analysis and physical tests. Concrete mixes: For each formulation of concrete proposed for use, submit constituent quantities per cubic yard, water cementitious ratio, concrete slump, type and manufacturer of cement. Provide

either a. or b., below, for each mix proposed.

- a. Standard deviation data for concrete mixes based on statistical records.
- b. Water cementitious ratio curve for concrete mixes based on laboratory tests. Provide average cylinder strength test results at 7 and 28 days for laboratory concrete mix designs. Provide results of 14 day tests if available.

C. Certifications

1. Certify that admixtures used in the same concrete mix are compatible with each other and the aggregates.
2. Certificate of conformance for concrete production facilities from NRMCA.
3. Certify that the Engineer is not associated with the independent testing laboratory proposed for use by the Engineer nor does the Engineer or officers of the Engineer's organization have a beneficial interest in the laboratory.

D. Qualifications

1. Independent Testing Laboratory
 - a. Name and address
 - b. Names and positions of principal officers and the name, position, and qualifications of the responsible registered professional engineer in charge.
 - c. Listing of technical services to be provided. Indicate external technical services to be provided by other organizations.
 - d. Names and qualifications of the supervising laboratory technicians.
 - e. Statement of conformance provided by evaluation authority defined in ASTM C1077. Provide report prepared by evaluation authority when requested by the Engineer.
 - f. Submit as required above for other organizations that will provide external technical services.

1.4 REFERENCE STANDARDS

A. ASTM International

1. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
2. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
3. ASTM C33 - Standard Specification for Concrete Aggregates.
4. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical

Concrete Specimens.

5. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
 6. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete
 7. ASTM C150 - Standard Specification for Portland Cement
 8. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 9. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 10. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 11. ASTM C311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete.
 12. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
 13. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Portland Cement Concrete.
 14. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
 15. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
- B. American Concrete Institute (ACI).
1. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
 2. ACI 232.2R - Use of Fly Ash in Concrete
 3. ACI 301 - Specification for Structural Concrete.
 4. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 5. ACI 305R - Hot Weather Concreting.
 6. ACI 306R - Cold Weather Concreting.
 7. ACI 315 - Details and Detailing of Concrete Reinforcement.

- 8. ACI 318 - Building Code Requirements for Structural Concrete.
- C. Concrete Reinforcing Steel Institute (CRSI)
 - 1. MSP - Manual of Standard Practice
- D. National Ready Mixed Concrete Association (NRMCA)
 - 1. Quality Control Manual, Section 3- Certification of Ready Mixed Concrete Production Facilities
- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. Comply with ACI 318, and other stated specifications, codes and standards. Apply the most stringent requirements of stated specifications, codes, standards, and this Section when conflicts exist.
- B. If, during the progress of the work, it is impossible to secure concrete of the specified workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the specified properties. Make all changes so ordered at the no additional cost to the Owner.
- C. Develop concrete mixes and their testing by an independent testing laboratory engaged by and at the expense of the Engineer. Methods of testing shall comply with the latest applicable ASTM methods.
- D. Independent testing laboratory shall meet the requirements of ASTM E329 and ASTM C1077 and be acceptable to the Engineer. Laboratories affiliated with the Engineer or in which the Engineer or officers of the Engineer's organization have a beneficial interest are not acceptable.
- E. Provide all field testing and inspection services and related laboratory tests. Methods of testing shall comply with the latest applicable ASTM methods. The following items shall be tested to verify conformity with this Section.
 - 1. Concrete placements - compressive strength (cylinders), compressive strength (cores), temperature, slump, and air content.
 - 2. Other materials that may require field testing.
- F. Provide laboratory tests of samples of constituents and of concrete as-placed. All materials incorporated in the work shall conform to accepted samples.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Ship and store reinforcing steel with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same designations as those shown on the submitted placement drawings. Provide reinforcing steel free from mill scale, loose rust, mud, dirt, grease, oil, ice or other foreign matter. Store off the ground, protect from moisture and keep free from rust, mud, dirt, grease, oil, ice or other injurious contaminants.
- B. Store products in conformity with the manufacturer's recommendations.
- C. Store or stockpile sand, aggregates, cement and fly ash in conformity with ACI 301.

PART 2 PRODUCTS

2.1 GENERAL

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance and manufacturer's service.
- C. Materials shall comply with this Section and any applicable State or local requirements.

2.2 MATERIALS

- A. Cement: Domestic portland cement conforming to ASTM C150. Do not use air entraining cements. The allowable types of cement for each class of concrete are shown in Table 1.
- B. Fine Aggregate: Washed inert natural sand conforming to ASTM C33.
- C. Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to ASTM C33, size 57. Limits of deleterious substances and physical property requirements as listed in ASTM C33, Table 4 for severe weathering regions.
- D. Water: Potable water free of oil, acid, alkali, salts, chlorides, (except those attributable to drinking water) organic matter, or other deleterious substances.
- E. Admixtures: Use admixtures free of chlorides and alkalis (except for those attributable to drinking water). The admixtures shall be from the same manufacturer when it is required to use more than one admixture in the same

concrete mix. Use admixtures compatible with the concrete mix including other admixtures.

1. Air Entraining Admixture: Conforming to ASTM C260. Proportion and mix in accordance with manufacturer's recommendations.
 2. Water Reducing Admixture: Conforming to ASTM C494, Type A. Proportion and mix in accordance with manufacturer's recommendations.
 3. Do not use admixtures causing retarded or accelerated setting of concrete without written approval from the Engineer. Use retarding or accelerating water reducing admixtures when so approved.
- F. Fly Ash: Class F fly ash complying with ASTM C618, including the requirements of Table 1 but with the Loss of Ignition (LOI) limited to 3 percent maximum and the optional physical requirements of Table 3.
- G. Deformed Concrete Reinforcing Bars: ASTM A615, Grade 60 deformed bars.
- H. Reinforcing Steel Accessories
1. Plastic Protected Wire Bar Supports: CRSI Bar Supports, Class 1 - Maximum Protection.
 2. Stainless Steel Protected Wire Bar Supports: CRSI Bar Supports, Class 2 - Moderate Protection with legs made wholly from stainless steel wire.
 3. Precast Concrete Bar Supports: CRSI Bar Supports, Precast Concrete Bar Supports. Precast concrete blocks that have equal or greater strength than the surrounding concrete.
- I. Tie Wires for reinforcement: 16 gauge or heavier black annealed wire.

2.3 MIXES

- A. An independent testing laboratory engaged by and at the expense of the Engineer shall establish concrete mixes and perform all sampling and laboratory testing of products and materials.
- B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce placeable, durable concrete conforming to these Specifications. Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing free water to collect on the surface.
- C. Base concrete mixes on standard deviation data of prior mixes with essentially

the same proportions of the same constituents or, if not available, develop concrete mixes by laboratory tests using the materials proposed for the work.

- D. Compression Tests: Provide testing of the proposed concrete mix or mixes to demonstrate compliance with the compression strength requirements in conformity with the provisions of ACI 318.
- E. Entrained air, as measured by ASTM C231, shall be as shown in Table 1.
- F. Slump of the concrete as measured by ASTM C143, shall be as shown in Table 1.
- G. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of the other admixture(s).

Table 1: Strength ASTM

Class	Design	Cement	Cementitious	W/C	WR	Fly Ash	Slump Range
(6)	(1)	C150	(2)	(3)	(4)	(5)	Inches
A	2500	Type II	440	0.62 max	Yes	Yes	1-4
D	4000	Type II	560	0.44 max	Yes	Yes	3-5

TABLE 1 NOTES:

- (1) Minimum compressive strength in psi at 28 days
- (2) Minimum cementitious content in lbs per cubic yard (where fly ash is used, cementitious content is defined as cement content plus fly ash content)
- (3) W/C is Maximum Water Cementitious ratio by weight
- (4) WR is water reducing admixture
- (5) Fly ash content in the range of 20-25 percent of the total cement content plus fly ash content, by weight
- (6) All concrete classes shall have 3.5 to 5 percent air entrainment.

2.4 MEASURING, BATCHING, MIXING AND TRANSPORTING CONCRETE

- A. Measure, batch, mix and transport concrete in conformance with ASTM C94 and the requirements herein or as otherwise approved in writing by the Engineer.
- B. Ready-mixed concrete, whether produced by a concrete supplier or the Engineer shall conform to the requirements above. Do not hand mix.
- C. Dispense admixtures into the batch in conformity with the recommendations of

the admixture manufacturer.

- D. Mix concrete until there is uniform distribution of the materials and discharge completely before the mixer is recharged. The mixer shall be rotated at a speed recommended by the mixer manufacturer and mixing shall be continued for at least 1-1/2 minutes after all the materials are in the mixer. Place concrete within 1-1/2 hours of the time at which water was first added, otherwise it will be rejected. Concrete which has been remixed or retempered, or to which an excess amount of water has been added, will also be rejected.

2.5 FORMS

- A. Provide forms free from roughness and imperfections, watertight and braced and tied to prevent motion when concrete is placed. Wooden spreaders will not be allowed in the concrete.
- B. Wire ties will not be allowed. Metal ties or anchorages which are necessary within the forms shall be so constructed that the metal work can be removed for a depth of at least 1-1/2-in from the concrete surface without damage by spalling. Clean forms before using and treat with form release agent, or other approved material.
- C. All exposed edges of the finished concrete shall be chamfered 3/4-in.

PART 3 EXECUTION

3.1 CONSTRUCTION JOINTS

- A. Locate construction joints where indicated or where approved by the Engineer.
- B. Continue all reinforcing steel through the joint.
- C. At construction joints and at concrete joints indicated to be "roughened", uniformly roughen the surface of the concrete to a full amplitude (distance between high and low points and side to side) of 1/4-in with chipping tools to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by waterblasting or sandblasting and prepare for bonding. At least two hours before and again shortly before the new concrete is deposited, saturate the joints with water. After glistening water disappears, coat joints with neat cement slurry mixed to the consistency of very heavy paste. The surfaces shall receive a coating at least 1/8-in thick, scrubbed-in by means of stiff bristle brushes. Deposit new concrete before the neat cement dries.

3.2 REINFORCING STEEL

- A. Fabricate reinforcing steel accurately to the dimensions shown. Bend bars around a revolving collar having a diameter of not less than that recommended in ACI 318.

All bars shall be bent cold.

- B. Provide tension lap splices in compliance with ACI 318. Stagger splices in adjacent bars where possible. Provide Class B tension lap splices at all locations unless otherwise indicated.
- C. Use precast concrete blocks where the reinforcing steel is to be supported over soil. Use plastic protected bar supports or steel supports with plastic tips where the reinforcing steel is to be supported on forms for a concrete surface that will be exposed to weather, high humidity, or liquid. Use stainless steel supports or plastic tipped metal supports in all other locations unless otherwise noted on the Drawings or specified herein.
- D. Before placing in position, clean reinforcement of loose mill scale and rust, mud, dirt, grease, oil and other coatings, including ice that reduce or destroy bond. When there is a delay in depositing concrete after the reinforcement is in place, bars shall be reinspected and cleaned again when necessary.
- E. Coat reinforcement which is to be exposed for a considerable length of time after being placed with a heavy coat of cement grout.
- F. Do not cover any reinforcing steel with concrete until the amount and position of the reinforcement has been checked and the Engineer has given permission to proceed.

3.3 INSPECTION AND COORDINATION

- A. Batching, mixing, transporting, placing and curing of concrete shall be subject to the inspection of the Engineer at all times. Advise the Engineer of readiness to proceed at least six working hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing and the alignment, cleanliness and tightness of formwork. Do not place concrete without the inspection and acceptance of the Engineer.

3.4 CONCRETE APPEARANCE

- A. Remix concrete showing either poor cohesion or poor coating of the coarse aggregate with paste. If this does not correct the condition, the concrete shall be rejected.
- B. Provide concrete having a homogeneous structure which, when hardened, will have the specified strength, durability and appearance. Provide mixtures and workmanship such that concrete surfaces, when exposed, will require no finishing except as specified herein.

3.5 PLACING AND COMPACTING

- A. Do not place concrete until forms, condition of subgrade and method of placement have been approved by the Engineer. Remove all debris, foreign matter, dirt, ice and standing water from the forms before depositing concrete. Do not place concrete on frozen subgrade, snow or ice. The contact surface between concrete previously placed and new concrete shall be cleaned and brushed with cement paste. Concrete, except as indicated on the Drawings, shall not be placed in water or submerged within 24 hours after placing, nor shall running water be permitted to flow over the surface of fresh concrete within 4 days after its placing.
- B. Deposit concrete as near its final position as possible to prevent segregation due to rehandling or flowing. Pumping of concrete will be permitted when an approved design mix and aggregate sizes suitable for pumping are used. Do not deposit concrete which has partially hardened or which has been contaminated by foreign materials. If the section cannot be placed continuously, place construction joints as specified or as approved. Place concrete for walls using tremie tubes in 12-in to 24-in lifts, keeping the surface horizontal. Do not drop concrete more than 4-ft.
- C. Use high frequency mechanical vibrators to obtain proper consolidation of the concrete. Do not use vibrators to move or transport concrete in the forms. Do not over-vibrate so as to segregate. Continue vibration until the frequency returns to normal, trapped air ceases to rise and the surface appears liquefied, flattened and glistening. Use spades, rods or forks so that concrete is completely worked around reinforcement, embedded items, pipe stubs, and openings and into corners of forms.

3.6 CURING AND PROTECTION

- A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.
- B. Cure all concrete in conformance with ACI 301. Concrete that is to be used for the containment of water shall be water cured. Water curing shall be by ponding, by continuous sprinkling or by covering with continuously saturated burlap. Other concrete shall be cured by either water curing, sheet material curing or liquid membrane curing compound except that liquid membrane curing compound shall not be used on any concrete surface where additional concrete is to be placed or where the concrete surface is to be coated or painted.
- C. Protect finished surfaces and slabs from the direct rays of the sun to prevent checking and crazing.
- D. During cold weather concrete shall be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 306R. Do not use salt, manure or other chemicals for cold weather protection.

- E. During hot weather concrete shall be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 305R. The temperature of the concrete shall be such that it will cause no difficulties from loss of slump, flash set or cold joints. Immediately cover plastic concrete with sheet curing material during hotweather.

3.7 FIELD TESTS

- A. Take field control cylinder specimens during the progress of the work, in compliance with ASTM C31. The number of sets of concrete test cylinders taken of each class of concrete placed each day will not be less than one set per day, nor less than one set for each 150 cu yds of concrete nor less than one set for each 5,000 sq ft of surface area for slabs or walls. Specimens will be formed in 6-in diameter by 12-in long non-absorbent cylindrical molds.
 - 1. A "set" of test cylinders shall consist of four cylinders: one to be tested at seven days and two to be tested and their strengths averaged at 28 days. The fourth may be used for a special test at 3 days or to verify strength after 28 days if 28 day test results are low.
 - 2. When the average 28 day compressive strength of the cylinders in any set falls below the required compressive strength or below proportional minimum seven-day strengths (where proper relation between seven and 28 day strengths have been established by tests), change proportions, cementitious content, or temperature conditions to achieve the required strengths at no additional cost to the Owner.
- B. Furnish material and labor required for the purpose of taking concrete cylinder samples. All shipping of specimens will be paid for by the Contractor.
- C. Test slump immediately prior to placing the concrete. Test shall be made in accordance with ASTM C143. When concrete is pumped, slump will be determined at point of truck discharge. If the slump is outside the specified range, the concrete will be rejected.
- D. Test for air content shall be conducted on a fresh concrete sample. Air content for concrete made of ordinary aggregates having low absorption shall be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173. If aggregates with high absorptions are used, the latter test method shall be used. When concrete is pumped, air content will be determined at point of placement.

3.8 STRIPPING AND FINISHING CONCRETE

- A. Do not remove forms before the concrete has attained a strength of at least 30 percent of the specified design strength nor before reaching approximately "100

day-degrees" of moist curing (whichever is the longer). Degree-days are defined as the total number of 24 hour periods multiplied by the weighted average daily air temperature at the surface of the concrete (e.g., 7 days at an average 50 degrees F = 350 degree-days).

- B. Exercise care to prevent damaging edges or obliterating the lines of chamfers, rustications or corners when removing the forms or doing any other work adjacent thereto.
- C. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to the satisfaction of the Engineer.
- D. Immediately after removal of forms remove tie cones and metal portions of ties. Fill holes promptly upon stripping as follows: Moisten the hole with water, followed by a 1/16-in brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1 to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer the grout into the hole until dense, and an excess of paste appears on the surface in the form of a spider web. Trowel smooth with heavy pressure. Avoid burnishing.
- E. Defective concrete and honeycombed areas: Chip down square and at least 1-in deep to sound concrete with hand chisels or pneumatic chipping hammers. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded in the parent concrete. If honeycomb exists around reinforcement, chip to provide a clear space at least 3/8-in wide all around the steel. For areas less than 1-1/2-in deep, the patch may be made in the same manner as described above for filling form tie holes, care being exercised to use adequately dry (non-trowelable) mixtures and to avoid sagging. Thicker repairs will require build-up in successive 1-1/2-in layers on successive days, each layer being applied (with slurry, etc.) as described above.
- F. Concrete to receive dampproofing and concrete not exposed in the finished work shall have off- form finish with fins and other projections removed and tie cones and defects filled as specified above.
- G. Screed top surface of slabs to the established grades and to a true plane with a tolerance of 1/8- in when checked with a 10-ft straightedge. Finish the surface to give a smooth, hard, even surface free from high or low spots or other defects. Concrete subject to pedestrian traffic shall be given a broom finish. Failure to meet these conditions shall be cause for removal, grinding, or other correction as directed by the Engineer.

3.9 SCHEDULE OF FINISHES

- A. Finishes to the base concrete for the following conditions shall be as scheduled below and as further specified herein:

CONCRETE AND REINFORCING STEEL

1. Exposed exterior concrete excluding slabs and walking surfaces - Rubbed finish.
2. Concrete for horizontal areas - Broomed finish, non-slip.
3. Tops of curbs and pads - Steel trowel finish.
4. Concrete not exposed in the finished work and not scheduled to receive an additional applied finish or material - Off-form finish at vertical surfaces, consolidate and screed to grade at horizontal surfaces.

3.10 SCHEDULE

- A. The following (Table 2) are the general applications for the various concrete design strengths to be used:

Table 2

Clas	Design Strength	Descriptio
A	2,500	Concrete fill and electrical raceway encasement
D	4,000	Slabs on grade, curbs, grade beams and all other structural concrete

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SECTION 03600
GROUT

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install grout complete as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Concrete joints and joint accessories are included in Section 03250.
- B. Cast-in-place concrete and concrete reinforcing are included in Section 03301.
- C. Miscellaneous metals are included in Section 05500.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of surface preparation, mixing and installation for:
 - 1. Commercially manufactured non-shrink cementitious grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to the specified ASTM standards, and Material Safety Data Sheet.
- B. Qualifications
 - 1. Submit documentation that grout manufacturers have a minimum of 10 years' experience in the production and use of the grouts proposed.

1.4 REFERENCE STANDARDS

- A. ASTM International
 - 1. ASTM C33 - Standard Specification for Concrete Aggregates
 - 2. ASTM C150 - Standard Specification for Portland Cement
 - 3. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic Surfacing and Polymer Concretes

4. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
5. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non- shrink)
6. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

A. Qualifications

1. Grout manufacturers shall have a minimum of 10 years' experience in the production and use of the type of grout proposed.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers and printed instructions.
- B. Store materials in full compliance with the manufacturer's recommendations. Limit total storage time from date of manufacture to date of installation to six months or the manufacturer's recommended storage time, whichever is less.
- C. Remove immediately from the site material which becomes damp, contains lumps, or is hardened and replace with acceptable material at no additional cost to the Owner.
- D. Deliver non-shrink cementitious grout as a pre-portioned blend in prepackaged mixes requiring only the addition of water.

1.7 DEFINITIONS

- A. Non-shrink Grout: A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state and bonds to a clean base plate.

PART 2 PRODUCTS

2.1 GENERAL

- A. The use of a manufacturer's name and product or catalog number is for the purpose of establishing the standard of quality desired.
- B. Like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

2.2 MATERIALS

- A. Non-shrink Cementitious Grout
 - 1. Non-shrink cementitious grouts: Conform to ASTM C1107. Grouts shall be portland cement based, contain a pre-proportioned blend of selected aggregates and shrinkage compensating agents and require only the addition of water. Non-shrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827.
 - a. General purpose non-shrink cementitious grout: Conform to the standards stated above. SikaGrout 212 by Sika Corp.; Set Grout by BASF Building Systems; NS Grout by The Euclid Chemical Co.; Five Star Grout by Five Star Products, Inc., or equal.
 - b. Flowable (Precision) non-shrink cementitious grout: Conform to the standards stated above. Masterflow 928 by BASF Building Systems; Hi-Flow Grout by The Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Five Star Grout by Five Star Products, Inc., or equal.
- B. Water
 - 1. Potable water free of oil, acid, alkali, salts, chlorides (except those attributable to drinking water), organic matter, or other deleterious substances.

PART 3 EXECUTION

3.1 PREPARATION

- A. Place grout where indicated or specified over cured concrete which has attained its specified design strength unless otherwise approved by the Engineer.
- B. Concrete surfaces to receive grout shall be clean and sound; free of ice, frost, dirt, dust, grease, oil, form release agent, laitance and paints and free of all loose material or foreign matter which may affect the bond or performance of the grout.
- C. Roughen concrete surfaces by chipping, sandblasting, or other dry mechanical means to bond the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.

1. Air compressors used to clean surfaces in contact with grout shall be the oilless type or equipped with an oil trap in the airline to prevent oil from being blown onto the surface.
- D. Remove all loose rust, oil or other deleterious substances which may affect the bond or performance of the grout from metal embedments or bottom of baseplates prior to the installation of the grout.
- E. Wash concrete surfaces clean and then keep moist for at least 24 hours prior to the placement of non-shrink cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, or flooding the surface. Upon completion of the 24 hour period, remove visible water from the surface prior to grouting.
- F. Provide forms for grout. Line or coat forms with release agents recommended by the grout manufacturer. Provide forms anchored in place and shored to resist the forces imposed by the grout and its placement.
 1. Forms for all grout other than concrete grout shall be designed to allow the formation of a hydraulic head and shall have chamfer strips built into forms.
- G. Level and align the structural or equipment bearing plates in accordance with the structural requirements or the recommendations of the equipment manufacturer, as applicable.
- H. Support equipment during alignment and installation of grout by shims, wedges, blocks or other approved means. The shims, wedges and blocking devices shall be prevented from bonding to the grout by bond breaking coatings and removed after grouting unless otherwise approved by the Engineer. Grout voids created by the removal of shims, wedges and blocks.

3.2 INSTALLATION - GENERAL

- A. Mix, apply and cure products in strict compliance with the manufacturer's recommendations and these specifications.
- B. Provide staffing and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.
- C. Maintain temperatures of the base plate, supporting concrete, and grout between 40 and 90 degrees F during grouting and for at least 24 hours after placement, until grout compressive strength reaches 1000 psi or as recommended by the grout manufacturer, whichever is longer. Do not allow differential heating or cooling of baseplates and grout during the curing period.
- D. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperatures and/or the temperature of the

materials in contact with the grout are outside of the 40 to 90 degrees F range.

- E. Install grout to preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or partial contraction joint.
- F. Reflect all existing underlying expansion, partial contraction and construction joints through the grout.

3.3 INSTALLATION - NON-SHRINK CEMENTITIOUS GROUTS

- A. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel or admixtures without prior approval by the Engineer.
- B. Do not mix by hand. Mix in a mortar mixer with moving blades. Pre-wet the mixer and empty excess water. Add pre-measured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.
- C. Placements greater than 3-in in depth shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.
- D. Provide forms as specified in Paragraph 3.01F. Place grout into the designated areas and prevent segregation and entrapment of air. Do not vibrate grout to release air or to consolidate the material. Fill all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes and vent holes as necessary.
- E. Place grout rapidly and continuously to avoid cold joints. Do not place grout in layers. Do not add additional water to the mix (retemper) after initial stiffening.
- F. Just before the grout reaches its final set, cut back the grout to the substrate at a 45 degree angle from the lower edge of bearing plate unless otherwise ordered and approved by the Engineer. Finish this surface with a wood float or brush finish.
- G. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement, until grout compressive strength reaches 1000 psi or as recommended by the manufacturer, whichever is longer. Saturate the grout surface by use of saturated burlap bags, soaker hoses or ponding. Provide sunshades. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

H. SCHEDULE

- I. The following list indicates where the particular types of grout are to be used:
1. General purpose non-shrink cementitious grout: Use at all locations where non-shrink grout is indicated on the Drawings, except for base plates greater in area than 3-ft wide by 3-ft long.
 2. Flowable (precision) non-shrink cementitious grout: Use under all base plates greater in area than 3-ft wide by 3-ft long. Use at all locations indicated on the Drawings to receive flowable (precision) non-shrink grout. Flowable (precision), non-shrink, cementitious grout may be substituted for general purpose non-shrink cementitious grout.

END OF SECTION

CONCRETE ELECTRICAL RACEWAY ENCASEMENT

SECTION 03800 CONCRETE ELECTRICAL RACEWAY ENCASEMENT

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install concrete encasement around underground electrical raceways as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Excavation, backfilling, fill and grading are included in Division 2.
- B. Concrete joints and joint accessories are included in Section 03250.
- C. Cast in place concrete and concrete reinforcing are included in Section 03301.
- D. Furnishing and installing electrical conduit is included in Division 16.
- E. Furnishing and placing polyethylene warning tape in the backfill above encasement is included in Division 16.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cement, lime, aggregate and all other concrete components shall be as specified in Section 03301 except that aggregate size shall not exceed 3/8-in. Concrete shall have a minimum compressive strength at 28 days of 2500 psi.

PART 3 EXECUTION

3.1 GENERAL

- A. Concrete shall conform to the requirements Section 03301 and as specified herein.
- B. Provide not less than 4-in of concrete between the outside of a raceway and the earth. Provide not less than 2-in of concrete between adjacent raceways. All raceway concrete placements shall be continuous between manholes or handholes and between manholes or handholes and structures.
- C. Where raceways pass through concrete walls, concrete encasement shall be extended through the finished flush with inside surfaces.

CONCRETE ELECTRICAL RACEWAY ENCASEMENT

- D. Encasements shall be reinforced as and where indicated on the Drawings.
- E. Encasements shall be laid in trenches on mats of screened gravel not less than 6-in thick.
- F. The minimum cover for raceway banks shall be 24-in.

END OF SECTION

SECTION 05500
MISCELLANEOUS METAL

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install all miscellaneous metal complete as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Concrete joint accessories are included in Section 03250.
- B. Masonry reinforcement, ties and accessories are included in Division 4.
- C. Structural steel, steel roof deck are included in Division 5.
- D. Pre-Engineered Cold-Formed Steel Roof Trusses are included in Section 05410.
- E. Aluminum doors and frames are included in Section 08111.
- F. Painting is included in Division 9.
- G. Pipe hangers and sleeves are included in Division 15.
- H. Equipment anchor bolts are included in the respective Sections of Divisions 11 and 15.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:
 - 1. Shop drawings, showing sizes of members, method of assembly, anchorage and connection to other members.
- B. Design Data
 - 1. Submit calculations or test data demonstrating that the railings will resist the loads specified in the Florida Building Code at the post spacing provided. Calculations shall be stamped by a professional engineer registered in Florida.
- C. Certificate

Submit certification that the railing system is in compliance with OSHA requirements and the Florida Building Code.

1.4 REFERENCE STANDARDS

A. Aluminum

Association (AA) 1. AA

M31C22A41

- a. M31: Mechanical Finish, Fine Satin
- b. C22: Finish, Medium Matte
- c. A41: Clear Anodic Coating, Class I

B. ASTM International

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A48 - Standard Specification for Gray Iron Castings.
3. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
4. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
5. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
6. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
7. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Plate, Sheet, and Strip Pressure Vessels.
8. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
9. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 Psi Tensile Strength.
10. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
11. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

12. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
13. ASTM A536 - Standard Specification for Ductile Iron Castings.
14. ASTM A570 - Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.
15. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
16. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
17. ASTM B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

C. American Institute of Steel Construction (AISC)

1. Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design.

D. American Welding Society (AWS)

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.2 - Structural Welding Code - Aluminum.
3. AWS D1.6 - Structural Welding Code - Stainless Steel

E. Federal Specifications

1. FS-FF-B-575C - Bolts, Hexagonal and Square

F. Occupational Safety and Health Administration (OSHA)

G. Florida Building Code 5th Edition

H. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. The work of this Section shall be completely coordinated with the work of other Sections. Verify, at the site, both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.

MISCELLANEOUS METAL

- | | | |
|-----|---|--|
| 2. | Other shapes; plates; rods and bars: | ASTM A36 |
| 3. | Structural Steel Tubing | ASTM A500, Grade B |
| 4. | Welded and Seamless Steel Pipe
S, | ASTM A501 or ASTM A53, Type E or
Grade B Schedule 40. Use
standard malleable iron
fittings, galvanized for
exterior work |
| 5. | Steel Sheets | ASTM A1008 |
| 6. | Gray Iron Castings | ASTM A48, Class 35 |
| 7. | Ductile Iron Castings | ASTM A536, Grade 65-45-12 |
| 8. | Aluminum Extruded Pipe | ASTM B429, Alloy 6063 T6
and Alloy 6061 T6 as
indicated |
| 9. | Aluminum Extruded Shapes | ASTM B221, Alloy 6061 T6 |
| 10. | Aluminum Sheet and Plate | ASTM B209, Alloy 6061 T6 |
| 11. | Stainless Steel Plates, Sheets, and Structural Shapes | |
| a. | Exterior, Submerged or Industrial Use
welded) | ASTM A240, Type 316 (Type 316L for |
| b. | Interior and Architectural Use | ASTM A240, Type 304 |
| 12. | Stainless Steel Bolts, Nuts, and Washers | ASTM A276, Type 316 |
| 13. | Carbon Steel Bolts and Studs
galvanized | ASTM A307, Grade A (hot dip
nuts and washers where noted) |
| 14. | High Strength Steel Bolts, Nuts and washers
galvanized per | ASTM A325 (mechanically
ASTM B695, Class 50, where noted) |
| a. | Elevated Temperature Exposure | Type I |
| b. | General Application | Type I or Type II |
| 15. | Galvanizing
minimum Ni | ASTM A123, Zn w/0.05 percent |
| 16. | Galvanizing, hardware
minimum Ni | ASTM A153, Zn w/0.05 percent |

- | | | |
|-----|---|-------------------------------|
| 17. | Galvanizing, anchor bolts
minimum Ni | ASTM F2329, Zn w/0.05 percent |
| 18. | Welding electrodes, steel | AWS A5.1 E70xx |

2.3 ANCHORS, BOLTS AND FASTENING DEVICES

- A. Unless otherwise noted, anchor bolts shall be ASTM F1554, Grade 36. Provide standard headed bolts with heavy hex nuts and Grade A washers. Where galvanized anchor bolts are shown or specified, provide standard headed bolts with heavy hex nuts and Grade A washers, all galvanized in accordance with ASTM F2329.
- B. Unless otherwise noted, bolts for the connection of carbon steel or iron shall be steel machine bolts; bolts for the connection of galvanized steel or iron shall be galvanized steel or stainless steel machine bolts; and bolts for the connection of aluminum or stainless steel shall be stainless steel machine bolts.
- C. Unless otherwise noted, expansion anchors shall be zinc plated carbon steel wedge type anchors complete with nuts and washers. Type 316 stainless steel wedge type anchors shall be used where they will be submerged or exposed to the weather or where stainless steel wedge type anchors are shown or specified. When the length or embedment of the bolt is not noted on the Drawings, provide length sufficient to place the wedge and expansion cone portion of the bolt at least 1-in behind the concrete reinforcing steel. Expansion anchors shall be Hilti, Kwik-Bolt III; Simpson Strong-Tie Wedge-All; Powers Power-Stud or equal.
- D. Compound masonry expansion anchors shall be lead expansion sleeve type anchors complete with nuts and washers. Anchors shall be precision die-cast zinc alloy with a minimum of two lead alloy expansion sleeves. When the length or embedment of the bolt is not noted on the Drawings, provide length sufficient to place the wedge and expansion sleeve portion of the bolt at least 1-in behind the concrete reinforcing steel. Expansion anchors shall be Star Expansion Industries, Star Slug-in or equal.
- E. Adhesive anchor system, for fastening to solid concrete substrate, shall be a system manufactured for the installation of post installed studs including anchoring hardware and chemical dispenser. Injection adhesive shall be a two-component epoxy system including a hardener and a resin, furnished in pre-measured side-by-side cartridges which keep the two components separate. Side-by-side cartridges shall be designed to accept a static mixing nozzle which thoroughly blends the two components and allows injection directly into the drilled hole. Provide zinc plated carbon steel or Type 316 stainless steel stud assemblies as indicated on the Drawings consisting of an all-thread anchor rod with nut and washer. Adhesive anchor system shall be Hilti Hit-RE 500 V3; Simpson Strong Tie SET-XP; ITW Ramset Red Head

Epcon G5; or equal. Unless otherwise noted, anchorage designs shown on the Drawings are based on Hilti Hit-RE 500 V3.

- F. Adhesive anchors, for fastening to hollow concrete block or brick, or hollow-core precast concrete planks shall be a three-part stud, screen tube and chemical dispenser anchoring system. Adhesive cartridges shall contain pre-measured amounts of resin and hardener which are mixed and deposited in a screen tube by a dispenser. Provide zinc plated carbon steel or Type 316 stainless steel stud assemblies as indicated on the Drawings consisting of an all-thread anchor rod with nut and washer. Anchors shall be Hilti HIT HY-70 System; Powers Pure 110+; Simpson ET-HP, or equal.
- G. Machine bolts and nuts shall conform to Federal Specification FF-B-575C. Bolts and nuts shall be hexagon type. Bolts, nuts, screws, washers and related appurtenances shall be Type 316 stainless steel.
- H. Toggle bolts shall be Hilti, Toggler Bolt or equal.

2.4 MISCELLANEOUS ALUMINUM

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Welding shall be on the unexposed side as much as possible in order to prevent pitting or discoloration of the aluminum exposed surface. Provide holes for temporary field connections and for attachment of the work of other trades.

2.5 MISCELLANEOUS STEEL

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories shall be of sufficient strength to safely withstand the

stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Provide holes for temporary field connections and for attachment of the work of other trades.

- C. Miscellaneous steel items shall include: beams, angles, lintels, metal stairs, support brackets, base plates for other than structural steel or equipment, closure angles, holddown straps and lugs, splice plates, subframing at roof openings and any other miscellaneous steel called for on the Drawings and not otherwise specified.
- D. Steel pipe pieces for sleeves, lifting attachments and other functions shall be Schedule 40 pipe unless otherwise shown on the Drawings. Wall and floor sleeves, of steel pipe, shall have welded circumferential steel waterstops at mid-length.
- E. Lintels, relief angles or other steel supporting masonry or embedded in masonry shall be galvanized.
- F. All steel finish work shall be thoroughly cleaned, by effective means, of all loose mill scale, rust and foreign matter and shall be given one shop coat of primer compatible with the finish coat after fabrication but before shipment. Paint shall be omitted within 3-in of proposed field welds. Paint shall be applied to dry surfaces and shall be thoroughly and evenly spread and well worked into joints and other open spaces.
- G. Galvanizing, where required, shall be the hot-dip zinc process after fabrication. Coating shall be not less than 2 oz/sq ft of surface.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install all items except those to be embedded in concrete or other masonry which shall be installed under Division 3 and Division 4 respectively. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown. Fastening to wood plugs in masonry will not be permitted.
- B. Abrasions in the shop primer shall be touched up immediately after erection. Areas left unprimed for welding shall be painted with primer after welding.
- C. Zinc coating which has been burned by welding, abraded, or otherwise damaged shall be cleaned and repaired after installation. The damage area shall be thoroughly cleaned by wire brushing and all traces of welding flux and loose or cracked zinc

coating removed prior to painting. The cleaned area shall be painted with two coats of zinc oxide-zinc dust paint conforming to the requirements of Military Specifications MIL-P-15145. The paint shall be properly compounded with a suitable vehicle in the ratio of one part zinc oxide to four parts zinc dust by weight.

- D. Specialty products shall be installed in accordance with the manufacturer's recommendations.
- E. Expansion bolts shall be checked for tightness a minimum of 24 hours after initial installation.
- F. Install adhesive anchor system in strict compliance with the manufacturer's recommendations, including drill bit diameter, surface preparation, temperature, moisture conditions, injection and installation of bolts. Use oil free compressed air to blast out loose particles and dust from the drilled holes. Bolts must be clean and free of dirt, oil, grease, ice or other material which would reduce bond.
- G. All railings shall be erected to line and plumb.
- H. All steel surfaces that come into contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.
- I. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.
- J. Where aluminum contacts masonry or concrete, apply a heavy coat of approved alkali resistant paint to the masonry or concrete.
- K. Where aluminum contacts wood, apply two coats of aluminum metal and masonry paint to the wood.
- L. Between aluminum gratings, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4-in thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.

END OF SECTION

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SECTION 09902
PAINTING

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install all painting complete as shown on the Drawings and as specified herein.
- B. It is the intent of this Section to paint all new, exposed structural and miscellaneous steel and appurtenances, steel doors and frames, steel frames for glazed openings, door closers, pipe, fittings, supports, valves, mechanical and electrical equipment, roof fans, chemical tanks and systems, electrical conduit and appurtenances, sluice gates, operators and posts, interior gypsum work, interior CMU walls (where scheduled), exposed ductwork; all as specified herein, as indicated on the Drawings, and all other work obviously required to be painted unless otherwise specified. Minor items omitted in the schedule of work shall be included in the work of this Section where they come within the general intent of the specifications as stated herein.
- C. Paint items so noted in paragraph 1.01B and in accordance with the Painting Schedule and Color Coding Schedule herein. Provide letters and numbers for markings as specified. Items noted in Painting Schedule and Color Coding Schedule herein as having factory finish and other obviously factory finished items shall not be field painted. The Contractor is responsible for having damaged factory finish painted items repaired or, if so ordered, for replacing items. The various Sections are responsible, as stated in each, for preparation and field touch-up of abrasions, welds, and damaged primed areas of primed or galvanized components after erection.
- D. The following surfaces or items are not required to be painted under this Section:
 - 1. Portions of metal, other than aluminum, embedded in concrete. This does not apply to the back face of items mounted to concrete or masonry surfaces, which shall be painted before erection. Aluminum to be embedded in or in contact with concrete or masonry shall be coated to prevent electrolysis.
 - 2. Non-ferrous metals (except copper) and stainless steels, unless specified or noted otherwise.
 - 3. Fencing.
 - 4. Concealed surfaces of pipe or crawl spaces.
 - 5. Acoustical ceilings and acoustical metal panels.

6. Tile.
7. Exterior concrete, unless specified or noted otherwise.
8. Door hardware, except door closers that are not finished.
9. Manhole frames and covers.
10. Fiberglass other than piping.
11. Packing glands and other adjustable parts, and nameplates and data plates of mechanical equipment.
12. Epoxy flooring.
13. Plumbing fixtures.
14. Furniture.
15. Maintenance equipment.
16. Factory prefinished architectural components.
17. Membrane roofing.
18. Acoustical metal deck.
19. Mechanical and electrical equipment that has been factory finished as specified in Divisions 11, 13, 15, and 16.

1.2 RELATED WORK

- A. Valve Identification is included in Division 1.
- B. Waterproofing and Dampproofing is included in Division 7.
- C. Surface Preparation and Shop Prime Painting is included in Section 09901.
- D. Building Signage is included in Division 10.
- E. Project signs are included in Division 1.
- F. Concrete is included in Division 3.
- G. Masonry is included in Division 4.
- H. Metals are included in Division 5.

1.3 SUBMITTALS

- A. Submit the following in accordance with Section 01300.
- B. Product Data: For each type of product indicated.
- C. Samples: Submit the following for each type of coating system and in each color and gloss of finish coat indicated.
 - 1. Color cards for initial color selections.
 - 2. Three sets of 8-in by 8-in samples, on 1/4-in hardboard, of all colors required for all types of paint. Resubmit until approved.
- D. Schedule of Painting Operations: Submit to the Engineer, in accordance with Section 01300, a complete Schedule of Painting Operations within 90 days after the Notice to Proceed. This Schedule is imperative so that the various fabricators may be notified of the proper shop prime coat to apply. Properly notify and coordinate the fabricators' surface preparation and painting operations with these specifications. This Schedule shall include for each surface to be painted, the brand name, the percent volume of solids, the coverage, and the number of coats the Contractor proposes to use in order to achieve the specified DFT, and color charts. When the Schedule has been approved, apply all material in strict accordance with the approved Schedule and the manufacturer's instructions. Wet and dry paint film gauges shall be made available to the Engineer to verify the proper application while work is in progress.
- E. Documentation of the compatibility between prime coats and finish coats shall be submitted along with the date and ambient conditions for all prime coat installation with an established recoat window allowed for each prime system. Corrective surface preparation techniques shall be submitted for all systems in the event that the recoat window is missed.
- F. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 REFERENCE STANDARDS

- A. Steel Structures Painting Council (SSPC)
 - 1. SSPC SP-1 - Surface Preparation Specification No. 1 Solvent Cleaning.
 - 2. SSPC SP-2 - Surface Preparation Specification No. 2 Hand Tool Cleaning.
- B. Where reference is made to one of the above standards, the revision in effect at the

time of bid opening shall apply.

1.5 DELIVERY, STORAGE AND HANDLING

- A. All painting materials shall be delivered to the mixing room in unbroken containers, bearing the manufacturer's brand, date of manufacture, and name. They shall be used without adulteration and mixed, thinned, and applied in strict accordance with manufacturer's directions for the applicable materials and surface before using.
- B. Painting materials shall be delivered to the job site in the original unopened containers, bearing the manufacturer's label. A Product Data Sheet and Material Safety Data Sheet for all painting, activators, thinners, accelerators, and other materials shall be obtained from the manufacturer for each shipment of materials to the job site. Painting materials shall be stored in a dry, well-ventilated area, not in direct contact with the ground, where the temperature is maintained between 40 and 120 degrees F. Damaged materials and/or materials exceeding the shelf life shall not be used.
- C. Paints shall be mixed in proper containers of adequate capacity. All paints shall be thoroughly stirred before use and shall be kept stirred while using. No unauthorized thinners or other materials shall be added to any paint. Air shall not be used directly for agitation. Pigmented material shall be strained after mixing. Where application equipment has strainers, they should be sized so as to allow pigment to pass but not foreign material. Multiple (2 or more) component catalyzed materials may not be used beyond the recommended pot life.
- D. Work areas will be designated by the Owner for storage and mixing of all painting materials. Materials shall be in full compliance with the requirements of pertinent codes and fire regulations. Proper containers outside of the buildings shall be provided and used for painting wastes, and no plumbing fixture shall be used for this purpose.
- E. All recommendations of the paint manufacturer in regard to the health and safety of workmen shall be followed.

1.6 PROJECT CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run

(batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

1.8 QUALITY ASSURANCE

A. Manufacturer Representative

1. The Contractor shall require the paint manufacturer to furnish a manufacturer's qualified technical representative to visit the project site for technical support as required and ordered and as may be necessary to resolve field questions or problems attributable to or associated with the manufacturer's products furnished under this Contract or the application thereof.

B. Pre-Painting Conference

1. Well in advance of commencement of painting operations, but after major equipment has been delivered, a pre-painting conference shall be held. All parties with an interest in the painting work shall attend, including the Contractor, the manufacturer, the Owner, the Engineer, and the painting Contractor. The Contractor shall contact each party and arrange the meeting.
2. The conference shall include an inspection of the areas to be painted by all parties and a discussion of the conformance of each area with the specifications. Important issues such as environmental conditions, climate control systems, original primer, DFT, and monitoring the number of coats that have been field applied shall be discussed and problems shall be resolved.
3. A written record of the meeting shall be submitted to the Engineer.

C. Cold Weather Construction

1. All paint shall be at room temperature before applying, and no painting shall be done when the temperature is below 50 degrees F, in dust-laden air, when rain or snow is falling, or until all traces of moisture have completely disappeared from the surface to be painted. Lower temperatures will only be allowed with written instructions from the paint manufacturer.

D. Inspection and Testing

1. All materials and work shall be accessible and subject to inspection by the Engineer.
2. The completed work shall be inspected visually by the Engineer for skips,

holidays, hiding, uniform color and appearance, and other imperfections. All defective work shall be corrected by the Contractor.

3. Coating thickness on steel shall be determined in accordance with SSPC PA 2. The number of readings will be a minimum of that stated in SSPC PA 2.
4. Coating integrity for coatings in immersion areas or subjected to splash and spillage shall be determined in accordance with NACE RP0188-88 using the low voltage wet sponge test method. All holidays will be clearly marked for repair.
5. The Contractor shall furnish to the job site and use for coating inspection and make available to the Engineer, the following test equipment:
 - a. Wet film thickness gauge.
 - b. Dry film thickness gauge (with certified thickness calibrator) equal to Mikrotest III; Elcometer Inspector III; or Positest.
 - c. Surface Temperature Gauge.
 - d. Holiday Detector, low voltage type such as Tinker & Razor Model M-1, Series 9533.
 - e. SSPC VIS-1-89T "Pictorial Surface Preparation Standard."
 - f. Keane-Tator Surface Comparator Number 372, or equal.
 - g. NBS Certified Coating Thickness Standards.
 - h. Sling Psychrometer.
 - i. Surface moisture metering device equal to Delmhors Model DB.

E. Warranty Inspection

1. A warranty inspection shall be conducted during the 11th month following completion of all coating and painting work. The Contractor, painting Contractor, and a representative of the coating material manufacturer shall attend this inspection with the Engineer and representative of the Owner.
2. All defective work shall be repaired in accordance with these specifications and to the satisfaction of the Engineer. The Owner may, by written notice to the Contractor, reschedule the warranty inspection to another date within the 1-year correction period or may cancel the warranty inspection altogether. If a warranty inspection is not held, the Contractor is not relieved of his responsibilities under the Contract Documents.

PART 2 PRODUCTS

2.1 MATERIALS

- A. All painting materials shall be supplied by one manufacturer, unless otherwise approved by the Engineer. The paint schedule has been prepared on the basis of Tnemec Company Inc. products and application recommendations, unless otherwise noted in the schedule. Equals by Ameron (VyGuard), Carboline, or ICI/Devoo. All materials shall meet NSF Standard 61 and be fully equal to the

Tnemec products listed in the following schedule. No brand other than those named will be considered for approval unless the brand and type of paint proposed for each item in the following schedule together with sufficient data substantiated by certified tests, conducted at no expense to the Owner, to demonstrate its equality to the paint(s) named, is submitted in writing to the Engineer for approval within 30 days after the signing of the Notice to Proceed. The type and number of tests performed shall be subject to the Engineer's approval.

- B. Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with the finish paints to be used. Refer to Section 09901 for special primers.
- C. No paint containing lead will be allowed. Oil shall be pure boiled linseed oil.

2.2 PAINT TYPES

- A. The following types of paints by Tnemec Co. have been used as a basis for the paint schedule:

<u>Series</u>	<u>Series Name</u>	<u>Generic Description</u>	<u>Finish</u>
6	Tneme-Cryl	100% acrylic latex emulsion	semi-
30	Spra-Saf EN	Hydrophobic Acrylic	
36	Undercoater	Wood Primer	
39-1261	Silicone Aluminum	high heat Silicone	
46H-413	Hi-Build Tneme-Tar	Coal-Tar Epoxy	
54-562:	Masonry Filler	Modified Epoxy Block Filler	
61	Tneme-Liner	Amine Epoxy	
66	Hi-Build Epoxoline	Polyamide Epoxy	
N69	Hi-build Epoxoline	Polyamidoamine Epoxy	
73	Endura-Shield	Semi-Gloss Acrylic	
90-97	Tneme-Zinc	Organic Zinc-Rich	
113	H.B. Tneme-Tufcoat	Water Based Epoxy	
115	Uni-Bond DF	Cross Linking Acrylic	
135	Chembuild	Surface Tolerant Epoxy	

N140	Pota-Pox Plus	Polyamidoamine Epoxy (NSF 61)
156	Enviro-Crete	Elastomeric Acrylate
201	Epoxoprime	Clear 100% Solids Epoxy
211-212/213	Glass Beads	Non-skid Additive for Series 291
218	Mortarclad	Epoxy Modified Concrete
222	Deco-Tread	Colored Quartz Filled Epoxy
275	Stranlok	Fiber Reinforced Novolac Epoxy
280	Tneme-Glaze	100% Epoxy
282	Tneme-Glaze	100% Novolac Epoxy
284	Deco-Clear	100% Solids Clear Epoxy
287	Enviro-Tread	Water Based Epoxy
291	CRU	Aliphatic Polyester Polyurethane Clear
434	Perma-Shield H2S	Modified Aliphatic Amine Epoxy Metal
435	Perma-Glaze	Modified Polyamine Epoxy

2.3 PAINT SCHEDULE

A. The following surfaces shall have the types of paints scheduled below applied at the dry film thickness (DFT) in mils per coat noted:

B. Ferrous Metals

1. Submerged or subject to splashing

Surface Preparation:	SSPC-SP5
Stripe Coat:	Series 435-5021 (10 mils DFT) applied by brush over weld seams
1 st Coat:	Series 435-5022 (15-20 mils DFT)
2 nd Coat:	Series 435-5021 (15-20 mils)
DFT) Min total DFT for 2 coats:	30 mils

2. Nonsubmerged (exterior)

Surface Preparation: SSPC-SP6
 Stripe Coat: Series 90-97 (2.5 - 3.5 mils DFT) applied by
 brush over weld seams
 Primer: Series 90-97 (2.5 - 3.5 mils DFT)
 Int. Coat: Series N69 (3.0 - 5.0 mils DFT)
 Topcoat: Series 73 (2.0 - 3.0 mils
 DFT) Min total DFT for 3 Coats: 9.5 mils

C. Non-Ferrous Metals and Galvanized Steel

1. Submerged or subject splashing

Surface Preparation: SSPC-SP1 and SSPC-SP7
 1st Coat: Series N69 (4.0 - 6.0 mils DFT)
 2nd Coat: Series N69 (4.0 - 6.0 mils
 DFT) Min total DFT for 2 Coats: 10.0 mils

2. Nonsubmerged (exterior)

Surface Preparation: SSPC-SP1 and scarify
 Primer: Series N69 (3.0 - 5.0 mils DFT)
 Topcoat: Series 73 (2.0 - 3.0 mils
 DFT) Min total DFT for 2 Coats: 6.5 mils

3. Nonsubmerged (interior)

Surface Preparation: SSPC-SP1 and scarify
 1st Coat: Series N69 (2.0 - 4.0 mils DFT)
 2nd Coat: Series N69 (2.0 - 4.0 mils
 DFT) Min total DFT for 2 Coats: 6.0 mils

4. Aluminum in contact with dissimilar metals

(nonsubmerged) Surface Preparation: SSPC-
 SP1 and scarify
 1st Coat: Series N69 (2.0 - 4.0 mils DFT)
 2nd Coat: Series N69 (2.0 - 4.0 mils
 DFT) Min total DFT for 2 Coats: 6.0 mils

D. Concrete Masonry Units (Block)

1. Interior (conditioned office space)

Surface Preparation: Clean and dry
 Block Filler: Series 54-562 @ 60 - 80 SF/gal
 1st Coat: Series 6 (2.0 - 3.0 mils DFT)
 2nd Coat: Series 6 (2.0 - 3.0 mils
 DFT) Min total DFT for 2 coats (excluding block filler):
 5.0mils

2. Interior (unconditioned process/pump rooms)

Surface Preparation: Clean and dry
 Block Filler (2 coats): Series 54-562 @ 60 - 80 SF/gal (8.0 - 10.0 mils DFT
 per
 coat)
 1st Coat: Series 113 (4.0 - 6.0 mils DFT)
 2nd Coat: Series 113 (4.0 - 6.0 mils
 DFT) Min total DFT for 2 Coats: 8.0 mils

E. Concrete (precast and cast in place)

1. Submerged or subject to splashing

Surface Preparation: SSPC-SP13
 Surfacer: Series 218 applied at 1/16"±
 1st Coat: Series N69 (4.0 - 6.0 mils DFT)
 2nd Coat: Series N69 (4.0 - 6.0 mils
 DFT) Min total DFT for 2 coats (excluding surfacer): 10.0
 mils

2. Nonsubmerged (interior conditioned

space) Surface Preparation: Clean and
 dry
 1st Coat: Series 6 (2.0 - 3.0 mils DFT)
 2nd Coat: Series 6 (2.0 - 3.0 mils
 DFT) Min total DFT for 2 Coats: 5.0 mils

3. Nonsubmerged (exterior)

Surface Preparation: Clean and dry
 1st Coat: Series 156 (4.0 - 6.0 mils DFT)
 2nd Coat: Series 156 (4.0 - 6.0 mils
 DFT) Min total DFT for 2 coats: 10.0 mils

F. Surfaces exposed to severe H₂S / H₂SO₄

Surface Preparation: SSPC-SP13

Surfacer: Series 218 (1/16" DFT)
 Mortar Coat: Series 434 (1/8" DFT)
 Glaze Coat: Series 435 (15-20 mils DFT)

G. Plastic piping nonsubmerged

1. Interior

Surface Preparation: SSPC-SP1 and scarify
 1st Coat: Series N69 (2.0 - 3.0 mils DFT)
 2nd Coat: Series N69 (2.0 - 3.0 mils DFT)
 DFT) Min total DFT for 2 coats: 5.0 mils

2. Exterior

Surface Preparation: SSPC-SP1 and scarify
 1st Coat: Series N69 (2.0 - 3.0 mils DFT)
 2nd Coat: Series 73 (2.0 - 3.0 mils DFT)
 DFT) Min total DFT for 2 coats: 5.0 mils

H. Ductile iron pipe

1. Immersion

Surface Preparation: SSPC-SP6
 1st Coat: Series N69 (6.0 - 8.0 mils DFT)
 2nd Coat: Series N69 (6.0 - 8.0 mils DFT)
 DFT) Min total DFT for 2 coats: 14.0 mils

2. Exterior

Surface Preparation: SSPC-SP6
 1st Coat: Series N69 (6.0 - 8.0 mils DFT)
 2nd Coat: Series 66 (2.0 - 4.0 mils DFT)
 3rd Coat: Series 73 (2.0 - 3.0 mils DFT)
 DFT) Min total DFT for 3 coats: 12.0 mils

I. Previously painted steel surfaces with solvent based coatings

1. Immersion

Surface Preparation: Pressure clean (3500 PSI) spot SSPC-SP10 (near white metal and SSPC-SP7 (brush blast)
 Spot Primer: Series N69 (3.0 - 5.0 mils DFT)
 1st Coat: Series N69 (4.0 - 6.0 mils DFT)
 2nd Coat: Series N69 (4.0 - 6.0 mils DFT)

2. Interior non-immersion

Surface Preparation: Pressure clean (3500 PSI) or solvent clean (SSPC-SP1)
 and spot power tool clean (SSPC-SP3)
 Spot Primer: Series 135 (3.0 – 5.0 mils DFT)
 Barrier Coat: Series 135 (3.0 – 5.0 mils DFT)
 Top Coat: Series N69 (4.0 – 6.0 mils DFT)

3. Exterior:

Surface Preparation: Pressure clean (3500 PSI) or solvent clean (SSPC-SP1)
 and spot power tool clean (SSPC-SP3)
 Spot Primer: Series 135 (3.0 – 5.0 mils DFT)
 Barrier Coat: Series 135 (3.0 – 5.0 mils DFT)
 Top Coat: Series 73 (2.0 – 3.0 mils DFT)

J. Overhead ceilings including (metal decking, rafters, ductwork, conduit, etc.)

1. Interior dry environments

Surface Preparation: Pressure clean (3500 PSI)
 Coating: Series 115 (2.0 – 4.0 mils DFT)

2. Interior wet environments

Surface Preparation: Pressure clean (3500 PSI) and brush blast
 (SSPC-SP7) Spot Primer: Series 135 (3.0 – 5.0 mils DFT)
 1st Coat: Series 135 (3.0 – 5.0 mils DFT)
 2nd Coat: Series 66 (3.0 – 5.0 mils DFT)

3. Exterior

Surface Preparation: Pressure clean (3500 PSI) and spot power tool clean
 (SSPC-SP3)
 Spot Primer: Series 135 (3.0 – 5.0 mils DFT)
 1st Coat: Series 30 (2.0 – 4.0 mils DFT)
 2nd Coat: Series 30 (2.0 – 4.0 mils DFT)

K. Wood (interior and exterior)

1. Surface Preparation: Clean and dry
 Primer: Series 36 (2.0 – 3.0 mils DFT)
 1st Topcoat: Series 6 (2.0 – 3.0 mils DFT)
 2nd Topcoat: Series 6 (2.0 – 3.0 mils DFT)
 DFT) Min total DFT for 3 Coats: 7.5 mils

- L. Any surfaces not specifically named in the Schedule and not specifically excepted shall be prepared, primed, and painted in the manner and with materials consistent with these specifications. The Engineer shall select which of the manufacturer's products, whether the type is indicated herein or not, shall be used for such unnamed surfaces. No extra payment shall be made for this painting.

2.4 LETTERING OF TITLES

- A. Each pipe system shall be labeled with the name of the materials in each pipeline and alongside this an arrow indicating the direction of flow of liquids. Titles shall be as so described in attached schedule. Titles shall not be located more than 5-li-ft apart, and shall also appear directly adjacent to each side of any wall the pipeline breaches, adjacent to each side of the valve regulator, flowcheck, strainer cleanout, and all pieces of equipment.
- B. Titles shall identify the contents by complete name. Identification title locations shall be determined by the Engineer but in general they shall be placed where the view is unobstructed and on the two lower quarters of pipe or covering where they are overhead. Title should be clearly visible from operating positions especially those adjacent to control valves.
- C. Titles on equipment shall be applied at eye level on machines where possible or at the upper most broad vertical surface of low equipment. Where more than one piece of the equipment item to be titled exists, the items shall be numbered consecutively as indicated on the mechanical drawings or as directed by the Engineer; for example Pump No. 1, Pump No. 2, etc. Titles shall be composed and justified on the left hand side as follows:
 - 1. Pump No. 1A
 - 2. Pump No. 2A
 - 3. Pump No. 1B
 - 4. Pump No. 2B
- D. Application of titles
 - 1. The color of the titles shall be black or white, as approved, to best contrast with the color of the pipes and equipment and shall be stencil applied.
 - 2. Text is to be in ALL CAPS worded exactly as shown in the Schedule. Titles are to be printed in a single line.
 - 3. Letter sizes

Outside Diameter of Pipe or Covering	Size of Legend Letters (in)
(in)	

$\frac{3}{4}$ to 1- $\frac{1}{4}$	$\frac{1}{2}$
1- $\frac{1}{2}$ to 2	$\frac{3}{4}$
2- $\frac{1}{2}$ to 6	1- $\frac{1}{4}$
8 to 10	2- $\frac{1}{2}$
More than 10	3- $\frac{1}{2}$

Equipment titles are to be 2-in high.

4. Arrow sizes. Where "a" is equal to $\frac{3}{4}$ of outside diameter of pipe or covering, the arrow shaft shall be 2 "a" long by $\frac{3}{8}$ "a" wide. The arrow head shall be an equilateral triangle with sides equal to "a." Maximum "a" dimension shall be 6-in.
5. When using direction arrows, point arrowhead away from pipe markers and in direction of flow. If flow can be in both directions, use a double-headed directional flow.

2.5 TITLES FOR EQUIPMENT

- A. Titles shall be provided in vinyl film on all equipment using 2-in high Optima Bold upper case, Grid 2 spacing, white or black in color as approved depending on substrate. Titles shall be mounted at eye level on machines where possible or at the upper most broad vertical surface of low equipment. Where more than one piece of the equipment item to be titled exists, the items shall be numbered consecutively as indicated on the mechanical drawings or as directed by the Engineer; for example Pump No. 1, Pump No. 2, etc. Titles shall be composed in more than one line if required and justified on the left-hand side as approved.

2.6 METAL TAGS

- A. For pipelines smaller than $\frac{3}{4}$ -in in diameter, securely fasten metal tags, 2- $\frac{1}{2}$ -in by $\frac{1}{2}$ -in, of Birmingham or Stubs aluminum with lettering etched and filled with enamel. Tags shall be approved by the Engineer.

2.7 VALVE MARKERS

- A. Furnish and install aluminum tags with engraved lettering as approved by Engineer on all above ground chemical system and process piping valves.

2.8 FABRICATED EQUIPMENT

- A. Unless otherwise indicated, all fabricated equipment shall be shop primed and shop or field finished.
- B. All items to be shop primed shall be thoroughly cleaned of all loose material prior to priming. If, in the opinion of the Engineer, any prime coating shall have been improperly applied or if material contrary to these specifications shall have been

used, that coating shall be removed by sandblasting to white metal and reprimed in accordance with these specifications.

- C. All shop prime coats shall be of the correct materials and applied in accordance with these specifications. Remove any prime coats not in accordance with these specifications by sandblasting and apply the specified prime coat at no additional cost to the Owner.
- D. Shop primed surfaces shall be cleaned thoroughly and damaged or bare spots retouched with the specified primer before the application of successive paint coats in the field.
- E. The Contractor shall be responsible for and take whatever steps are necessary to properly protect the shop prime and finish coats against damage from weather or any other cause.
- F. A shop finish coat shall be equal in appearance and protection quality to a field applied finish coat. If, in the opinion of the Engineer, a shop finish coat does not give the appearance and protection quality of other work of similar nature, prepare the surfaces and apply the coat or coats of paint as directed by the Engineer to accomplish the desired appearance and protection quality. Submit to the Engineer substantial evidence that the standard finish is compatible with the specified finish coat.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
 - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry (Clay and CMU): 12 percent.
 - c. Wood: 15 percent.
 - d. Gypsum Board: 12 percent.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 4. Coating application indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. All surfaces to be painted shall be prepared as specified herein and shall be dry and clean before painting. Special care shall be given to thoroughly clean interior concrete and CMU surfaces to receive polyamide cured epoxy paint of all marks before application of finish.
- B. All metal welds, blisters, etc, shall be ground and sanded smooth. All pits and dents shall be filled and all imperfections shall be corrected so as to provide a smooth surface for painting. All rust, loose scale, oil, tar and asphalt bearing coatings, grease and dirt shall be removed by use of approved solvents, wire brushing, grinding or sanding.
- C. Concrete surfaces shall have been finished as specified in Section 03350. Report unsatisfactory surfaces to the Engineer. Concrete shall be left for one month minimum before painting and shall be free of dust, oil, curing compounds and other foreign matter.
- D. Concrete masonry unit surfaces shall be smooth and cleaned of all dust, loose mortar and other foreign matter.
- E. All PVC pipe and other plastic matrix surfaces to be painted shall be sanded to an approved profile and cleaned of residue before painting.
- F. All PVC pipe and other plastic matrix surfaces to be painted shall be lightly sanded and cleaned of residue before painting.
- G. Galvanized, aluminum, and copper surfaces shall have all oxidation and foreign material removed before painting by SSPC SP-1, using an approved V.O.C. compliant method. Galvanized and, when ordered, the other metal surfaces specified above shall be hand tool cleaned to SSPC SP-2 standards to provide a uniform 1 mil surface profile.
- H. Existing Surfaces to be Repainted
 - 1. Existing masonry, steel and other previously field painted surfaces indicated on drawings, or so noted, shall be repainted.
 - 2. Preparation shall be in general as specified above for new surfaces except that all loose paint shall be removed and all edges of existing paint shall be feathered to ensure a smooth surface.
 - 3. Paint removal, capture of its residue, and its disposal shall be handled in accordance with all laws and regulations concerning disposal of hazardous materials.

4. Primer (spot) and paint used for a particular surface shall, in general, be as scheduled for that type of new surface. Provide an approved organic zinc-rich (min. 83% zinc in dried film) primer as specified. Confirm with the paint manufacturer that the paint proposed for a particular repaint condition will be compatible with the existing painted surface. Perform adhesion and compatibility tests on existing substrates as ordered and required. Repainted areas shall be covered by the same guaranty specified for remainder of Project.

3.3 WORKMANSHIP

A. General

1. At the request of the Engineer, sample areas of the finished work prepared in strict accordance with this Section shall be furnished and all painting shall be equal in quality to the approved sample areas. Finished areas shall be adequate for the purpose of determining the quality of workmanship. Experimentation with factory or paint manufacturer's warehouse mixed colors shall be furnished to the satisfaction of the Engineer where standard chart colors are not satisfactory.
2. Protection of furniture and other movable objects, equipment, fittings and accessories shall be provided throughout the painting operation. Canopies of lighting fixtures shall be loosened and removed from contact with surface, covered and protected and reset upon completion. Remove all electric plates, surface hardware, etc, before painting, protect and replace when completed. Mask all machinery name plates and all machined parts not receiving a paint finish. Dripped or spattered paint shall be promptly removed. Lay drop cloths in all areas where painting is being done to adequately protect flooring and other work from all damage during the operation and until the finished job is accepted.
3. On metal surfaces apply each coat of paint at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. One gallon of paint as originally furnished by the manufacturer shall not cover a greater area when applied by spray gun than when applied unthinned by brush. Deficiencies in film thickness shall be corrected by the application of an additional coat(s). 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 finish either by decreasing the coverage rate or by applying additional coats of paint.

B. Field Priming

1. Steel members, metal castings, mechanical and electrical equipment and other

metals which are shop primed before delivery at the site will not require a prime coat on the job. All piping and other bare metals to be painted shall receive one coat of primer before exposure to the weather, and this prime coat shall be the first coat as specified in the painting schedule. Surface preparation of bare metal shall be the responsibility of the Contractor.

2. Equipment which is specified to receive a baked-on enamel finish or other factory finish shall not be field painted unless the finish has been damaged in transit or during installation. Surfaces that have been shop painted and have been damaged, or where the shop coat or coats of paint have deteriorated, shall be properly cleaned and retouched before any successive painting is done on them in the field. All such field painting shall match as nearly as possible the original finish. Preparation and painting shall be provided by the Contractor.
3. Equipment shipped with a protective shop painting coat or coats shall be touched up to the satisfaction of the Engineer with primers as recommended by the manufacturer of the finish paint. Preparation and painting shall be provided by the Contractor.

C. Field Painting

1. All painting at the site shall be under the strict inspection of the Engineer. Only skilled painters and, where dictated by special conditions or systems and so ordered, specialist painters shall be used on the work.
2. All paint shall be at room temperature before applying, and no painting shall be done when the temperature is below 60 degrees F, in dust-laden air, when rain or snow is falling, or until all traces of moisture have completely disappeared from the surface to be painted.
3. Successive coats of paint shall be different shades (from paint manufacturer's stock or shop mixed paint) of the required colors so as to make each coat easily distinguishable from each other with the final undercoat the approximate shade of the finished coat to ensure no show-through as approved.
4. Finish surfaces shall not show brush marks or other irregularities. Undercoats shall be thoroughly and uniformly sanded with the type paper appropriate for the undercoats to remove defects and provide a smooth even surface. Top and bottom edges of doors shall be painted.
5. Painting shall be continuous and shall be accomplished in an orderly manner so as to facilitate inspection. Materials subject to weather shall be primed coated as quickly as possible. Surfaces of exposed members that will be inaccessible after erection shall be cleaned and painted before erection.

6. All painting shall be performed by approved methods with number of coats modified as required to obtain the total dry film thickness specified. Spray painting shall be performed specifically by methods submitted and as approved by the Engineer.
7. All surfaces to be painted as well as the atmosphere in which painting is to be done shall be kept warm and dry by heating and ventilation, if necessary, until each coat of paint has hardened. Any defective paint shall be scraped off and repainted in accordance with the Engineer's directions.
8. Before final acceptance of the work, all damaged surfaces of paint shall be cleaned and repainted as directed by the Engineer.
9. Only the aluminum work noted on the Drawings or in the Painting Schedule shall be field painted.

3.4 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when coatings are being applied:
 1. Owner will engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will perform tests for compliance with specified requirements.
 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Engineer, and leave in an undamaged condition.

- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 COLOR CODING FOR PIPES AND EQUIPMENT

- A. Color coding shall consist of color code painting and identification of all exposed conduits, trough items, and pipelines for the transport of gases, liquid, and semi-liquids including all accessories such as valves, insulated pipe coverings, fittings, junction boxes, bus bars, connectors, and all operating accessories which are integral to the whole functional mechanical pipe and electrical conduit system. Colors shall be as noted in the Color Coding Schedules at the end of this Section.
- B. All hangers and pipe support floor stands shall be painted the same color and with the same paint as the pipe it supports. The system shall be painted up to but not including the flanges attached to the mechanical equipment nor the flexible conduit connected to electrical motors. When more than one pipe system is supported on the same bracket, the bracket shall be painted the same color as the adjacent wall or ceiling. Colors shall be as noted in the Color Coding Schedule as selected and approved by Engineer.
- C. All systems that are an integral part of the equipment, that is originating from the equipment and returning to the same piece of equipment, shall be painted between and up to but not including, the fixed flanges or connections on the equipment.
- D. The color code establishes, defines, and assigns a definite color for each category of pipe. Pipelines, equipment, or other items that are not listed in the Color Coding Schedule shall be assigned a color by the Engineer and shall be treated as an integral part of the Contract.
- E. Banding for pipes shall be as specified in the Color Coding Schedule. Bands shall be 2-in wide and spaced 5-ft on center, located on each end of the pipe title, at 2-ft from the title bands, and at wall penetrations.
- F. All moving parts, drive assemblies, and covers for moving parts which are potential hazards shall be Safety Orange #CA26.
- G. All safety equipment shall be painted in accordance with OSHA standards.
- H. All inline equipment and appurtenances not assigned another color shall be painted the same base color as the piping. The pipe system shall be painted with the pipe color up to but not including the flanges attached to pumps and mechanical equipment assigned another color. Tanks shall be painted the color of the piping system that they serve, unless the tank is fiberglass and levels are monitored through the tank.

- I. All conduit shall be painted to match its background surface.
- J. Control panels shall be factory finished.
- K. All colors will be confirmed by the Engineer from color charts submitted by the Contractor, based on the color coding schedule herein.

3.7 COLOR IDENTIFICATION

- A. All color numbers and names herein refer to master color card. Colors of specified equal manufacturers may be substituted with approval of the Engineer.
- B. Building surface colors shall be painted as scheduled in the Color Coding Schedule or as selected by the Engineer.
- C. The following Tnemec colors shall be used as a basis for the Color Coding Schedule:

<u>Colors</u>	<u>Tnemec Name</u>	<u>Tnemec #</u>
White	White	11WH
International Orange	International	05SF
Safety Yellow	Lemon Yellow	02SF
Safety Green	Hunter Green	08SF
Brown		24YB
Dark Brown		23YB
Safety Red	Chilean Red	07SF
Gray	Slate Gray	32GR
Safety Blue	True Blue	11SF
Black	Black	35GR

3.8 COLOR CODING SCHEDULE

- A. Color selection for the following items are to be reviewed by the Engineer and approved by the Owner at the time of shop drawing review. The Contractor shall submit color charts for color selections.

<u>Piping and Legend</u>	<u>Color</u>	<u>Bands</u>
Basin Drain	Brown	White
Drain	Gray	Safety Blue
Dewatering Filtrate	Gray	Safety
Digester Sludge	Brown	International
Grit Basin Influent		

<u>Piping and Legend</u>	<u>Color</u>	<u>Bands</u>
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PAINTING

High Pressure Air	Green	
Instrument Air	Green	
Irrigation Water	Blue	Black
Low Pressure Air	Green	
Natural Gas	Orange	Black
Non Potable Water	Blue	Black
Polymer Solution	White	Safety Green/Black/Red
Potable Water	Safety Green	
Return Activated Sludge	Brown	Gray/Red
Raw Sewage	Gray	Black
Scum	Dark Brown	Gray
Secondary Effluent	Gray	International
Sludge	Brown	Safety Blue/Black
Sanitary Force Main		
Sample	Safety Green	Safety Yellow
Storm Water		
Thickened Sludge	Brown	Red/Black
Vacuum	Safety Yellow	Safety Blue
Water Activated Sludge	Brown	Gray/Black

Building and Architectural Components

Interior Wall Color Sherwin Williams SW 6105 Divine

White Interior Metal Doors and Frames to match wall

color

Other Colors, if not identified in appropriate Specification Sections, shall be selected by the Engineer and approved by the Owner.

END OF SECTION

SECTION 11215
EFFLUENT VERTICAL TURBINE PUMPS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install, complete and ready for operation and field test, the pre-purchased Effluent Vertical Turbine Pumps including their respective drives and controls as shown on the Drawings and as specified herein. Refer to Exhibit A of these specification for submittal data on Vertical Turbine Pumps.

END OF SECTION

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SECTION 11231
GAS CHLORINATION SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Furnish and install equipment and appurtenances necessary to complete work shown or specified. The equipment is to be supplied by a single engineer-approved, equipment supplier for installation by contractor.

1.03 REFERENCES

- A. The following references apply:
 1. American National Standards Institute (ANSI).
 2. American Society for Quality Control (ASQC).
 3. American Society of Mechanical Engineers (ASME).
 4. American Society for Testing Materials (ASTM).
 5. American Water Works Association (AWWA).
 6. Chlorine Institute (CI).
 7. Confinement of Substances Hazardous to Health (COSHH).
 8. Institute of Electrical and Electronics Engineers (IEEE).
 9. International Standards Organization (ISO).
 10. Member States of the European Council (EC).
 11. National Electrical Code (NEC).
 12. National Electrical Manufacturers Association (NEMA).
 13. National Fire Code (NFC).
 14. National Institute of Occupational Safety & Health (NIOSH).
 15. Occupational Safety and Health Administration (OSHA).
 16. Standard Fire Code (SFC).
 17. Uniform Fire Code (UFC).
 18. Water Environment Federation (WEF).
 19. Uniform Building Code
 20. Chlorine Institute

1.04 SYSTEM DESCRIPTION

- A. The Contractor shall furnish and install a complete and operation Gas Chlorination System including the gas (chlorine or sulfur dioxide) cylinders, gas feed equipment, gas detectors, scales, scrubber, and controls.

- B. Provide a complete vacuum operated, solution feed, 100 pounds per day (PPD)

compound loop control chlorine gas feeder system with automatic switchover, safety equipment and accessories as shown on the contract drawings and specified herein.

1.05 SUBMITTALS

- A. Furnish mechanical drawings, electrical drawings and catalog cut sheets of equipment. Include sufficient data to show that the system conforms to the specification requirements as noted in paragraph 2.01 Performance Requirements.
- B. Submittals should include, but not be limited to:
 - 1. General arrangement / assembly drawings
 - 2. Performance calculations
 - 3. Performance test results
 - 4. Power and control wiring diagrams
 - 5. Blower data, motor data and performance curves
 - 6. Manufacturer's catalog information consisting of descriptive literature, specifications and materials of construction for all components
 - 7. Step-by-step operating and start-up procedures
 - 8. Lists of spare parts, tools, and supplies
 - 9. Wiring diagrams of all control circuits
 - 10. Troubleshooting instructions
- C. After successful startup, the manufacturer or trained representative will provide certification that the system is properly installed, tested and is ready for full time operation
- D. The manufacturer shall furnish the Owner with two (2) copies of maintenance data on all machinery and equipment furnished for the system. The manuals shall include the following:
 - 1. Equipment operating and maintenance instructions
 - 2. Parts lists
 - 3. Assembly and disassembly instructions
 - 4. Equipment specifications and guaranteed performance data
 - 5. Recommendations for preventive maintenance

1.06 QUALITY ASSURANCE

- A. The equipment and material to be furnished under this Contract shall be free from defects. The complete system shall be by one manufacturer having complete system responsibility for the operation of the system.
- B. The equipment shall be manufactured and tested under ISO certification meeting the following standards: ISO9001-1994, EN ISO9001-1994, ANSI/ASQCQ9001-1994.

- C. The products furnished under this section shall be of a manufacturer as named in 2.01F who has been regularly engaged in the design and manufacture of the specified equipment. Said manufacturer must demonstrate, to the satisfaction of the Engineer, that the quality and functionality of the supplied equipment is equivalent to that specified.
- D. The Contractor shall comply with the rules and regulations of authorities having jurisdiction over the work specified herein, including but not limited to, the NFPA 1 Uniform Fire Code.
- E. All materials and fabrications, furnished in accordance with this specification, shall comply with all federal and state laws and local ordinances of the place of installation and with applicable codes and standards. Unless otherwise noted, the documents with addenda, amendments, and revisions in effect on the date of the purchase order will apply.

1.07 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage and handling of products in accordance with the manufacturer's recommendations.

1.08 WARRANTY REQUIREMENTS

- A. A. Manufacturer shall warrant the Chlorination Safe Station system against defects in materials and workmanship for a period of eighteen (18) months from the date in which the title has passed to the buyer or twelve (12) months from the date of installation, whichever occurs first.

1.09 SYSTEM START-UP

- A. The equipment manufacturer shall furnish the services of a qualified field engineer to check installation, start-up and instruct operating personnel in the proper operation and maintenance of the equipment.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. DE NORA Water Technologies, Hydro-Instruments or Pre-Approved Equal.

2.02 EQUIPMENT

- A. Provide the following minimum scope:
 1. Two (2) Vacuum regulators
 2. One (1) Automatic switchover module
 3. Two (2) Flowmeter panel

4. Two (2) Ejector/check valve assembly
5. Two (2) Corporation Stops
6. One (1) Electronic Scale, dual cylinder
7. One (1) Gas detector
8. One (1) Gas detector power back-up
9. One (1) Emergency kit
10. One (1) Self-contained air mask with spare cylinder and wall mounted enclosure
11. One (1) Chlorine Residual Analyzer
12. Four (4) Vent Exhaust Gas Arrestors or Equivalent Vent System.
13. One (1) Control Panel
14. One (1) Windsock
15. All interconnecting Tubing, Valves, & Appurtenances required
16. One (1) Set of Spare Parts
17. One (1) RPBF and (1) Flowmeter for the water service
18. One (1) audible and visual alarm

2.03 EQUIPMENT BUILDING:

- A. Building shall be a Precast Concrete Building supplied by Others. The system supplier shall coordinate with the contractor and building supplier all penetrations required for piping, controls, heaters, detectors, alarms, vents and any other requirements needed for a complete and safe system.
- B. The Chlorine System Supplier shall coordinate the sizing, location and suitability of an automated building ventilation system as required to meet safety regulations for chlorine gas operations.
- C. Provide all feed equipment, metering equipment, analyzers, etc. as specified herein or otherwise required for a complete operable system as specified. Provide all equipment, materials, etc. suitable for use with chlorine gas. Provide layout drawings for the building supplier showing all wiring, piping, tubing, etc. required for complete operation.
- D. The chlorination system will provide a complete vacuum operated, solution feed, 100 pounds per day (PPD) compound loop control chlorine gas feeder system with automatic switchover, duty/standby and safety equipment mounted in a Precast Concrete Building per the specification and as shown on the contract drawings. A remotely mounted Chlorine Residual Analyzer will monitor the chlorine residual leaving the plant and will be supplied by the contractor.

2.04 VACUUM REGULATOR

- A. The vacuum regulator shall feed gas under vacuum from the source to the point of application up to a feed rate of 100 PPD (2 kg/h) chlorine.
- B. The vacuum regulator shall mount directly on the cylinder or manifold gas valve by means of a yoke assembly and shall be provided with a gas valve direction indicator and

integrated gas flowmeter. The gas flowmeter shall have dual scale (English/metric) and be sized for an operating maximum capacity of 100 PPD/2 kg/h.

- C. The vacuum regulator shall be constructed of molded plastic, suitable for wet or dry gas service and all springs shall be of tantalum alloy. The corrosion-resistant yoke assembly shall have a fusion-bonded epoxy coating and shall be fitted with a field replaceable silver inlet valve and filter assembly.
- D. Vacuum shall be controlled by a spring-opposed double diaphragm in the vacuum regulator. Pressure shall be prevented from building in the system by means of a spring-loaded, diaphragm actuated pressure relief valve located in the vacuum regulator. Each regulator shall be equipped with a gravity-actuated loss-of-gas indicator. An integrated switch shall be provided to indicate loss of gas.
- E. The vacuum inlet shall be 5/8 inch.
- F. The following vacuum regulator spare parts shall be provided:
 - 1. One (1) set rate valve O-rings.
 - 2. One (1) set meter gaskets.
 - 3. One (1) replacement filter.
 - 4. One (1) insect screen.
 - 5. One (1) multi-purpose wrench.

2.05 AUTOMATIC VACUUM SWITCHOVER MODULE

- A. The automatic vacuum switchover module shall be wall mounted and operated on a spring-loaded toggle. The module shall be capable of switching from one source to another source at a feed rate of 100 PPD (2 kg/h) chlorine.
- C. The automatic vacuum-operated switchover module shall automatically switch the gas supply from an empty source to a full source. The system shall have automatic reset and shall not permit return to the initial gas source until the second gas source is exhausted.
- C. The switchover shall be constructed of molded plastic, suitable for wet or dry gas service and all springs shall be of tantalum alloy.
- D. The vacuum inlet and outlet shall be 5/8 inch tubing connectors.

2.06 GAS FEEDERS, WALL PANEL

- A. The gas feeder shall automatically regulate chlorine gas feed rates in response to flow and/or residual input signals. The panel shall contain an automatic gas control valve with integral controller, gas flowmeter, vacuum gauge and optional high and low vacuum switches. The wall panel shall have a maximum capacity of chlorine gas feed rates in response to flow and residual input signals. The wall panel shall have a maximum capacity of 3000 PPD/60 kg/h and operate under sonic flow.

- B. The flowmeter with dual scale (English/metric) shall indicate the gas flow and shall have a maximum indicated capacity of 100 PPD. The entire panel shall operate under vacuum from the gas inlet connection to the gas outlet connection.
- C. The Gas Flow Control Valve shall be stepping motor operated with the motor and electronic components mounted in a NEMA 4X enclosure. The valve shall be integrated with a microprocessor-based controller designed to control chemical feed. The valve shall be field configurable for flow proportioning, residual, compound loop or feed forward control. The compound loop control feature shall have the capability of automatic variable lag time adjustment. All setup, tuning and control adjustment shall be achieved from the pushbutton panel.
- D. Standard features shall include: built-in multiplier for feed forward control; automatic transfer from compound loop control when either the residual or flow signal is lost; bump-less transfer between manual and automatic control, digital vacuum fluorescent display; alarm indication; user configurable alarm contacts; control switch inputs; and a 4-20 mA dc flow transmitter output signal.
- E. The valve shall be capable of a unique 11 point valve plug characterization feature that matches the valve plug characteristic to the gas flow meter. This shall insure a true gas flow retransmission signal to remote monitoring instruments such as a recorder or SCADA system without the need for limited range auxiliary differential pressure metering devices. The valve shall operate under sonic gas flow conditions without the requirement for a differential pressure regulator to maintain a constant flow rate with varying vacuum levels.
- F. The valve shall be able to accept three (3) either 4-20 mA dc or 1-5 V dc inputs. Inputs shall be field selectable, two (2) for flow transmitter and/or residual analyzer and one (1) for remote set point. There shall be two (2) contact inputs one shall be for vacuum switch alarm and the other for a remote standby switch.
- G. The display shall be a 2-line, 16 character vacuum fluorescent display. Display shall display operational parameters as well as alarm conditions. The valve shall be powered by 100-250 Vac, 47-66 Hz and shall be auto-ranging. The valve shall be equipped with a manual control knob (multi-turn) available to position the valve plug when dosage control is in "off" position or if power fails.
- H. The valve shall be able to feed chlorine, sulfur dioxide, ammonia or carbon dioxide gases. The maximum feed rate shall match the flowmeter capacity indicated above.
- I. The optional vacuum switches shall be wired to the automatic control valve and have auxiliary contacts available for remote status indication. The vacuum switches shall monitor the vacuum levels from the vacuum source and the vacuum level between the panel and the vacuum regulator.
- J. The panel shall be of rigid polyethylene. All components shall be pre-wired and pre-

pipled using materials suitable for gas service.

- K. The vacuum inlet and vacuum outlet shall be 5/8 inch tubing for 500 PPD and below, and 1 inch NPT for above 500 PPD.

2.07 EJECTORS/CHECK VALVES

- A. Where gas is to be fed to multiple points of distribution, the gas feeder shall be furnished with the following additional components for each point: an appropriately sized ejector and rate control valve. Additional points shall be controlled manually or automatically as specified in the Functional Description and as shown on the contract drawings.
- B. Each ejector shall be provided with dual back check valves and an emergency drain connection. Accuracy of chlorine feed shall be $\pm 4\%$ of the set rate over a 20:1 range for both automatic and manual feed. The single meter panel shall be wall mounted and provided with a chlorine gas flowmeter with dual scale (English/metric) indication. The flowmeter shall have a feed rate capacity up to 500 PPD/10 kg/h.
- C. Within the ejector there are dual check valves and an emergency drain connection to prevent water from reaching the vacuum regulator.
- D. The gas feeder shall be constructed entirely of materials resistant to the corrosive attack of chlorine gas.
- E. The ejector shall have a 5/8 inch vacuum connection.

2.08 DIFFUSERS/CORPORATION STOPS

- A. The corporation stop shall be provided with 1 inch IPS threads. The assembly shall be provided complete with a 1 inch hose adapter, 1 inch NPT adapter and ejector close-coupling adapter for inlet connection. The corporation stop shall have a 1/2 inch PVC solution tube.

2.09 GAS DETECTORS

- A. The chlorine, sulfur dioxide and ammonia gas detector shall consist of a wall mounted receiver and remote sensor. The chlorine and sulfur dioxide gas detector shall have a range of 0-10 parts per million (ppm), ammonia will have a range of 0-50 ppm or 0-100 parts per million (ppm).
- B. The receiver shall provide a LED bar graph display. The LED bar graph display shall be color-coded to indicate sensor status, gas concentration and alarm set point. Additional

LEDs shall provide for indication of set point alarm, sensor malfunction, power ON and sensor ready. The receiver shall be housed in a NEMA 12 enclosure.

- C. The sensor shall be an electrochemical type requiring no chemical addition with a response time of 60 seconds maximum for 80% of full range at 20 degrees C. The sensor shall be wall mounted and housed in a NEMA 12 enclosure.
- D. The alarm and malfunction contacts shall be SPDT rated at 10 amps at 240 Vac or 28 Vdc maximum resistive or inductive load. The alarm and malfunction contacts shall be field configurable for manual reset (latching) or automatic reset (non-latching).
- E. Communications between the sensor and receiver shall be 3-wire, shielded, 22 gauge cable. The maximum distance between the receiver and sensor shall be 1000 feet/305 meters.
- F. The gas detector shall operate from a (120 Vac), (240 Vac), 50/60 Hz, 1 phase power supply. The receiver and sensor electronics shall have provisions for protection against radio frequency/electromagnetic interference.
- G. Weatherproof visual and audible alarms shall be provided.
- H. A sensor test kit shall be provided.

2.10 GAS DETECTORS, ACCESSORIES

- A. The Gas Detector Power Back-up, with internal battery automatically provides power to the Gas Detectors in the event of a power failure. No manual switching is required. The Gas Detector Power Back-up shall automatically and continuously recharge to supply maximum support to the Gas Detector.
- B. The Gas Detector Power Back-up shall be provided with a POWER switch, POWER indicator, a LED indicator for ALARM, an audible alarm and an OFF control for silencing the audible alarm. The Gas Detector Power Back-up shall provide charging rate and battery status LED indicators. A high and a low charging rate shall be provided to the internal 18 volt battery.
- C. The Gas Detector Power Back-up shall operate from a (120 Vac), (240 Vac), 50/60 Hz, 1 phase power supply. Terminals for battery power back-up shall be provided.

2.11 SAFETY EQUIPMENT, AIR MASKS AND ACCESSORIES

- A. The pressure-demand air mask shall be supplied without a carrying case.

- B. The apparatus shall be provided with full vision mask gauge, regulator, shoulder harness, 30-minute air tank, spare 30-minute air tank, and shall be suitable for chlorine gas service. The apparatus shall be NIOSH/MSHA certified.
- C. A 14 gauge steel wall mounted enclosure, suitable for outdoor mounting with an industrial enamel yellow finish, shall be provided for mounting of the Air Mask and a spare 30 minute tank

2.12 EQUIPMENT FOR A CHLORINE VENT EXHAUST GAS ARRESTOR (VEGA) SYSTEM

- A. The VEGA system shall be fully passive and shall be designed to neutralize up to 3 pounds (1.4 kg) of cumulative chlorine vent exhaust from a chlorinator VR (Vacuum Regulator) while never exceeding the NFPA 1 Uniform Fire Code allowable ½ IDLH until bed exhaustion.

B. Design Criteria

1. Design chlorine vent rate 0.12 pounds per hr (0.05 kg per hr)
2. Design vaporization percent 100%
3. Design chlorine vaporization rate 0.65 scfh (0.02 m³ per hr)
4. Design vent amount, total 3 pounds (1.4 kg)
5. Temperature 70°F (21.1°C)
6. Max. temp. during service cycle 140°F (60°C)
7. Max. chlorine exhaust concentration less than 100 ppbv

C VEGA SYSTEM OPERATION

1. In the event of a chlorine vacuum regulator vent, the vent exhaust gas arrestor will passively neutralize the chlorine gas.
2. The chlorine gas will gravity flow from the VR vent to the floor mounted arrestor bottom inlet. The exothermic reaction between the chlorine and the dry neutralizing media will cause a draft as the clean hot air rises and exits the arrestor top outlet.
3. The pressure loss through the VEGA will be less than an equivalent length of tubing.
4. The chlorine discharge concentration will be less than the NFPA 1 Uniform Fire Code allowable ½ IDLH.
5. Exhaustion will be evident by a change in color from white to yellow by the colorimetric indicator strip on the VEGA exhaust line.

- D. A single ISO 9001 approved manufacturer shall be responsible for the overall performance of the VEGA. The system manufacturer shall have a minimum of ten years successful experience, with thirty or more operating installations of chlorine gas treatment systems in the United States, and shall be prepared to submit evidence of this fact in the form of names, addresses, and, or actual contacts at these installations.

- E. Only those manufacturers that have successfully tested and have published test data prior

to bid, on an actual prototype dry-chemical chlorine arrestor, to verify system performance, will be accepted as the supplier. Such testing shall have been conducted in a full-scale arrestor at full-scale chlorine loads.

F. Only those manufactures that meet the requirements of the specification and are certified to ISO 9001:2000 standards shall be accepted. The manufacturer shall submit ISO: 9001 certification at time of bidding.

G. Vent Exhaust Gas Arrestor Vessel:

1. One (1) 10" sq x 17" high (25.4 cm sq x 43.2 cm high), high density polyethylene, 70 mil gauge, container with carrying handle, built-in hand grips and lockable lid, white opaque, and UV inhibited
2. 1/2" F-NPT side mounted bottom inlet and top outlet PVC bulkhead fittings with internal screens
3. 3/4" clear PVC external inlet and outlet observation elbows with colorimetric chlorine indicator strips
4. One (1) kit of two (2) each of three tubing connectors for 3/8", 1/2", 5/8" tubing
5. Bulkhead 1/2" shipping plugs
6. Total filled weight not to exceed 35 pounds (15.9 kgs)

H. Dry Media:

1. Provide chemically impregnated carbon-free media to neutralize chlorine gas. The media shall be generally spherical in shape, porous, non-flammable and capable of removing, absorbing and adsorbing chlorine throughout the entire media bed. Media shall be macroporous alumina oxide substrate with sodium thiosulfate impregnation capable of operating at -40°F (40°C) temperatures. Media containing activated carbon are not acceptable.
2. Quantity: Minimum 30 pounds (13.6 kg)
3. Average crush strength: 12 pounds (5.4 kg)
4. Average Density: 50 pound/cu ft (801 kg/m³)
5. Average media diameter: 1/8" (3.18 mm)

I. Connecting Tubing:

1. The tubing and other fittings as needed between the VEGA and the vacuum regulator vent and any tubing needed to an outside vent for a single VEGA arrangement. The contractor shall provide the tubing between a VEGA "piggy-back" stacked arrangement if used. All tubing shall be flexible and complete with all necessary connectors per the Chlorine Institute and vacuum regulator manufacturer's recommendations.

2.13 SAFETY EQUIPMENT

A. An emergency repair kit for chlorine cylinders shall be supplied. The emergency repair kit shall be designed to repair leaks that occur on chlorine containers.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

- A. The Contractor shall inspect all equipment immediately upon receipt.

- B. The equipment shall not be installed, if damaged, until repairs have been made in accordance with the manufacturer's written instructions.

3.02 INSTALLATION

- A. The Contractor shall install the equipment in accordance with the drawings and manufacturer's recommendations.

3.03 START-UP SERVICES AND TESTING

- A. The equipment manufacturer shall furnish the services of a qualified field engineer to provide start-up and testing in accordance with the manufacturer's written instructions.

- B. After start-up and testing, the manufacturer's representative shall instruct operating personnel in the proper operation and maintenance of the equipment.

- C. The manufacturer's representative shall provide the following minimum service requirements:
 - 1. One (1) - 8-hour days on site for start-up and testing.
 - 2. One (1) - 8-hour days on site for operator training.

END OF SECTION

GAS CHLORINATION SYSTEM

SECTION 11282
SLIDE GATES AND WEIR GATES

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install complete, slide gates, weir gates, operators, operating systems and appurtenances as shown on the Drawings and as specified herein.

1.2 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:
 - 1. Complete description of all materials.
 - 2. Certified shop and installation drawings showing all details of construction, dimensions and anchor bolt locations.
 - 3. Descriptive literature, bulletins and/or catalogs of the equipment.
 - 4. A complete bill of materials.
 - 5. The weight of each component.
 - 6. Description of surface preparation and shop prime painting of gates and accessories.
- B. In the event it is not possible to conform to certain details of this Section, describe completely all non-conforming aspects.
- C. Operation and Maintenance Data
 - 1. Operating and maintenance instructions for each type of equipment shall be furnished to the Engineer as provided for in Section 01730.

1.3 REFERENCE STANDARDS

- A. ASTM International
- B. National Electrical Manufacturers Association (NEMA)
- C. Aluminum Association, Inc. (AA)

- D. Factory Mutual (FM)
- E. Underwriters Laboratories (UL)
- F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.4 QUALITY ASSURANCE

- A. The slide gates, weir gates, operators, operating stems and appurtenances specified under this Section shall be furnished by manufacturers who are fully experienced, reputable and qualified in the manufacture of the equipment furnished. The slide gates, weir gates, operators, operating stems and all related equipment shall be designed, constructed and installed in accordance with the best practices and methods.

1.5 MAINTENANCE

- A. Tools and Spare Parts
 - 1. Special tools required for normal operation and maintenance, shall be furnished with the equipment by the supplier.
 - 2. Spare parts routinely requiring replacement during one year's operation at design loading shall be furnished by the supplier.

PART 2 PRODUCTS

2.1 ALUMINUM SLIDE GATES AND WEIR GATES

- A. The slide gates and weir gates shall have the characteristics and dimensions as shown on the Drawings and specified herein.
- B. The stainless steel slide gates and accessories shall be self-contained or conventional type with the disc arranged to lower or raise to open and with the guides designed to mount on the face of, or embedded in concrete.
- C. The guides shall be of Type 316 stainless steel construction. The guides shall be designed for maximum rigidity, shall have a weight of not less than 3 lbs/ft and will be provided with holes for anchor bolts every 18-in for face mounted units or embedding keyways for embedded units. Guides shall extend beneath the opening a sufficient amount to support the disc in the fully down or open position for downward opening gates.
- D. Guides in the gate frame shall be of a double slot design. The primary slot shall

accept the plate of the disc and the second slot shall be sufficiently wide so that the reinforcing ribs of the disc may extend into it. Guides shall be supplied with polyethylene bearing strips to reduce friction along the guide surfaces.

- E. An angle shall be welded to the guides across the invert of the opening on face-mounted gates and up both sides of all gates. A hollow bulb "J" or "P"-seal will be attached to this angle with stainless steel strips and attaching bolts. The seal shall be arranged so that it will deflect a minimum of 1/16-in. Angle, strips and bolts shall be the same material as the guides.
- F. The operating stem shall be Type 316 stainless steel with a minimum diameter of 1-1/2-in designed to withstand at least twice the rated output of the operator. The slenderness ratio (l/r) shall be less than 200.
- G. Where the guides extend above the operating floor, they shall be sufficiently strong so that no further reinforcing will be required. Where required, the yoke to support the operating benchstand will be formed by two angles welded at the top of the guides to provide a one-piece rigid frame. The arrangement of the yoke will be such that the disc and stem can be removed without disconnecting the yoke.
- H. The disc or sliding member shall be tabulated, of the same composition as the frame, reinforced with "U" or angle-shaped aluminum welded to the plate not more than 16-in apart. The disc shall not deflect more than 1/360 of the span of the gate under the design head. Reinforcing ribs shall extend into the guides so that they overlap the seating surface of the guide. A specially molded resilient seal shall be mounted on the bottom of embedded unit discs or on the edge of the disc to provide flush bottom closure. The shape of the seal shall produce a seating surface having a minimum width of 3/4-in and the seal shall extend into the secondary slot of the guide. The vertical face of the seal shall be in contact with the seating surface of the guide to provide a proper seal at the corners. Reinforcements, retainer and bolts shall be of the same material as the disc. The invert of embedded unit frames shall have an angle welded to the lower ends of the guides to form a seating surface for a resilient seal mounted on the disc. Angle shall be of the same material as the guides.
- I. All parts of the gate shall have a minimum thickness of 1/4-in.
- J. Rising stems shall be connected to the disc by means of a cast aluminum stem connection, threaded and bolted to the stem and welded to the disc. Non-rising stems shall have a bronze nut. The stems shall have adjustable bronze stop collars above and below the lift nut to prevent overopening or overclosing the gate.
- K. Floor stands shall be furnished for all gate operators not supported on the gate yoke. Floor stands shall be cast-iron or cast steel construction. The pedestal height shall be such that the crank shaft will be approximately 36-in above the operating floor. Wall brackets shall be used to support floor stands where shown on the Drawings and shall be furnished in cast iron or welded steel construction, designed to withstand all

normal operating loads. Where shown on the Drawings, floor stands shall be offset type mounted on the floor surface, and offset to align with the gate stem. The floor stand shall be mounted on a heavily ribbed reinforced cast iron bracket anchored to the concrete with Type 316 stainless steel anchors. The bracket and anchor bolts shall be sized to transfer the upward or downward thrust required to ultimately fail the stainless steel stem. The design and detail of the brackets and anchor bolts shall be provided by the gate manufacturer and acceptable to the Engineer. The bracket, anchors, backplate and accessories shall be supplied as part of the gate assembly by the gate manufacturer.

- L. All necessary attaching bolts and anchor bolts shall be Type 316 stainless steel and shall be furnished by the slide gate manufacturer.
- M. All stems shall be provided with fracture resistant clear butyrate plastic stem covers complete with indicator markings to indicate gate position. Stem covers shall not discolor or become opaque for a minimum of 5 years after installation. The top of the stem cover shall be closed. The bottom end of the stem cover shall be mounted in a housing or adapter plate for easy field mounting
- N. Manual operators shall be furnished where shown on the drawings and shall consist of a handwheel or crank operator mounted on the gate yoke or on a floorstand.
 - 1. Handwheel operators shall have a minimum 18-in diameter handwheel and shall operate the gate under the specified operating head with not greater than 40 lbs of force on the handwheel. The operator shall be fully enclosed, equipped with roller bearings above and below the operating nut and mechanical seals. Alternatively, polyethylene bearing pads may be used. The hand wheel shall be readily removable so that a power wrench may be used to open and close the gate by the wrench to the nut.
 - 2. Crank operators shall have either single or double gear reduction depending upon the lifting capacity required. Double reduction operators shall also be two speed type, with a square nut drive on the high speed and low speed shafts. Each type shall be provided with a threaded cast bronze lift nut to engage the operating stem. Bearings shall be provided above and below a flange on the operating nut to support both opening and closing thrusts. Operators shall be designed for a maximum crank effort of 40 lbs under the specified operating conditions. Gears, where required, shall be steel with machined cut teeth designed for smooth operation. The pinion shafts on crank-operated floor stands, either single or double ratio, shall be supported on tapered roller bearings and enclosed in a cast iron case and cover. Positive mechanical seals shall be provided on the operating nut and the pinion shafts to exclude moisture and dirt and prevent leakage of lubricant out of the hoist. Lubricating fittings shall be provided for the lubrication of all gears and bearings. The crank shall be of cast iron with a revolving brass grip. The crank shall be removable.

3. Operators shall be equipped with fracture-resistant clear butyrate plastic stem covers which shall not discolor or become opaque for a minimum of 5 years after installation. The top of the stem cover shall be closed. The bottom end of the stem cover shall be mounted in a housing or adapter plate for easy field mounting. Stem covers shall be complete with indicator markings to indicate gate position. An arrow with the word "OPEN" shall be permanently attached or cast onto the operator to indicate the direction or rotation to open the gate. The direction of rotation to open shall be clockwise.
 4. On gates as shown, provide dual operators to maintain stability of the disc. Operators shall be crank operators as specified above, joined together by a shaft such that operating a crank on one will cause both operators to move together.
 5. On gates as shown, provide non-rising stem type operators consisting of a stem with 2-in square nut on top mounted in a cast iron floor box set in the concrete floor above the gate. Provide one tee wrench for each gate
- O. Slide gates, weir gates and appurtenances shall be by Rodney Hunt Company, Orange, MA Whipps, Inc.; Athol, MA Hydrogate, or Waco.
- P. All aluminum components shall be entirely anodized in conformance with the AA C22-A41. All gates shall be given a coating of nickel flouride.
- Q. All stainless steel components shall be Type 316 and shall conform to the appropriate ASTM standards except as otherwise specified herein.

2.2 SURFACE PREPARATION AND SHOP PAINTING

- A. All surfaces shall be prepared, shop primed, and finished as part of the work of this Section. Surface preparation and shop painting shall be as specified in Section 09901 and Section 09902.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation of all gates and guides shall be done in a workmanlike manner. Handle, store and install the equipment specified in this Section in strict accordance with the manufacturer's drawings and recommendations. Frames and guides shall be installed in a true vertical plane and shall be installed with 90 degree corners.
- B. Gates with embedded guides and inverts shall be installed in accordance with the recommendations of the manufacturer subject to the Engineer's approval.
- C. The installation of all gates shall be under the supervision of a

SLIDE GATES AND WEIR GATES

representative of the manufacturer furnishing the gates.

3.2 FIELD TESTING

- A. Furnish the services of a factory representative, as provided under Part 1, who has complete knowledge of proper operation and maintenance to inspect the final installation and supervise a test of the equipment. These services may be combined with those provided under Part 1.
- B. After installation, all slide gates and weir gates shall be field tested at maximum differential head to ensure that all items of equipment are in compliance with this Section, including the leakage requirements.
 - 1. Maximum allowable leakage for slide gates and weir gates shall be 0.1 gpm/ft of perimeter under the design seating head. Additional seals shall be provided as required to insure that the above leakage requirement is met.
- C. In the event that any unit fails to meet the above requirements, the necessary changes shall be made and the unit retested. If the unit remains unable to meet the test requirements to the satisfaction of the Engineer, it shall be removed and replaced with a satisfactory unit at no additional cost to the Owner.

END OF SECTION

SECTION 11312
TERTIARY FILTERS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK:

- A. Each Discfilter shall consist of a central drum onto which the discs with the filter media panels are assembled. The rotating filter drum is supported on the front and rear ends by sleeve bearings. Each filter unit shall include center drum, discs with filter media panels, support frame with cover, backwash spray assembly with pump, backwash trough/pipe, drive mechanism, automatic control system and components as specified.
- B. Filter shall be equivalent to the design as shown on the plans.

1.2 QUALITY ASSURANCE:

- A. Applicable Standards:
 - 1. ASTM -American Society for Testing and Materials
 - 2. AISI -American Iron and Steel Institute
 - 3. AGMA -American Gear Manufacturer's Association
 - 4. NEMA- National Electrical Manufacturer's Association
 - 5. NEC -National Electric Code
 - 6. AWS D1.6 - Structural Welding Code: Stainless Steel
- B. To assure unity of responsibility, center tube, discs with filter media panels, support frame with cover, backwash spray assembly with pump, backwash trough, drive mechanism, automatic control system and components as specified shall be furnished and/or coordinated by a single manufacturer.
- C. Base Bid Manufacturer:
 - 1. WesTec SuperDisc Model TD 2415-15
 - 2. Kruger High Flow Discfilter Model 2216, Type 1F
- D. Deductive Substitute Equipment Manufacturers:
 - 1. Deductive Substitute equipment/supplier will be considered if the substitute is the same or better than the product named and described in the specifications in function, performance, reliability, quality and general configuration and cost. Determination of the equality of a substitute shall be determined by the Engineer after the bid, based on submittal data received with the Contractor's bid

documents. Should the write-in deductive substitute be determined "not equal", then the bidder shall supply the equipment listed in the Base Bid column. The Owner is not obligated to except the deductive substitute.

2. The filtration equipment shall be furnished by a manufacturer who shall have at least five (5) years' experience in the United States or ten (10) years' experience elsewhere in the design, production, assembly and field service of equipment of like type, size and capacity in similar applications. The equipment manufacturer shall have at least twenty (20) successful installations in the United States utilizing equipment of like type in similar applications. The Engineer may request a list of the successful installation, including date, location, filter capacity and owner contact information.
3. The equipment supplier must have manufacturing and warehouse facilities located in the United States including parts inventory, and personnel based in the United States and employed by the supplier to provide direct technical and field support. The equipment manufacturer must provide information supporting their ability to provide these services.
4. The disc filtration technology shall be accepted filtration technology for compliance with the State of California Water Recycling Criteria (Title 22).
5. Decreases in installation and O/M costs will also be considered in the selection as well.

1.3 SUBMITTALS

- A. Submit as specified in Section 01330.

1.4 PERFORMANCE REQUIREMENTS

- A. The Discfilter System shall be capable of meeting the following performance requirements.

Performance Criteria, System	Value
Peak Hourly Flowrate (MGD)	6.0
Design Flowrate (MGD)	4.0
Maximum Influent TSS (mg/L)	≤20
Daily Average Influent TSS, (mg/L)	≤5
Monthly Average Effluent TSS*, mg/L	≤5
Filter Design Data	
Maximum Filter Pore Size, μm	<20
Filter Material	Varies
Number of Units	1
Maximum Headloss across filter at Peak Flowrate at Backwash Initiation (ft)	2.5

Maximum Flow per Wetted SF of Filter Area at the Design Flowrate	6 gpm/sf
Backwash Cleaning System	
Max Backwash Total Horsepower	25 HP, 460v, 3 phase
Maximum Backwash Flowrate, gpm	3% of Flow

- B. The automatic backwash filter system shall be suitable for filtering domestic wastewater after secondary treatment and clarification. Each filter shall be designed to operate on a continuous basis and shall be designed to operate while receiving varying flows.
- C. The proposed disc filtration system shall not exceed a hydraulic loading rate of 6.00 gpm/sf at the design flow rate. The number of discs will vary upon each vendor.
- D. Any equipment manufacturer that does not meet the experience requirements stated within this specification shall provide a Performance Bond or other suitable means of financial guarantee that the disc filtration system will meet the performance requirements described above. The Performance Bond shall be for a duration of 36 months after system startup.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. All fabricated metal shall be AISI 304 stainless steel as a minimum standard. Any wetted/exposed metal not meeting the minimum standard shall be noted in the proposal along with the protective coating system and expected lifetime between coatings. Vendors may offer deductive alternates for evaluation by the Engineer and Owner.
- B. The valves, equipment, materials of construction and controls specified under this section supersede valves, equipment, materials of construction and controls specified elsewhere in the contract documents. Purchased components such as gear reducers, pumps, motors, valves, and actuators shall be provided with standard recommended manufacturers paint, unless otherwise specified within this section.
- C. The disc filtration units shall be fully preassembled and factory inspected prior to shipping the filtration units. Drive motor and backwash pump are to be installed at the factory and provided integral to the filtration unit. Any in-field assembly that may require excessive installation hours of the filtration system by the contractor shall be noted.

2.2 DISC ASSEMBLY

- A. All filters shall be composed of modular and removable discs. Each disc shall consist of disc segments that can be easily mounted or dismounted without special tools or

considerable downtime.

- B. Nominal media pore size shall not exceed 20 microns. Filtration systems utilizing media greater than 20 microns shall not be accepted.
- C. Filter discs must be constructed of modular segments and each disc segment must include a substantially open area along the length of the radial support to allow the liquid to flow from one section to the other as the discs are rotated.

2.3 COVERS

- A. If high pressure spray wash is used, the upper part of the filter shall be furnished with a weather resistant cover to prevent aerosols. One side of the cover shall have access lid(s) that can be opened to allow operator access to all of the discs and backwash nozzles. All filters shall have some means of sun protection of the exposed water to prevent algae growth and UV degradation of the filter equipment and media.

2.4 BACKWASH CLEANING SYSTEM

- A. Externally Fed Discfilters shall be equipped with a backwash-collecting trough for removing solids. The trough shall be constructed of 304 stainless steel. The trough length shall be sufficient to capture reject water from all filter discs. The trough shall be elevated to prevent contact with the influent stream. The reject water shall leave the trough by gravity via the backwash outlet connection. Piping from the trough to the outlet connection shall be 304 stainless steel connected with stainless steel shielded, flexible elastomeric PVC couplings. The backwash outlet connection shall be a 6 inch ANSI loose flange. It shall be equipped with a single oscillating backwashing system with moving spray headers for efficient cleaning of the filter cloth and for reduction of the consumption of backwash water. All panels shall receive 110 psi pressure backwash spray. Systems with separate solids removal and backwash discharge systems shall not be acceptable.

2.5 DRIVE MECHANISM

- A. A drive assembly shall be incorporated to rotate the center tube/disc assembly during the backwash cycles. The drive motor shall be easily accessed for inspection and maintenance.
- B. The drive assembly shall consist of a single gear motor with chain or belt driven sprocket. The motor shall be standard efficiency TEFC rated.
- C. Reducer design end rating shall equal or exceed AGMA requirements.

2.6 FLOW BYPASS

- A. A means for bypass shall be in the inlet structure to allow for diversion of unexpected high inlet water level without contamination of the filtered effluent chamber. The bypass means shall be constructed by others and shall be at the inlet side of the filter unit. Filter unit shall be capable of bypassing influent flow without contaminating effluent.

2.7 WEIRS

- A. All weir assemblies shall provide adequate weir length to allow for operation of the filtration equipment throughout the specified flow ranges as noted above.

2.8 DISCFILTER SPARE PARTS

- A. Due to differences in filtration equipment, Spare Part Kits shall be listed separately along with prices for each recommended spare part and shall not be included in the bid price. Spare parts shall be considered any piece of the filtration system that will need to be replaced in under 5 years of continuous operation including media, nozzles, pumps, belts, chains, bearings, and any other normal wear parts. The list shall include the expected frequency of replacement to allow for maintenance cost evaluations.

2.9 CONTROL PANEL AND OPERATION

- A. The Discfilter operation shall be managed by an automated control system. The automatic control will be designed around a Programmable Controller. The control system is an integral part of the Discfilter system and shall be provided in a UL labeled, NEMA 4X 304 Stainless Steel enclosure. Each Discfilter unit shall include a control system which shall consist of a programmable controller, fused main disconnect, control transformer, branch circuit breakers, motor starter/protector, hand-off-automatic switches, and liquid level sensor relay for initiating backwash. The power feed to the control panel shall be 480VAC 60Hz 3 phase, control voltage shall be 120VAC 60 Hz 1 phase.
- B. The control panel enclosure shall meet the following criteria, 304 Stainless Steel, seams continuously welded and ground smooth, seamless foam-in-place gasket for watertight dust-tight seal, door opens 180°, quarter turn latches opened or closed using a screw driver, and NEMA Type 4X , UL Listed 4X.
- C. The main disconnect shall be enclosed in the control panel, with a handle mechanism extending through the door. The main disconnect shall be a fused disconnect rated for 30 Amps 3-Pole. The main disconnect shall be composed of three primary components; 30A fused disconnect, extension shaft, NEMA 4X operating handle.
- D. Each filter shall be equipped with an adjustable water level sensor located in the influent chamber for the purpose of backwash initiation. The installing Contractor

is to provide wiring and conduit to connect the level sensor to a liquid level relay located in the Discfilter Control Panel.

- E. Each filter unit will be supplied with a high level sensor. The device used for the high level sensor will be the same part(s) and number used for the backwash level sensor. The high level sensor will be mounted in such a way as to insure that the device indicates when the water reaches a height above the backwash level sensor and has entered a high level scenario. When the high level sensor is activated, it will activate a relay inside the control cabinet and a pilot light on the front of the control panel will illuminate. The pilot light will be labeled "Filter High Level". The high level relay will have a spare set of normally open dry contacts available for monitoring.
- F. Field wiring terminal blocks for the Discfilter Control Panel will be din rail mountable, individually numbered, rated for 600 Volts 30 Amps.
- G. Motor wiring terminal blocks for the Discfilter Control Panel will be din rail mountable, individually numbered, rated for 600 Volts 65 Amps.
- H. A motor starter located in the Discfilter Control Panel will manage the start/stop of the Backwash Pump motor. The motor starter will be sized appropriately to match the requirements of the Backwash Pump motor. The motor starter will be a starter, rated 0.1 ~ 25Amps @ 460VAC 3 phase, ½ ~ 20HP @ 460VAC 3 phase, rotary handle operator, visible trip indication, protection by overload, short circuit, undervoltage and shunt. The motor starter will be equipped with auxiliary contacts for monitoring and control.
- I. A VFD located in the Discfilter Control Panel will manage the start/stop of the Filter Drum motor. The VFD will be sized appropriately to match the requirements of the Filter Drum motor. The VFD will be equipped with an integral keypad display for VFD interface and configuration, use sensorless flux vector technology, use with 3-phase asynchronous motors, monitoring and control inputs and outputs, motor and drive protection. The VFD will not require input/output filters or harmonic testing. The VFD will be hardwired for control and monitoring and will not require any communication protocols such as Ethernet, DeviceNet, and Modbus.
- J. The control panel shall be equipped with SCADA signals (dry contacts) for the following: Backwash Pump Auto, Backwash Pump Run, Backwash Pump Fail, Filter Drum Auto, Filter Drum Run, Filter Drum Fail, Backwash Requested, Discfilter High Level. The listed signals will be wired to terminals located inside the Filter Control Panel. The Programmable Controller shall also be supplied with ethernet communication capabilities to allow the plant SCADA system to monitor the status of the filter via the existing plant network. IP addresses for ethernet based equipment shall be coordinated with the Owner's system integrator for incorporation into the SCADA system.
- K. The control panel shall contain a fiber to copper media converter/network switch to facilitate interconnection with the plant SCADA system.

- L. The control panel shall have external pilot lights mounted on the door indicating run status of the filter unit and backwash cycle. The pilot lights will be NEMA 4X, 120VAC, standard.
- M. The control panel shall have external selector switches (Hand-Off-Automatic). The selector switches will be NEMA 4X, 30mm, non-illuminated, manual return and equipped with contact blocks. The control panel selector switches will allow the drum drive and backwash motor to be operated in Hand mode.
- N. The completed control panel shall be factory tested before shipment.
- O. The Programmable Controller will perform logic, timing, counting and real time clock operations. The Programmable Controller will be programmed using software to allow configuration of a downloadable program featuring input instructions, output instructions, timer instructions, counter instructions and counter instructions. The Programmable Controller will be capable of communicating to other Controllers that are of the same make and model via a cable that interconnects the units up to a maximum of eight units. The Programmable Controller will be equipped with 12 Digital Inputs (120VAC) and 4 Relay Outputs, additional I/O can be added via I/O expansion module. The Programmable Controller shall be an Allen Bradley CompactLogix PLC flashed with firmware revision 24 (No Substitute).
- P. The Control System will be supplied with one Operator Interface. The Operator Interface will be capable of interacting with the Programmable Controller. The Operator Interface will be capable of displaying text and graphics, allow operator setpoint entry, and provide system status display. The Operator Interface shall be an Allen Bradley 10" PanelView Plus 7 (No Substitute).
- Q. Control system will also allow for continuous back washing in HAND mode.
- R. The installing Contractor is responsible for providing Interconnecting wiring and/or conduit between the supplied control panel and Filter equipment. The installing Contractor shall provide any junction or pull boxes or any other like device needed to supply the interconnecting wiring.
- S. All field connections/terminations to the supplied control panels, the Discfilter equipment and between the Discfilter and supplied control panels shall be the responsibility of the installing Contractor.

PART 3 EXECUTION

3.1 GENERAL

- A. The Contractor shall install the Filter system per the Equipment Manufacturer's directions and the drawings. The Contractor will provide all supports and

anchoring required to install the Filter unit. The plumbing/interconnecting piping, electrical connections, grating and handrails shall be provided by the Contractor as detailed on the drawings and specifications including winterization such as piping insulation or heat tracing/heat tape. The Equipment Manufacturer will provide adequate protection of the equipment for shipment to the project site. Installation instructions will be provided that specifically outline installation of the Discfilter. Lifting instructions will be provided to assist the Contractor.

3.2 FIELD SERVICES

- A. The Equipment Manufacturer shall furnish the services of a factory-trained representative based in the United States and employed by the manufacturer, for four (4) working days and two (2) separate trips. These two trips shall consist of one (1) trip to monitor the installation and one (1) trip for start-up and instruction of plant operating personnel. The start-up training shall be recorded or provided via a separate training video. The Contractor will provide to the Equipment Manufacturer a minimum prior notice of three (3) weeks in order to schedule these services.

PART 4 WARRANTY

4.1 GENERAL

1. The Equipment shall materially conform to the description in this Specification and the Contract Documentation and shall be free from defects in material and workmanship. The warranty periods 2 years from beneficial use meeting the design requirements. Should any major defect occur during the warranty period that is abnormal requiring frequent repair and replacement, then the warranty period shall be reset upon replacement and recommissioning. Any equipment manufacturer that does not meet the experience requirements stated within this specification shall provide a warranty of 5 years from beneficial use.

END OF SECTION

SECTION 13125
PRE-FABRICATED CONCRETE BUILDING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This section provides specification requirements for a Pre-Fabricated Concrete Building, consisting of reinforced pre-cast walls, roof; interior and exterior lighting, and HVAC system. The building will serve as the main electrical service and control building for the specific project. Building will be supplied without a floor, unless noted otherwise.
- B. The Building shall be delivered to the location identified on the contract drawings as a fully functional unit, including all electrical conduits, HVAC, doors and all necessary components identified on the contract drawings.
- C. Prior to delivery, the Supply Contractors shall be coordinate with the Owner or Authorized Representative to verify final floor template layout and required floor penetration locations. Supply Contractor shall make all adjustments to doors, seals, and fasteners for satisfactory operation.
- D. Any exceptions/deviations to this specification shall be indicated in writing and submitted with the quotation.

1.02 SUBMITTALS

- A. Submittals shall be in accordance with Submittals Section. A large scale template shall be submitted indicating exact location and size opening required for all floor / side wall penetration locations required to supply electrical and monitoring components, if bottom floor is provided.

1.03 REGULATORY & QUALITY ASSURANCE REQUIREMENTS

- A. ACI-318-2008, "*Building Code Requirements/or Reinforced Concrete*". Concrete Reinforcing Institute, "*Manual a Standard Practice*"
- B. ASCE-7-05 "*Building Code Requirement for Minimum Design Loads in Buildings and Other Structures*"
- C. Florida Building Code - 2007, with 2009 Supplements
- D. Unified Facilities Guide Specifications. Divisions 00-09; 21-23; 26-28; 33
- E. UL-752 Test Method Level Four (4) for Bullet Resistance certified by an Independent Structural Engineer.
- F. Concrete Reinforcing Institute, "*Manual of Standard Practice*".

- G. Building fabricator must have a minimum of 5-years experience manufacturing and setting transportable precast concrete buildings.
- H. Steel Construction Manual - AISC-360-05.
- I. PCI Design Handbook - 6th Edition
- J. International Building Code - 2009
- K. National Electrical Code - 2008
- L. Life Safety Code - NFPA 101-03
- M. ANSI A117.1-2003
- N. ADA Standards - 28 CFR Part 36 - 1994

1.04 WARRANTY

- A. A minimum five (5) year warranty shall be provided by the Building Manufacture and Material Contractor warranting the integrity of the Pre-Cast Concrete Building structure against defects in material and workmanship. The warranty shall include the complete non-prorated repair or replacement of the defective material.

PART 2 PRODUCTS

2.01 ACCEPTABLE PREFABRICATED BUILDING MANUFACTURES:

- A. The precast concrete pre-fabricated transportable building shall be EASI- SET brand as manufactured by Concrete Modular Systems, or prior approved equal. Building to be delivered and placed on slab in accordance with manufacturer's recommendations.
- B. Building to be provided by manufacturer with all necessary openings as required for providing service to electrical controls, drives and service enclosures / cabinets in conformance with manufacturer's requirements.
- C. A floor plan template with knock-out opening locations and dimensions shall be included in submittal package for review. Prior to delivery of the Building to the Project site, Contractor shall verify completion of foundation and alignment of final electrical conduit stub-ups.

2.02 DIMENSIONS & DESIGN LOADS

- A. Building exterior dimensions shall be as provided in the contract drawings. As a minimum, the building shall be a minimum of 12' wide x 20' long x 11' tall with a single sloped roof. Low side of building shall be 10'6" respectively including roof panel thickness. Wall shall be 4" thick, floor thickness of 5" (if specified), and a roof thickness of

6" at center tapering to 4" at the sides (2" slope). The roof panel shall extend a minimum of 3" beyond the wall panel on each side.

B. Design Loads:

- a. Seismic load performance category 'C', Exposure Group III
- b. Standard Live Roof Load - 65 PSF
- c. Standard Floor Load - 250 PSF
- d. Standard Wind Loading - 150 MPH

C. Roof, walls and floor (if specified) panels must each be produced as single component monolithic panels. No roof, floor, or vertical wall joints will be allowed, except at corners. Wall panels shall set on top of floor panel.

2.03 CONSTRUCTION

- A. Concrete shall be Steel-reinforced, polypropylene fiber reinforced, 4000 PSI minimum 28 day compressive strength, air-entrained (ASTM C260) and shall be insulated.
- B. Reinforcing Steel shall be ASTM A615, grade 60 unless otherwise indicated.
- C. Reinforcing Fiber shall be Polypropylene fiber, Fibermesh @ 1.5 pounds per cubic yard.
- D. All panels shall be securely welded together with 1/4" thick steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A253, Grade C. All fasteners to be 1/2" diameter coil thread bolts. Cast-in anchors used for panel connections to be Dayton-Superior #F-63, or approved equal.
- E. All wall joints between panels shall be caulked on the exterior and interior surface of the joints. Caulking shall be Sonneborn Sonolastic 150 elastic sealant or approved equal, color to match adjacent building surface.
- F. All floor to wall joints shall be sealed to create a continuous and permanent water tight seal on both interior and exterior surfaces with a polyurethane sealant. Sealant shall be Sikaflex-2c, as manufactured by Sika Corporation or approved equal, color to match adjacent building surface.

2.04 ACCESSORIES

- A. Doors and Frames: Shall comply with Steel Door Institute "Recommended Specifications for Standard Steel Doors and Frames" (SDI-IOO), and as herein specified. The buildings shall be equipped with two one (1) 3'-0" W x 7'-0"H x 1 3/4" single fiberglass reinforced polyester (FRP) door with FRP frames. Dimensions shall be measured for clear interior opening. Doors and frames shall be SDI Grade III, Model \$, seamless with 0.125 in face sheet (door), and 0.1875 (frame). Fiberglass content shall be minimum 30% to maximum 40%, with UV stabilization. Doors shall have flush top closure and minimum 1 3/4" thick.

Coated with minimum 15 mil gel coat thickness. Color to be selected by Owner. Coordinate with Owner on final exterior colors and exterior finish.

- B. Door Hardware shall be as follows:
 - a. Hinges to be Cal Royal #BB-31 – 4.5 x 4.5 x NRP, US32D (316 SS Pin & Plate), Min. 3 per door.
 - b. Lock set to be Schlage Lock L9456-06L, US26D Finish. The Key Schedule will be: **Okaloosa County Water & Sewer Electrical/LS Key: AB1 (5 ea)**
Contact is Warren Hollow Metal Doors and Frames, Inc. 800.850.9821.
 - c. Threshold to be Hager Companies 417SA x 36", CL with neoprene seal
 - d. Door Closer to be Cal Royal CR441 Series, or approved equal.
 - e. Drip Cap to be Hager Companies 81OS, or approved equal.
 - f. Door Bottoms to be Hager Companies 743S, US32D

2.05 FINISHES

- A. Interior of Building
 - a. Walls & Ceiling: R-19 Insulation Package with Fiberglass Reinforced Plastic Paneling, White
 - b. Floor (if specified): Smooth steel form finish.
- B. Exterior of Building shall be split face block finish on all exterior wall surfaces, unless otherwise noted. Aggregate must be seeded into top of panel while in form, chemically retarded, and high-pressure water-washed to expose the aggregate to a depth of 1/8".
- C. Roof to have smooth trowel finish sealed with a clear waterproofing. Color to be selected by Owner

2.06 HVAC

- A. The building shall be heated and cooled with two (2) externally mounted HVAC unit, and programmable thermostat controls.
- B. Wall Mounted HVAC Units
 - a. Units shall be manufactured by BARD Manufacturing Company, Model # W30A1-C0ZMP5X4X or approved equal.
 - b. Size: minimum 2.5-Ton, 35,400 BTU Cooling capacity, 9.0 EER with coated coils and condenser section and commercial exhaust ventilator.
 - c. Quantity: 1
 - d. Voltage: 460v- 3 phase with motor overload and phase rotation protection.
 - e. Aluminum finned copper coils, twin multi speed blowers.
 - f. R-410A Refrigerant
 - g. Galvanized 20 Gauge Zinc Coated Steel Cabinet, baked on enamel per ASTM B117-03.
 - h. Electric Heat Strips with automatic limit and thermal cut-off safety control.

- i. Compressor Control Module shall have built-in off-delay timer adjustable from 30 seconds to 5 minutes. 2-minute on-delay if power interrupt. 120-second bypass for low pressure control.
- j. ASHRAE/IESNA 90.1-2007 , ANSI/ARI Standard 390-2003, Intertek ETL Listed to Standard for Safety Heating and Cooling Equipment ANSI/UL 1995/CSA 22.2
- k. Controller/Thermostat:
 - i. Bard Manufacturing, Model # MC3000, Advanced Solid State Controller
 - ii. 2 stage cooling control for each connected air conditioner
 - iii. Input power: 18 to 32VAC, 60/50Hz, power is supplied from each unit with isolation circuitry: no line or low voltage phasing allowed
 - iv. Backup power: connection for -24VDC or -48VDC (-20 to -56V)
 - v. Digital display: 4-character LCD
 - vi. Temperature display: F or C
 - vii. Operating temperature range: 0 to 120F (-18 to 49C)
 - viii. Temperature accuracy: +/- 1F from 60-85F (16-30C), +/- 1% outside 60-85F
 - ix. Memory: EEPROM for set point and changeable parameters (maintains settings on power loss)
 - x. Six (6) Push-button controls: On/Off switch-Change lead unit-Increase and Decrease set points-Program/Save-Comfort
 - xi. Enclosure: 20-gauge pre-painted steel, 9.25"W x 13.50"H x 3.00"D, hinged cover, thirteen (13) .875" diameter electrical knockouts
- C. Exterior units shall be painted to match final building color.

2.07 ELECTRICAL

- A. Vapor proof lighting and receptacles shall be provided within the enclosure as specified in the contract drawings.

2.08 SITE PREPARATION

- A. Precast building slab shall bear fully on a 6" thick FDOT crushed stone base compacted to 100% Standard Proctor Density or 4000 psi fiber reinforced concrete. Pad footprint shall be at least one foot larger than the length and width of building.

END OF SECTION 13125

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SECTION 13300
PROCESS INSTRUMENTATION AND CONTROLS -
GENERAL PROVISIONS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Application Engineering (AE) services shall be provided by the Engineer. All of the programming and application engineering including graphics shall be provided by the AE. The AE shall design and coordinate the instrument and control system for proper operation with related equipment and materials furnished by other suppliers under other sections of these Specifications and with related existing equipment. All equipment inputs and control parameters shall be monitored as shown in the Drawings and Specifications.
- B. Provide services necessary to achieve a fully integrated and operational system as shown on the Drawings and Specifications. Auxiliary and accessory devices necessary for system operation or performance to interface with existing equipment or equipment provided by other suppliers under other Sections of these Specifications, shall be included and furnished by the General Contractor but coordinated by the AE whether they are shown on the instrument drawings or not. These devices include, but are not limited to, 10BASE-2 to 10BASE-T converters, transducers, current isolators, signal conditioners, interposing relays, etc.
- C. Substitutions on functions or type of equipment specified will not be acceptable. In order to insure the interchangeability of parts, the maintenance of quality, the ease of interfacing between the various subsystems, and the establishment of minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained. In order to insure compatibility between all equipment, it shall be the responsibility of the system supplier to coordinate all interface requirements with mechanical and electrical system suppliers and furnish any signal isolation devices that might be required.
- D. Equipment shall be fabricated, assembled, installed, and placed in proper operating condition in full conformity with detail Drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer as approved by the Engineer. All equipment provided shall be fully and completely compatible with the existing system and components.
- E. To facilitate the Owner's future operation and maintenance, products shall be of the same major instrumentation manufacturer, with panel mounted devices of the same type and model as far as possible. The AE shall coordinate with other system suppliers that are furnishing PLC equipment and field instruments so that the selected manufacturers are the same throughout the plant.

- F. All equipment and installations shall satisfy applicable Federal, State, and local codes.
- G. Supplementing this Section, the Drawings and the related Specification sections provide additional details showing panel elevations, instrument device schedules, functional requirements of the system, and interaction with other equipment.
- H. Coordinate and schedule all required testing and training with the Engineer and Owner.

1.2 RELATED WORK

- A. Furnish all materials, labor, and services specified herein and in the following Specification Sections as required to ensure a single, coordinated system is supplied.
 - 1. Section 13310 - Programmable Logic Controller (PLC) and Digital Equipment
 - 2. Section 13315 - Process Instrumentation and Controls - Products
 - 3. Section 13320 - Fiber Optic Data Highway Network
 - 4. Section 13325 - Control Panels and Panel Mounted Equipment
- B. Divisions requiring coordination shall include, but not be limited to, the following:
 - 1. Division 0 - Bidding and Contract Requirements
 - 2. Division 1 - General Requirements
 - 3. Division 11 - Equipment
 - 4. Division 13 - Special Construction
 - 5. Division 15 - Mechanical
 - 6. Division 16 - Electrical
- C. Coordinate with all equipment suppliers, system suppliers, mechanical contractor, electrical contractor, and subcontractors.

1.3 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01300. These shop Drawings shall fully demonstrate that the equipment and services to be furnished will comply with

the provisions of these specifications and shall provide a true and complete record of the equipment as manufactured and delivered. Submittals shall be bound in separate three-ring binders, with an index and sectional dividers, with all Drawings reduced to a maximum size of 11-in by 17-in for inclusion within the binder.

- B. The Engineer shall determine whether a product is an "Approved Equal" based upon the information listed herein and the manufacturer's data sheets regarding the models specified. Alternate equipment must meet the criteria listed herein and any additional information in the manufacturer's data sheets in order to be accepted as an "Approved Equal". Supplier must furnish five (5) working installation references for any alternate equipment along with Owner, contact, and telephone number.
- C. The submittals listed below shall be provided as a minimum. Other submittals not listed here may be required by other specification sections. Each submittal must be complete. No partial submittals shall be accepted.

- 1. Field Instruments
- 2. Digital system software and Hardware
- 3. Control Panels and Panel Mounted Equipment
- 4. Testing
- 5. Training
- 6. Loop Diagrams
- 7. Operation and Maintenance (O&M) Manuals

D. Field Instruments Submittal

- 1. General
 - a. This submittal shall provide complete documentation of all field instruments. A complete Bill of Materials (BOM) listing all instrumentation equipment shall be provided.
- 2. Data Sheets
 - a. Provide data sheets for each instrument listing model numbers, options, and ancillary devices that are being provided.
 - b. The data sheets shall be provided with an index, proper identification, and cross referencing. The data sheets shall include, but not be limited to, the following information:
 - c. Plant Equipment Number and ISA tag number per the Loop Diagrams
 - d. Product (item) name used herein and on the Contract Drawings
 - e. Manufacturer's complete model number

- f. Location of the device
 - g. Input - output characteristics
 - h. Range, size, and graduations
 - i. Physical size with dimensions, enclosure NEMA classification and mounting details
 - j. Materials of construction of all components
 - k. Instrument sizing calculations where applicable
 - l. Certified calibration data for all flow metering devices
3. Equipment Specification Sheets
- a. Provide equipment specification sheets which shall fully describe the device, the intended function, how it operates and its physical environmental and performance characteristics. Each data sheet shall have appropriate cross references to loop or equipment identification tags. As a minimum the specification sheets shall include the following:
 - 1) Dimension, rigid-clearances
 - 2) Mounting or installation details
 - 3) Connection
 - 4) Electrical power or air requirements
 - 5) Materials of construction
 - 6) Environmental characteristics
 - 7) Performance characteristics
 - 8) Complete information regarding the field instruments as required by ISA5.4 standards shall be provided under this contract.
- E. Digital System Hardware and Software Submittal
- 1. General
 - a. This submittal shall provide complete documentation of the proposed hardware (PLC's, RIO's, communication equipment, cables, peripherals, etc.) A complete Bill of Materials (BOM) listing all digital hardware equipment shall be provided.
 - b. The submittal shall include the following:
 - 2. System Block Diagram
 - a. A complete schematic system block diagram(s) showing the interconnections between major hardware components including, but not limited to:
 - 1) Existing system
 - 2) Panels
 - 3) Computer and peripheral devices
 - 4) Local digital processors and like equipment
 - 5) Uninterruptible Power Supplies (UPS)
 - b. The block diagram shall reflect the total integration of all digital devices in the system and any Operator Interface Unit (OIU) locations. Location of all components shall be clearly identified with appropriate cross references.

- c. The diagram shall reference all interconnecting cabling requirements for digital components of the system including any data communication links.
3. Data Sheets
 - a. A data sheet for each hardware component listing all model numbers, options, auxiliary and ancillary devices that are being provided.
 - b. The data sheets shall be provided with an index, proper identification, and cross referencing. They shall include, but not be limited to, the following information:
 - 1) Equipment Number and ISA tag number per the Loop Diagrams (as applicable)
 - 2) Product (item) name used herein and on the Contract Drawings
 - 3) Manufacturer's complete model number
 - 4) Location of the device
 - 5) Input/output characteristics
 - 6) Physical size with dimensions, enclosure NEMA classification
 - 7) Materials of construction of all components
 - 8) Power supply device sizing calculations where applicable
 4. System Input/Output List
 - a. The Digital System Hardware submittal shall contain a complete system Input/Output (I/O) list for equipment connected to the control system under this Contract.
 - b. Submit the I/O list in a Microsoft Excel readable electronic file. The list shall be sorted first by ISA tag name and second by I/O type (i.e., AI, AO, DI, DO, etc.).
 - c. The I/O list shall follow the ISA numbering and labeling as far as possible. The list shall contain, as a minimum, the following for each active point and spare point:
 - 1) I/O List
 - a) Tag name
 - b) Type of I/O (i.e., DI, DO, AI or AO)
 - c) I/O terminal point physical location (panel name, rack, slot, etc.)
 - d) I/O point address (addresses to communicate with workstation and field devices)
 - e) Point name (or "SPARE")
 - f) Point description
 - g) Range and engineering units
 - h) Alarm limits
 - i) Relay normal status contact configuration
 - j) 2-wire or 4-wire instrument
 - d. The Digital System Hardware submittal shall also contain all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or

guards, and equipment layouts in order to enable the Contractor to proceed with the detailed site preparation for all equipment.

F. Control Panels and Panel Mounted Equipment Submittal

1. General

- a. This submittal shall provide complete documentation of all panel instruments included in each of the new and existing PLC Control panels provided and modified. A complete Bill of Materials (BOM) listing all instrumentation and control equipment shall be provided.

2. Data Sheets

- a. Provide data sheets for each component listing all model numbers, options, and ancillary devices that are being provided.
- b. The data sheets shall be provided with an index, proper identification, and cross referencing. The data sheets shall include, but not be limited to, the following information:
 - 1) Plant Equipment Number and ISA tag number per the Loop Diagrams
 - 2) Product (item) name used herein and on the Contract Drawings
 - 3) Manufacturer's complete model number
 - 4) Location of the device
 - 5) Input - output characteristics
 - 6) Range, size, and graduations
 - 7) Physical size with dimensions, enclosure NEMA classification and mounting details
 - 8) Materials of construction of all components
 - 9) Panel instrument or control device sizing calculations where applicable

3. Equipment Specification Sheets

- a. Provide equipment specification sheets which shall fully describe the device, the intended function, how it operates, and its physical environmental and performance characteristics. Each equipment specification sheet shall have appropriate cross references to loop or equipment identification tags with model number and information pertaining to the item highlighted. As a minimum the specification sheets shall include the following:
 - 1) Dimension, rigid-clearances
 - 2) Mounting or installation details
 - 3) Connection
 - 4) Electrical power or air requirements
 - 5) Materials of construction
 - 6) Environmental characteristics
 - 7) Performance characteristics

4. Detailed Drawings

- a. Provide detailed drawings covering PLC control panel, and/or enclosures

which shall include:

- 1) Cabinet assembly and layout Drawings to scale. Drawings shall include both front and interior subpanel layouts.
 - 2) Material, fabrication, and painting specifications
 - 3) Panel wiring diagrams showing all power connections to equipment within and on the panel, combined panel power draw requirements (volts, amps), breaker sizes, fuse sizes, and grounding. This wiring diagram shall be in ladder logic format and shall reference the appropriate loop drawing for continuations or details where required. Show all wire numbers and terminal block designations.
- b. The submittal shall also contain all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts in order to enable the Contractor to proceed with the detailed site preparation for all equipment.
 - c. The submittal shall also include heat dissipation calculations for each enclosure, provided. Coordinate the heat dissipation for components furnished for each control panel.

G. Testing Submittals

1. Test Plan

- a. A test plan shall be submitted after all the submittals have been approved by the Owner and Engineer. The test plan shall be submitted prior to the preparation of the detailed test procedures and submit outlines of the specific proposed tests. Submittals shall include examples of the proposed forms and checklists.
- b. The test plan should include the following as a minimum:
 - 1) System hardware summary
 - 2) A testing schedule describing the specific tasks to be performed and the time allotted for each task
 - 3) Communications tests to the various PLCs for discrete and analog I/O data transfer
 - 4) 100 percent (100%) I/O point test including all spare points based upon the previously submitted system I/O list

2. Test Procedures

- a. The test procedures shall be submitted after the preliminary test procedure submittals have been reviewed and returned stamped either "approved" or "approved as noted, confirm." The submittal shall document the proposed procedures to be followed during the test. Procedures shall include test descriptions, forms, and checklists to be used to control and document the required tests. Testing may not be started until all Testing Submittals have been approved.
- b. For Test Documentation submit a copy of the signed off test procedures upon completion of each required test.

H. Training Submittals

1. Training Overview

- a. Submit an overview of the proposed training plan. Each proposed course shall include:
 - 1) An overview of the training plan explaining why specific courses are proposed
 - 2) Course title and objectives
 - 3) Prerequisite training and experience of attendees
 - 4) Recommended attendees
 - 5) Course Content - A topical outline
 - 6) Course Duration
 - 7) Course Location - Training center or job-site
 - 8) Course Format - Lecture, laboratory demonstration, etc.

2. Training Plan

- a. Upon receipt of the Owner's, and Engineer's comments on the preliminary training plan, submit the specific proposed training plan. The training plan shall include:
 - 1) Definition of each course
 - 2) Specific course attendance
 - 3) Schedule of training courses including dates, duration, and location of each class
 - 4) Resumes of the instructors who will actually conduct the training

I. Loop Diagrams Submittal

1. General

- a. Provide detailed loop diagrams on single 11-inches x 17-inches or 8.5-in x 11-inches sheet for each monitoring or control loop. The loop diagram shall show all components of the loop both analog, digital, and discrete including all relays, switches, dropping resistors, etc. which are being provided for proper operation. Loop numbers used shall correspond to the loop numbers indicated in the contract documents. The format shall be the International Society of Automation, Standard for Instrument Loop Diagrams, ISA 5.4, and the following requirements. On each diagram present a tabular summary of:
 - 1) the output capability of the transmitting instrument
 - 2) the input impedance of each receiving instrument
 - 3) estimate of the loop wiring impedance based on wire sizes and approximate length used
 - 4) the total loop impedance
 - 5) reserve output capacity
- b. Show all interconnecting wiring between equipment, panels, terminal junction boxes and field mounted components. The diagrams shall show all components and panel terminal board identification numbers and all wire

numbers. This diagram shall include all intermediate terminations between field elements and panels (e.g., terminal junction boxes). The diagrams shall be coordinated with the electrical subcontractor and bear his mark showing this has been done.

- c. Show location of all devices
- d. Show instrument description showing type, manufacturer, model number, range, set points, and operation (e.g., fail open, open on energization, normally closed, etc.) as applicable.
- e. Show all instrument loop power or instrument air requirements back to termination on terminal block or bulkhead, fuse blocks (including fuse size), etc., as applicable.
- f. Show all shield grounding points within cabinets and panels.
- g. Complete information regarding the field instruments as required by ISA5.4 standards shall be provided on the loop diagrams under this contract.

J. Operation and Maintenance (O & M) Manuals Submittal

1. Refer to Sections 01300 and 01730 for additional O & M manuals requirements.
2. Prior to final acceptance of the system and Owner training, operating and maintenance manuals shall be furnished in accordance with Section 01730 and as detailed below:
 - a. A complete "As Constructed" set of approved shop Drawings
 - b. Original O&M Manuals and electronic media supplied with components furnished.
 - c. Original license agreements, serial numbers, and documentation for software components.
 - d. Signed copies of applicable test documentation.
3. These will be presented as a paper copy and an electronic version, suitable for integration into the FIM system.

1.4 REFERENCE STANDARDS

A. Instrumentation, Systems and Automation Society (ISA)

1. ISA 5.2 - Binary Logic Diagrams for Process Operations
2. ISA 5.3- Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.
3. ISA 5.4 - Instrument Loop Diagrams
4. ISA 5.5 - Graphic Symbols for Process Displays

- B. National Electrical Manufacturers Association (NEMA)
- C. Where reference is made to one of the above Standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. The AE shall maintain a fully equipped office/production facility with full-time employees capable of configuring, installing, calibrating, troubleshooting, and testing the system specified herein and under Sections 13315, 13320, and 13325. Qualified repair personnel shall be available and capable of reaching the facility within a 24 hour period.
- B. The Contractor shall furnish equipment which is the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.

1.6 SYSTEM DESCRIPTION

- A. The AE shall be responsible for providing a complete and operative Instrumentation and Control system for the Arbennie Pritchett Reclaimed Water Expansion. Services the AE shall be responsible for include, but not be limited to, the following:
 - 1. Integration and programming of all field devices and instrumentation as shown on the Contract Drawings and called out in the Specifications Sections 13315 and 13325 and as specified herein. Detailed descriptions of equipment to be furnished and installation requirements are called out in Sections 13300, 13315, and 13325 of the Specifications and shown on the Instrumentation Loop Diagrams.
- B. The General Contractor shall be responsible for all other items including but not limited to:
 - 1. All field devices and instruments as shown on the Contract Drawings and called out in the specifications.
 - 2. All control panels, miscellaneous panel equipment, as shown on the Instrumentation Drawings shall be furnished and tested in accordance with Sections 13300 and 13325 of the Specifications. Including modification of control panels if necessary
 - 3. The General Contractor shall provide all additional equipment such as patch panels, cabling (i.e., Cat 6) and cable accessories, punchdown blocks, and including tools necessary for connecting the peripherals, PLCs, Servers, Ethernet and input/output devices, etc., to complete the network. The Electrical

Subcontractor shall install, terminate, and test all cable provided by the General Contractor. The AE shall coordinate with the Electrical Subcontractor on length and size requirements for this equipment through the Subcontractor.

4. The PLCs, Operator Interface Units (OIUs), servers, plus associated hardware and software to monitor, control and record information for the purposes of reporting and trending the process furnished under this contract as shown on Drawings and as specified herein and Section 13310.
5. Refer to P&ID drawings for additional requirements.

C. The General Contractor shall refer to the Contract Drawings and the Specifications for complete information concerning all equipment and services to be furnished under this contract.

1.7 DELIVERY, STORAGE AND HANDLING

A. Shipping Precautions

1. After completion of shop assembly, factory test, and approval all equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling at job site.
2. Special instructions for proper field handling, storage and installation required by the manufacturer for proper protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in reseal-able plastic bags or other acceptable means of protection.
3. None of the control equipment shall be shipped to the job site until the room(s) is environmentally suitable.

B. Identification

1. Each component shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on the outside of the package.

C. Storage

1. Equipment shall not be stored out-of-doors. Equipment shall be stored in dry permanent shelters including in-line equipment and shall be adequately

PROCESS INSTRUMENTATION AND CONTROLS - GENERAL

protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired by the Contractor at his/her own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such tests as directed by the Engineer. This shall be at the cost and expense of the Contractor, or the apparatus shall be replaced by the Contractor at his/her own expense.

1.8 PROJECT/SITE REQUIREMENTS

- A. Environmental Requirements - All control cabinets shall be actively environmentally controlled to maintain temperatures & dew point within normal operating ranges of control equipment & mounted therein, if located in a non-air-conditioned space.
- B. Existing Conditions - The General Contractor shall ascertain existing range of environmental conditions at each site for appropriateness of cabinet environmental control system. This is an operating plant and all work must be coordinated on a day to day basis with the operating personnel.
- C. Field Measurements - The General Contractor shall be responsible for the proper fit and adherence to applicable codes of all control equipment and cabinetry to be located in the field. The General Contractor shall verify and document location of level switches, ultrasonic sensors, with respect to top slab elevation and their corresponding ranges and calibration.

1.9 MAINTENANCE

- A. Spare Parts
 - 1. Spare parts shall be as defined in the related specification sections. All spare parts shall be new and unused.
 - 2. All spare parts shall be individually packaged and labeled.
 - 3. The spares listed above shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity and temperature.

1.10 ACCURACY GUARANTEE

- A. Provide equipment guarantee per Section 01740.

PART 2 PRODUCTS

2.1 INSTRUMENTATION GENERAL

A. Type

1. All instrumentation supplied shall be of the Manufacturer's latest design and shall produce or be activated by signals which are established standards for the water and wastewater industries.
2. All electronic instrumentation shall be of the solid-state type and shall utilize linear transmission signals of 4 to 20 mA dc (milliampere direct current), however, signals between instruments within the same panel or cabinet may be 1-5V dc (volts direct current), or the like.
3. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based signals will be allowed.
4. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings or as required.
5. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Electrical Drawings, to comply with the National Electrical Code.
6. All indicators and recorder readouts shall be linear in process units, unless otherwise noted.
7. All transmitters shall be provided with integral digital indicators or in process units, accurate to two percent.
8. Electronic equipment shall be of the Manufacturer's latest design, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for their purpose, to assure optimum long term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.
9. All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, in-so-far as possible, and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.
10. The field mounted digital system equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

11. All electronic/digital equipment shall be provided with radio frequency interference protection and shall be FCC approved.

B. Electrical

1. All equipment shall be designed to operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplied required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
2. Materials and equipment used shall be U.L. approved wherever such approved equipment and materials are available.
3. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored.

2.2 LIGHTNING/SURGE PROTECTION

- A. *General* - Lightning/Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring. Instruments shall be housed in a suitable metallic case, properly grounded. Ground wires for all surge protectors shall be connected to a good earth ground, and where practical, each ground wire run individually and insulated from each other. These protectors shall be mounted within the instrument enclosure or a separate NEMA 4 junction box coupled to the enclosure. All contact points shall be copper with nickel plating. The transient response of units shall be less than 1 nanosecond. The surge protector should meet IEEE C-62-41 Standards. Lightning/surge protectors shall be provided at each instrument in the field.

1. Manufacturer
 - a. Surge Suppression Inc
 - b. Phoenix Contact
 - c. EDCO
 - d. Joslyn
 - e. Approved equal

- B. *Power Supply* - Protection of all 120 VAC instrument power supply lines shall be provided. Cabinet(s)/panel(s) and groups of field instruments, regardless of location (indoor or outdoor), shall be protected by isolation transformers and surge suppressors. Individual field instruments shall be protected by individual surge suppressors.

- C. *Signal Line* - All signal lines shall be protected through the use of varistors (MOVs), line to line and line to ground inductors. Zener diodes and gas tube arrestors with fuses on a PC board mounted in a snap track and labeled. These shall be provided at both ends of the signal lines and as close to the instruments as possible.
- D. The General Contractor shall provide all lightning, surge protection for all PLC panels and equipment inside and field mounted instruments that shall be furnished by the General Contractor.

2.3 TUBING AND FITTINGS

- A. All instrument air header takeoffs and branch connections less than 2-in shall be 316 stainless steel.
- B. All instrument shut-off valves and associated fittings shall be supplied in accordance with the piping specifications and all instrument installation details. Fittings shall be Swagelok 316 stainless steel or equal and valves shall be Whitney 316 stainless steel or equal.
- C. All instrument tubing shall be fully annealed ASTM A269 Seamless 316 grade free of OD scratches having the following dimensional characteristics as required to fit the specific installation:
 - 1. 1/4-in to 1/2-in O.D by 0.035 wall thickness.
 - 2. 5/8-in to 1-in O.D by 0.049 wall thickness.
 - 3. 1-in O.D by 0.065 wall thickness.
 - 4. 1-1/4-in O.D by 0.065 wall thickness.
 - 5. 1-1/2-in O.D by 0.083 wall thickness.
 - 6. 2-in O.D by 0.95 wall thickness.
- D. All process connections to instruments shall be annealed 1/2-in O.D. stainless steel tubing, Type 316.
- E. All tube track shall be supported by stainless steel and installed as per manufacturer's installation instructions.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

- A. The process control system, instrumentation, and accessory equipment shall be

installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms, and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. All information relevant to the placing of process control work shall be obtained in the field. In case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

- B. The instrumentation loop diagrams indicate the intent of the interconnection between the individual instruments. Any exceptions should be noted. Two (2) complete sets of approved shop drawings shall be kept at the job site during all on-site construction. Both sets shall be marked up identically to reflect any modifications made during field installation or start-up. All markings shall be verified and initialed by the Engineer or his designated representative.
- C. Following completion of installation and the Operational Readiness Test, one (1) set of the marked up drawings shall be provided to the Engineer; the other set shall be retained by the Supplier for incorporation of the mark-ups into final as-built documentation.
- D. The instrumentation installation details on the Contract Drawings indicate the designed installation for the instruments specified. Where specific installation details are not specified or shown on the Drawings, the American Petroleum Institute (API) Recommended Practice 550 shall be followed as applicable.
- E. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the Contractor shall bear full responsibility for such violations and assume all costs arising therefrom.
- F. All equipment used in areas designated as hazardous shall be designed for the Class, Group, and Division as required on the Electrical Drawings for the locations. All work shall be in strict accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the Supplier shall bear full responsibility for such violations and assume all costs arising therefrom.
- G. Unless specifically shown in the Contract Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands as detailed on the installation detail drawings. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, valve manifolds for calibration, testing, and blow down service shall also be provided. For slurries, chemical or corrosive fluids, inline diaphragm seals shall be provided.
- H. All piping to and from field instrumentation shall be provided with necessary unions, test tees, couplings, adaptors, and shut-off valves.

- I. Field instruments requiring power supplies shall be provided with local electrical shutoffs and fuses as required.
- J. Brackets and hangers required for equipment mounting shall be provided and shall be installed in a workmanlike manner and not interfere with any other equipment.
- K. The General Contractor shall investigate each space in the building through which equipment must pass to reach its final location. If necessary, the General Contractor shall be required to ship material in sections sized to permit passing through restricted areas in the building. The General Contractor shall also investigate and make any field modifications to each cabinet, enclosure, and panel to assure proper space and access (front, rear, side).
- L. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the manufacturer of the instrumentation equipment, but in no case shall more than one ground point be employed for each shield.
- M. Lifting rings shall be removed from cabinets/assemblies. Hole plugs the same color as the cabinet shall be provided for the holes.
- N. The General Contractor, acting through the Engineer, shall coordinate the installation, placing and location of system components, and their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. The Electrical Subcontractor shall be responsible for ensuring that all field wiring for power and signal circuits is done correctly in accordance with best industry practice and provide for all necessary system grounding to ensure a satisfactory functioning installation. The Contractor hereunder shall schedule and coordinate his work under this Section with that of the electrical work specified under applicable Sections of Division 16.

3.2 TESTS (GENERAL)

- A. The equipment suppliers shall test all equipment at the factory prior to shipment. Unless otherwise specified in the individual specification sections, all equipment provided by the equipment supplier shall be tested at the factory as a single fully integrated system.
- B. As a minimum, the testing shall include the following:
 - 1. Operational Readiness Tests (ORT).
 - 2. Functional Demonstration Tests (FDT).

- C. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.
- D. All tests shall be conducted in accordance with prior Engineer approved procedures, forms, and checklist. Each specific test to be performed shall be described and a space provided after it for signoff by the appropriate party after its satisfactory completion.
- E. Copies of these signoff test procedures, forms, and checklists will constitute the required test documentation.
- F. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide suitable means of simulation. Define these simulations techniques in the test procedures.
- G. All testing shall be coordinated with all affected Contractors, the Owner, Engineer, and the Construction Manager.
- H. The Engineer reserves the right to test or retest all specified functions whether or not explicitly stated in the prior approved Test Procedures.
- I. The Engineer's decision shall be final regarding the acceptability and completeness of all testing.
- J. No equipment shall be shipped until the Engineer has received all test results and approved the system is ready for shipment.
- K. The General Contractor shall furnish the services of servicemen, all special calibration and test equipment and labor to perform the field tests, for the equipment and services furnished under Sections 13315, 13325, and as specified herein.

3.3 OPERATIONAL READINESS TESTS (ORT)

- A. General: Prior to startup and the Functional Demonstration Test, the entire system shall be certified (inspected, tested, and documented) that it is READY for operation.
- B. Loop/Component Inspections and Tests: The entire system shall be checked for proper installation, calibrated, and adjusted on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and these Specifications.
 - 1. The Loop/Component Inspections and Tests shall be implemented using Engineer approved forms and check lists.
 - a. Each loop shall have a Loop Status Report to organize and track its

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inspection, adjustment, and calibration. These reports shall include the following information and checkoff items with spaces for sign off by the AE:

- 1) Project Name.
 - 2) Loop Number.
 - 3) Tag Number for each component.
 - 4) Checkoffs/sign offs for each component.
 - a) Tag/identification
 - b) Installation
 - c) Termination - wiring
 - d) Termination - tubing
 - e) Calibration/adjustment
 - 5) Checkoffs/sign offs for the loop.
 - 6) Panel interface terminations
 - a) I/O interface terminations
 - b) I/O signal operation
 - c) Inputs/outputs operational: received/sent, processed,adjusted
 - d) Total loop operation
 - 10) Space for comments.
- b. Each active Analog Subsystem element and each I/O module shall have a Component Calibration Sheet. These sheets shall have the following information, spaces for data entry, and a space for sign off by the AE:
- 1) Project Name.
 - 2) Loop Number.
 - 3) Component Tag Number of I/O Module Number.
 - 4) Component Code Number Analog System.
 - 5) Manufacturer (for Analog system element).
 - 6) Model Number/Serial Number (for Analog system).
 - 7) Summary of Functional Requirements. For example:
 - a) For Indicators and Recorders: Scale and chart ranges
 - b) For Transmitters/Converters: Scale and chart ranges
 - c) For Computing Elements: Function
 - d) For Controllers: Action (direct/reverse) control Modes (PID)
 - e) For Switching Elements: Unit range, differential (FIXED/ADJUSTABLE), reset (AUTO/MANUAL)
 - f) For I/O Modules: Input or output
 - 8) Calibrations; for example:
 - a) For Analog Devices: Required and actual inputs and outputs at 0, 10, 50, and 100 percent of span, rising and falling.
 - b) For Discrete Devices: Required and actual trip points and reset points.
 - c) For Controllers: Mode settings (PID).
 - d) For I/O Modules: Required and actual inputs or outputs for 0, 10, 50, and 100 percent of span, rising and falling.
 - 9) Space for comments.
 - 10) Space for sign off by AE, Engineer, and Owner.

2. The General Contractor is required to maintain the Loop Status Reports and Components Calibration sheets at the job-site and make them available to the Engineer/Owner at any time.
3. These inspections and tests do not require witnessing. However, the Engineer will review and initial all Loop Status Sheets and Component Calibration Sheets and spot-check their entries periodically and upon completion of the Operational Readiness Tests. Any deficiencies found shall be corrected.

3.4 FUNCTIONAL DEMONSTRATION TEST (FDT)

- A. Prior to startup and the Functional Demonstration Test, the entire installed instrument and control system shall be certified that it is ready for operation. All preliminary testing, inspection, and calibration shall be complete as defined in the operational readiness tests.
- B. Once the facility has been started up and is operating, a witnessed Functional Demonstration Test shall be performed by the AE on the complete system to demonstrate that it is operating and in compliance with these Specifications. Each specified function shall be demonstrated on a paragraph-by-paragraph, loop-by-loop and site-by-site basis.
- C. Loop-specific and non-loop-specific tests shall be the same as specified under Witnessed Factory Tests except that the entire installed system shall be tested and all functions demonstrated.
- D. Updated versions of the documentation specified to be provided for during the Factory Tests shall be made available to the Engineer at the job-site both before and during the tests. In addition, one copy of all O&M Manuals shall be made available to the Engineer at the job-site both before and during testing.
- E. The daily schedule specified to be followed during the Factory Tests shall also be followed during the Functional Demonstration Testing.
- F. The system shall operate for a continuous 100 hours without failure before this test will be considered successful.
- G. Demonstrate communication failure and recovery.
- H. Demonstrate total power failure and recovery.

3.5 TRAINING

- A. The training program shall be structured such that the operating personnel will understand the system's operation, and the functions available in the system.

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- B. On-site Training: On-site (field) training shall be conducted at the Owner's facilities and shall provide detailed hands-on instruction to Owner's personnel covering; troubleshooting, maintenance procedures, calibration procedures, and system operation. System operation shall include, but shall not be limited to operation of local pump controls, chemical feed, fiber optic communication, monitoring and control.
- C. The training and instruction, insofar as practicable, shall be directly related to the System being supplied hereunder. The training shall include a field training program consisting of hands-on instruction utilizing the Owner's System.
- D. Training personnel shall be intimately familiar with the Control System. The AE shall provide trainers that have familiarized themselves with the designed operations of the Plant and how the control system executes the operation.
- E. Plant Operator field training shall be structured specifically for operations type personnel. Training personnel shall be prepared to walk-thru the logic used to control the equipment and how the Control System executes that logic.
- F. Plant Operator field training shall be introductory in nature during pre-startup training and more in depth and detailed during post-startup training.
- G. The AE shall, at a minimum, have the following teaching aids available for distribution during Plant Operator field training sessions: Revised Preliminary O&M Manuals (pre-startup); Final O&M Manuals (post-startup); Copies of all complete generated graphic displays; Process, Mechanical, and Instrumentation Diagrams as presented in the Contract Documents.
- H. Fifty (50) percent of all Plant Operator field training shall be "hands-on" utilizing the installed Control System to the fullest possible extent.

3.6 WARRANTY/PREVENTIVE MAINTENANCE

- A. A written maintenance agreement executed by The AE shall be provided to the Engineer on behalf of the Owner for on-site warranty and preventive maintenance services. This maintenance agreement shall include all labor, parts, and emergency calls providing on-site response within 24 hours, to provide complete system maintenance for a period of one year after Owner's Final Acceptance of the Project.
- B. Emergency maintenance procedures or plant visits may coincide with a preventive maintenance visit; however, they shall not replace the work intended to be performed during a preventive maintenance visit. The General Contractor shall have full responsibility for their respective equipment that they furnished for this project, hardware and software preventive and corrective maintenance.
- C. During the one-year maintenance period, observation of maintenance operations by

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Owner's personnel, and the instruction of said personnel in the details of the maintenance work being performed, shall be provided. At the end of the maintenance contract period, the Electrical Contractor shall replenish the spare parts supply to the original status of component parts and physical condition.

- D. The costs for the one-year warranty and preventive maintenance service contract shall be provided and quoted to the Engineer on behalf of the Owner at the end of the project.
- E. An annual fee shall be quoted within 90 days after final acceptance for the purpose of entering a contract for annual maintenance subsequent to the first year of maintenance. Standard per diem rates for providing breakdown service shall be set forth in the contract. Such rates shall be fair and reasonable and reflect the lowest rates offered to most favored customers. The fee quoted shall be firm for a minimum of 90 days from date of issue.
- F. Refer to Section 01740 for special extended warranty requirements.

3.7 SOFTWARE LICENSE

- A. The General Contractor shall provide a site software license for purchased software required. Provisions shall be made in the license to include all applications, all operating systems, and all communication systems.

3.8 CONTROL SYSTEM DIAGRAMS AND DETAILS

- A. To assist the General Contractor in determining the scope of work, a series of P&IDs and details are provided. Unless specifically stated otherwise, the system supplier shall be responsible for providing all instrumentation, control equipment and auxiliary devices necessary to perform the functions specified herein and as shown and described on these diagrams. Any auxiliary devices such as lightning/surge protectors, relays, timers, signal isolators, signal boosters, etc. which are necessary for complete operation of the system, or to perform the functions specified shall be included, whether or not they are specifically shown or tabulated on the loop diagrams.
- B. The Electrical Subcontractor is responsible for installing and wiring the PLCs.
- C. The intent of the P&IDs is to describe in detail, the hardware, software and functional requirements of a process measurement or control system. They are not intended to convey requirements for conduit and wiring between panels or system components. This information is included in appropriate electrical specifications and Drawings.

END OF SECTION

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SECTION 13310

PROGRAMMABLE LOGIC CONTROLLER (PLC) AND DIGITAL EQUIPMENT

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. The General Provisions of Section 13300 apply to this Section.
- B. Furnish all labor, materials, equipment and incidentals required, to install, complete and ready for operation, the panels depicted on the Drawings and on the Instrumentation Details provided.
- C. The General Contractor shall furnish all labor, materials, equipment, and incidentals required to install, complete and ready for operation computer/PLC based control system for the Project.
- D. Components and enclosures and instrumentation may be provided the General Contractor sub-suppliers and/or manufacturers, but the packaging of these components and the production of the final product shall conform to this specification and shall be the sole responsibility of the General Contractor.
- E. Panel mounted Operator Interface Units (OIUs) for the PLC control panels shall be provided by the General Contractor as specified herein and shown on drawings.
- F. The Application Engineer (AE) shall return the PLC and OIU equipment to the General Contractor for installation, termination, testing as specified herein, when all programming and configuration has been completed by the AE.
- G. All software shall be the latest revision at time of completion of project.
- H. All equipment and installations shall satisfy applicable Federal, State and local codes.
- I. Supplementing this Section, the Drawings and related Specification sections provide additional details showing panel elevations, instrument device schedules, functional requirements of the system and interaction with other equipment.
- J. The AE shall furnish startup assistance, training, and system check out services, as specified under Section 13300 and herein.
- K. All software packages provided under this contract shall be licensed under the Owner's name and address as provided by the Owner.

1.2 SUBMITTALS

- A. Refer to Section 13300.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 13300.

1.4 SPARE CAPACITY

- A. Provide a minimum of 20 percent installed spare capacity for the components listed below:

1. PLC memory
2. PLC I/O points
3. PLC rack slots
4. PLC OIUs
5. Computer disk drives
6. Process monitoring and control database
7. Graphic displays

1.5 SPARE PARTS

- A. In addition to the spare parts listed in other instrumentation sections, provide 20percent or at least one of the following:

1. Major network devices
2. Media converters
3. Ethernet switches
4. Major Programmable Logic Controller (PLC) components
5. Optical communications modules
6. Operator interface units (one of each type)
7. Remote I/O modules
8. Chassis power supplies

- 9. PLC CPUs (one of each type)
- 10. Serial communications modules

1.6 WARRANTY

- A. Refer to Section 13300

PART 2 PRODUCTS

2.1 GENERAL

- A. Equipment shall be installed in environmentally controlled air-conditioned areas as shown on the Drawings. They shall be designed to operate between 0 degrees Celsius and 40 degrees Celsius and up to 95 percent humidity assuming no condensation occurs. The system shall be able to withstand, non-operation storage temperature of minus 10 degrees Celsius to plus 40 degrees Celsius without damage.
- B. The General Contractor shall use the following specifications as a guide to determine the cost of the PC equipment required, and shall provide an Allowance in that amount for PC purchase at the time of construction. Supply computer and network equipment as shown on drawings.

2.2 NETWORKING EQUIPMENT

- A. Fast Ethernet Switch
 - 1. Networking equipment installed in FP-6101 shall match the plant and Owner's standard used throughout the facility. Networking equipment shall be provided with all necessary ports to facilitate interconnection of the new filters into the Plant Monitoring and Control System (PMCS).

2.3 PROGRAMMABLE LOGIC CONTROLLER (PLC)

- A. Major hardware components of the PLC portion of the control system shall include:
 - 1. Redundant Central Processing Unit (CPU).
 - 2. Input/Output Modules.
 - 3. Power Supply and Chassis
 - 4. Operator Interface Units (OIU)

B. General

1. Furnish and install PLC equipment as required by the Drawings and the following Specification, including all necessary auxiliary equipment, in order to provide a fully integrated and working system.
2. Components shall be chosen from the list in this Section and assembled such that the intended function is achieved. Furnish all cables, connectors, and ancillary devices necessary for the complete functioning of each PLC.
3. Distribute series of I/O points across multiple modules and racks so as to eliminate a single point of failure. For example, if there are two identical pumps, terminate the I/O for each pump in a different card and a different rack with separate power supply where possible.
4. The PLC shall be Allen-Bradley ControlLogix.
5. The selected PLC manufacturer shall be the same throughout the plant.

C. All components used should be selected from the following component list:

1. Processor CPU ControlLogix 5570 :1756-L72
2. Controlnet Bridge I/O:1756-CN2R
3. Ethernet I/P Bridge:1756-EN2T
4. Digital Input Module:1756-IB16I
5. Digital Output Module:1756-OW16
6. Analog Input Module:1756-IF6I
7. Analog Output Module:1756-OF8
8. Remote I/O Interface Module

D. Operator Interface Unit (OIU)

1. Color touch screen panel will be provided as shown on the drawings.
2. The OIU shall support 800 x 600, color graphics on a 10" display.
3. The OIU shall be an Allen-Bradley Panelview Plus 7.

E. Managed Industrial Ethernet Rail Switches - FiberOptic

PROGRAMABLE LOGIC CONTROLLER (PLC) AND DIGITAL EQUIPMENT

1. Where indicated on the system architecture drawings, PLCs shall be equipped with a fiber optic converter for connecting to the fiber optic network. Each Rail Switch shall be a standalone unit powered by 24VDC and provided with mounting hardware as needed.

2.4 SOFTWARE

A. PLC programming software

1. PLC programs will be developed using RSLogix 5000 professional edition version 24. The Owner will utilize firmware version 24.052 for all programming to maintain system redundancy.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The panels shall be installed at locations as shown on the Drawings.
- B. Panels shall be factory tested prior to shipment. Field installation shall consist only of setting the panel in place and making necessary electrical and conduit connections.
- C. Refer to Section 13300.

3.2 TESTS (GENERAL)

- A. Panels and panel assemblies shall be tested for proper operation at the Instrumentation System Supplier's factory, or other selected site, prior to the shipment of any panel to the jobsite.
- B. Prior to shipment, a Witnessed Factory Test shall be performed at the System Supplier's factory, or other selected site, on panels provided. The test shall demonstrate specified functions by simulating inputs and outputs to the panels.
- C. Acceptance of shop tests by Owner or Design-Builder shall not constitute a waiver of requirements to meet the field tests under specified operating conditions, nor does inspection relieve the manufacturer of his responsibility in any way.
- D. Refer to Section 13300.

END OF SECTION

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SECTION 13315
PROCESS INSTRUMENTATION AND CONTROLS - PRODUCTS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Refer to Instrumentation General Provisions, Section 13300.
- B. Furnish all labor, materials, equipment, and incidentals required to install complete and ready for operation, the instruments depicted on the instrumentation drawings.
- C. Field verify all new and existing instruments for proper functionality. The Electrical Contractor shall be responsible for providing power and signals to all systems requiring them.
- D. All equipment used in areas designated as hazardous shall be designed for the Class, Group, and Division as required on the Electrical Drawings for the locations. All work shall be in strict accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the Supplier shall bear full responsibility for such violations and assume all costs arising there from.
- E. Indicating transmitters and other displays that are exposed to sunlight shall be equipped with adequate sunshields. The sunshield shall consist of one or more pieces of stainless steel, FRP, or other suitable material of sufficient size to cover the top, sides, and rear of the panel (where applicable), and to hang over the front of the panel to shade any instruments mounted there. Sunshield pieces shall be secured to the panel by bolts and shall have no less than 1 inch of clearance from the panel and from one another, to allow for air circulation over the sunshield surfaces and access to panel door(s).

1.2 RELATED WORK

- A. Refer to Section 13300.

1.3 SUBMITTALS

- A. Refer to Section 13300.

1.4 REFERENCE STANDARDS

- A. Refer to Section 13300.

1.5 QUALITY ASSURANCE

- A. Refer to Section 13300.

1.6 MAINTENANCE AND TEST EQUIPMENT

- A. Refer to Section 13300.

PART 2 PRODUCTS

2.1 INSTRUMENTS

A. Ultrasonic Level Transmitters -

1. Shall be a Siemens Echomax XPS-10 Transducer with a Siemens Hydorranger 200 HMI Controller or Engineer approved equal. Assemblies shall have a NEMA 4X rating. The Hydorranger 200 HMI controller shall be powered with 120Vac, provide 4-20mA outputs for level and be provided with a sunshield.
2. Units - LIT/LE 200-9
3. Range - As required by the depth of the wetwell(s) being monitored.

B. Float Switches -

1. Shall be Anchor Scientific Roto-Float-SST or Engineer approved equal. Shall be supplied with cable length as required to reach associated equipment and mounting hardware
2. Units - LSL 200-14 & LSH 200-15
3. Range/Length - As required by the well depth and equipment mounting location.

C. Pressure Transmitters -

1. Shall be an ABB 266AST, Endress Hauser Cerabar PMP71 or Engineer approved equal. Units shall be loop powered and provide a 4-20mA output. Assemblies shall be NEMA 4X. Shall be provided with pressure snubber, block valve, bleed valve, mounting hardware and sunshield.
2. Units - PI 200-12 & PI 200-13
3. Range - As required for the process

D. Turbidity Analyzers -

1. Shall be Hach TU5300 series with Hach sc200 controller or Engineer approved equal. The assembly shall be NEMA 4X and provided with a sun shield.
2. Units - AIT/AE 200-8

3. Range - As required by the Engineer
- E. Chlorine & pH Analyzers -
1. Shall be a Prominent DULCOMETER DACb Controller with associated DULCOTEST chlorine and pH sensors or Engineer approved equal. The assembly shall be NEMA 4X and provided with a sun shield.
 2. Units - AIT/AE 200-7 & AIT/AE 200-6
 3. Range - As required by the Engineer
- F. Electromagnetic Flow Meters -
1. Shall be a Endress Hauser Promag W400 or Engineer approved equal. Shall be provided with a NEMA 4X remotely mounted controller, grounding rings, and sun shield.
 2. Units - FIT/FE 100-1, FIT/FE 100-3, FIT/FE 200-10, & FIT/FE 200-11
 3. Range/Size - Flow range as required by the Engineer. Diameter as required by the pipe size.

PART 3 EXECUTION

3.1 GENERAL

- A. See execution requirements in Section 13300.

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CONTROL PANELS AND PANEL MOUNTED EQUIPMENT

SECTION 13325 CONTROL PANELS AND PANEL MOUNTED

EQUIPMENT PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The General Provisions of Section 13300 apply to this Section.
- B. Furnish all labor, materials, equipment and incidentals required, to install, complete and ready for operation, the panels depicted on the Drawings and on the Instrumentation Details provided.
- C. The following control panels will be provided under this section:
 - 1. Chemical Feed Building
 - 2. Reclaimed Pumping Station
 - 3. New and Existing Tertiary Filtration System

1.02 SUBMITTALS

- A. Refer to Section 13300.

1.03 DELIVERY, STORAGE AND HANDLING

- A. The panels shall be mounted on wood skids four inches high. Adequate crating will be provided for the panel being shipped where a transfer from one truck to another is planned.
- B. Instruments shall be blocked and tied to prevent damage during shipment. Front-panel mounting instruments shall be removed and prepacked in their original containers for shipment.
- C. Accessories, drawings, instruction bulletins, etc., shall be packed and shipped with the panel.
- D. Refer to Section 13300.

1.04 SPARE CAPACITY

- A. Provide a minimum of 20 percent installed spare capacity for the following:
 - 1. Terminal Blocks
 - 2. Power supplies
 - 3. Control panel space

1.5 SPARE PARTS

CONTROL PANELS AND PANEL MOUNTED EQUIPMENT

- A. In addition to the spare parts listed in other instrumentation sections, provide 20 percent or at least one of the following:
 - 1. Surge suppressors
 - 2. Uninterruptible Power supplies
 - 3. Fuses: 20 percent of each size and type use, but no less than ten of each size and type.
 - 4. DC Power Supplies
 - 5. Corrosion Inhibiting Vapor Capsules.
- B. The spares and consumables listed above shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity and temperature.

1.6 WARRANTY

- A. Refer to Section 13300.

PART 2 PRODUCTS

2.1 GENERAL

- A. Refer to Section 13300.

2.2 LIGHTNING/SURGE PROTECTION

- A. Refer to Section 13300.

2.3 CONTROL PANEL - GENERAL REQUIREMENTS

- A. Furnish and install the panels per Specifications and Drawings.
- B. The construction and wiring shall be in accordance with this Specification and applicable panel drawings. The panel drawings will specify the arrangement of instruments to be mounted on the front, rear, and sides of the panels.
- C. Unless otherwise specified on applicable panel drawings, all panels shall be of the fully enclosed type designed for use with high-density instrumentation mounting.
- D. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for each local panel provided under this Contract shall be keyed alike.

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- E. The instruments designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment.
- F. Conductors running from the field to the panels shall be continuous without splices, except at approved junction boxes. The junction boxes shall have terminal blocks with 20 percent spare terminals. Special care shall be exercised to carry grounding lines through such junction boxes with the least possible resistance. Cables entering panels shall be multiconductor. Conduit and multiconductor cables entering panels shall be sealed to prevent the intrusion of gas and moisture.
- G. Multiconductor cable shall be used between junction boxes and the panels.
- H. All components shall be mounted in a manner that shall permit servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates, and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Mounting orientation shall be in accordance with the requirements of each component. Components shall be identified with suitable plastic or metal engraved tags attached with drive pins adjacent to (not on) each component identifying the component in accordance with the Drawings and Specifications.
- I. The internal framework of each panel shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging and lifting of the control panels during installation. Plugs shall be provided and shall unobtrusively fill the panel lifting ring holes when substituted for the lifting rings after installation is complete.
- J. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.
- K. All panels shall be supplied with suitable nameplates which identify the panel and individual devices as required. Nameplates shall be provided for all flush mounted equipment in the interior and exterior of each panel. Nameplates shall be approximately 1-in x 3-in constructed of white and black laminated, phenolic material having engraved Micarta letters approximately 1/8-in high, extending through the white face into the black layer. Nameplates shall be beveled and attached to panels with epoxy glue.

2.4 CONTROL PANEL - MATERIALS AND CONSTRUCTION

- A. Unless otherwise specified, all panels located in indoor non-process areas shall be of NEMA 12 construction and shall be labeled by Underwriters Laboratories.

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Freestanding panels shall be constructed of 12 gauge or thicker sheet steel, suitably braced internally for structural rigidity and strength. Stainless steel shall be substituted where specified in the Drawings. Wall or Unistrut mounted panels shall be 14 gauge or better steel. All exposed welds, seams, or edges shall be ground smooth. Front panels or panels containing instruments shall be 10 gauge or thicker sheet steel, reinforced to prevent warping or distortion. All doors shall be lockable, mounted with strong, continuous, piano type hinges and be provided with door handles and three point latches, or screw clamps.

- B. All panels located in outdoor areas, or in indoor process areas, and where specified in the Contract Documents, shall be of NEMA 4X construction and shall be labeled by Underwriters Laboratories. Except where indicated otherwise in Contract Documents, NEMA 4X panels, whether wall or Unistrut mounted panels or freestanding panels, shall be constructed of 316 Stainless Steel. Minimum thickness shall be 12 gauge for freestanding panels, 14 gauge for wall or Unistrut mounted panels. Continuous door hinge, hinge pin, door clamps, hasp and staple for padlocking, shall be of stainless steel construction. Interior panels of 10 gauge steel construction shall be provided where necessary for instrument mounting.
- C. Provide explosion-proof enclosures where required in hazardous areas.
- D. Panels shall be provided with full length, fully gasketed rear doors or front access doors as shown on the panel details. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments. For freestanding panels, full length rear access door shall be not greater than 24-in in width. All doors shall open a minimum of 90 degrees.
- E. Approximate size and equipment layout as shown on the panel details and other Drawings.
- F. The panel shall be suitable for top or bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry the panel top shall be provided with nominal one foot square removable access plates which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, or other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.
- G. Support Structures. Do not use expansive screw anchors, shields, or other fastening items containing lead or other material that might loosen or melt under fire conditions. Do not use power-actuated fasteners and devices.
- H. Finish Requirements
 - 1. All sections shall be descaled, degreased, filled, ground and finished. The enclosure, when fabricated of carbon steel, shall be finished with two rust

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resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.

2. The panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.
 3. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sanding shall be applied to the intermediate exterior coat before top coating.
 4. All FRP panels located in direct sunlight shall be provided with a protective coating to prevent discoloration and cracking.
 5. Apply a minimum of two coats of flat white lacquer on the panel interior after priming.
 6. Panel exterior color shall be ANSI 61 Gray, to match existing.
- I. Manufacturer
1. All panels shall be by Hoffman or equal.

2.5 CONTROL PANEL - TEMPERATURE CONTROL

- A. Should sufficient heat be generated within a panel where dissipation cannot be adequately accomplished an air conditioner shall be provided.
- B. The internal temperature of all panels shall be regulated so as not to exceed 100 degrees Fahrenheit. Under no circumstances shall the panel cooling equipment compromise the NEMA rating of the panel.
- C. NEMA 4X rated panels that are exposed to sunlight shall be equipped with adequate sunshields. The sunshield shall consist of one or more pieces of stainless steel, FRP, or other suitable material of sufficient size to cover the top, sides, and rear of the panel (where applicable), and to hang over the front of the panel to shade any instruments mounted there. Sunshield pieces shall be secured to the panel by bolts and shall have no less than 1 inch of clearance from the panel and from one another, to allow for air circulation over the sunshield surfaces and access to panel door(s).

2.6 CONTROL PANEL - CORROSION CONTROL

- A. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Northern Instruments Model Zerust VC;

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Hoffman Engineering Model A-HCI; or equal. Corrosion inhibitors shall not be installed and activated until the panel is delivered to the site.

2.7 CONTROL PANEL - INTERNAL CONSTRUCTION

- A. Panel equipment shall be mounted and wired on or within the cabinet. Wiring shall comply with the National Electrical Code. Wiring within the panel shall be grouped together with harnesses or ducts and secured to the structure. Wiring shall be numbered in compliance with the numbering system used on the wiring/connection diagrams. Wiring and connection diagrams shall comply with ISA S5.4 Instrument Loop Diagrams and shall be submitted by the manufacturer as part of the Shop Drawings for review by the Design-Builder.
- B. Power and low voltage DC signal wiring shall be routed in separate wire ways. Crossing of the two system wires shall be at right angles.
- C. Power wire shall be 12 AWG Type THHN/THWN stranded and shall be insulated for not less than 600 volts unless specified otherwise. Conductors shall be of tinned copper construction. All interconnecting wiring, except for electronic circuits, shall be rated for not less than 90 degrees C.
- D. Control and signal wire shall be 1 pair 16 AWG stranded. Analog signal wire shall be shielded. Conductors shall be of tinned copper construction.
- E. Electronic Communications cable (such as RS-232) shall be low-capacitance, double-shield cables consisting of twisted pairs with 22 AWG stranded conductors and PVC jacketing.
- F. Wire colors shall be:
 - 1. Line Power - Black
 - 2. Neutral White
 - 3. AC Control Red
 - 4. DC Control Blue
 - 5. DC common Gray
 - 6. Equipment or Chassis Ground Green
 - 7. Externally powered interlocks Yellow
- G. Wiring shall terminate at a master terminal board, rigid type and numbered. The master terminal board shall have a minimum of 20 percent spares.

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- H. Terminal blocks shall be arranged in vertical rows and separated into groups (Power, AC control, DC signal, and alarm). Terminal strips shall be provided for the purpose of connecting all control and signal wiring. Terminal blocks shall be Phoenix style, IEC rated, Allen-Bradley or similar, with the appropriate voltage rating (600 volts minimum).
- I. Each 4-20 mA analog signal loop shall be individually fused. Each group of discrete loops for a common piece of equipment shall be fused.
- J. Wiring trough for supporting internal wiring shall be plastic type with snap on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by using stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.
- K. Wire connectors shall be the hook fork type with insulated barrel for crimp type compression connection to the wire.
- L. Each wire shall be provided with a numbered heat shrink tubing identification marker, with the same number at both ends. Numbering shall be in accordance with the Control Panel Drawings and shall include the instrument Loop Number. Identification markers shall be pretyped. Handwritten markers or paper markers will not be permitted.
- M. Direct interlock wiring between equipment will not be allowed. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6-in of the side panel or adjacent terminal.
- N. Wiring troughs shall not be filled to more than 60 percent visible fill. Wiring trough covers shall be match marked to identify placement. If component identification is shown on covers for visibility, the ID shall also appear on the mounting sub-panel.
- O. Each panel shall have an LED light fixture, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.
- P. Each panel shall have a specification grade duplex convenience receptacle mounted internally within a stamped steel device box with appropriate cover.
- Q. A lamp test push button shall be provided on the control panel to test the indicator lamps in all the CMC switches, at the same time.
- R. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.
- S. Each panel shall be provided with a separate copper power grounding bus (safety)

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in accordance with the requirements of the National Electrical Code.

- T. Each panel, where applicable, shall be provided with analog signal isolation (I/I) where analog signals are sent from one panel or console to another.
- U. Each panel shall be provided with surge suppression protection (electrical transients) for connections between AC power systems and electrical and electronic equipment. Surge suppressor grounding shall be accordance with the manufacturer's recommendations. Refer to Section 13300.
- V. Each panel shall be provided with a fused power disconnectswitch.
- W. All wiring to hand switches and the like which are live circuits independent of the panel's normal circuit breaker protection shall be clearly identified assuch.
- X. Panels shall have an initial installed capacity of I/O (terminal blocks, fuses, surge suppressors, interposing relays) as shown on drawings and as described in the specification sections plus 20 percent installed spares and capacity for 20 percent input/output expansion within the enclosures provided.
- Y. Print storage pockets shall be provided on the inside of each panel. Its size shall be sufficient to hold all of the prints required to service the equipment.

2.8 UNINTERRUPTIBLE POWER SUPPLY (UPS)

- A. The power supplied to each panel shall be protected by an Uninterruptible Power Supply (UPS). UPS shall prevent spikes, sags, surges, noise, and harmonics from adversely affecting equipment. UPS input and output shall be galvanically isolated from one another. Input and output power shall be 120 VAC, 60 Hz.
- B. UPS shall contain internal backup batteries sufficient to allow all connected equipment to run continuously for no less than 30 minutes at full load. Provide calculations which show these requirements can be met.
- C. UPS shall automatically switch to battery power upon loss of line input, and back to line input upon return to normal condition, using a continuous no-break connection to ensure no momentary power interruptions.
- D. The UPS shall be UL listed for installation into an industrial control panel.
- E. UPS shall be Allen-Bradley model 1609 or approved equal.

2.9 MISCELLANEOUS PANEL COMPONENTS

- A. Pilot Type Indicating Lights

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1. Type:
 - a. Heavy duty oiltight type which utilizes a low voltage lamp.
2. Functional/Performance:
 - a. Units shall be provided with low voltage lamps suitable for the voltage supplied. Lights supplied with 120VAC power shall have integral reduced voltage transformers.
 - b. Lamps shall be replaceable from the front of the unit.
 - c. Units shall be push-to-test.
3. Physical:
 - a. Lens color shall be as indicated on the instrument device schedule. Lens shall be approximately 1-1/4-in diameter.
 - b. Provide legend faceplates engraved to indicate the required function of each device.
 - c. Units shall be rated NEMA 13 for indoor panels. Units located outdoors or indicated to be weatherproof shall be rated NEMA 4X.
4. Manufacturers:
 - a. Eaton/Cutler Hammer
 - b. Schneider Electric/Square D
 - c. Allen Bradley
 - d. Approved equal

B. Rotary Hand Switches and Push Buttons

1. Type:
 - a. Control devices shall be heavy duty, oiltight type with stackable contact blocks.
2. Functional/Performance:
 - a. Provide contact arrangement and switching action as required for the control system specified.
3. Physical:
 - a. For 120VAC service provide contacts rated 10 amps at 120VAC, for 24VDC service provide silver sliding contacts rated 5 amps at 125VDC, for electronic (millivolt/ milliamp) switching provide contacts rated 1 amp at 28VDC.
 - b. Push buttons shall have flush type operators. Selector switches shall have knob or wing lever operators.
 - c. Units shall be rated NEMA Type 13 for indoor service. Units located outdoors or indicated to be weatherproof shall be rated NEMA 4X.
 - d. Provide legend plates denoting switch/push button position/function.

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4. Options/ Accessories Required:
 - a. Provide lock-out-push buttons, key-operators, etc., as indicated on the instrument device schedule.
 - b. Provide make-before-break bridging contacts where required.
 5. Manufacturers:
 - a. Eaton/Cutler Hammer
 - b. Schneider Electric/Square D
 - c. Allen Bradley
 - d. Approved equal
- C. Industrial Relays and Time Delays
1. Type:
 - a. Industrial heavy duty relays.
 2. Functional/Performance:
 - a. Contact arrangement/function shall be as required to meet the specified control function specified.
 - b. Contacts shall be rated 10 amps continuous at 600 volts.
 - c. Relays shall be provided with convertible contact blocks.
 - d. Pneumatic time delay relays shall be used on time delays less than 180 seconds and shall be adjustable.
 - e. Solid state time delay relays shall be used on time delays between 180 seconds and one-hour.
 3. Options/ Accessories Required:
 - a. Provide all mounting rails, etc. that are required.
 4. Manufacturers:
 - a. Eaton/ Cutler Hammer
 - b. Schneider Electric/Square D
 - c. Allen Bradley
 - d. Approved equal
- D. General Purpose Relays and Time Delays
1. Type:
 - a. Units shall be of the general purpose plug-in type.
 2. Functional/Performance:
 - a. Coil voltage shall match supply voltage.
 - b. Contact arrangement/function shall be as required to meet the specified control function.
 - c. Mechanical life expectancy shall be in excess of 10,000,000.
 - d. Duty cycle shall be rated for continuous operation.

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- e. Units shall be provided with integral indicating light to indicate if relay is energized.
 - f. Solid state time delays shall be provided with polarity protection (DC units) and transient protection.
 - g. Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.
3. Physical:
 - a. For 120VAC service provide contacts rated 10 amps at 120VAC, for 24VDC service provide contacts rated 5 amps at 28VDC, for electronic (milliamp/ millivolt) switching applicator provide gold plated contacts rated for electronic service.
 - b. Relays shall be provided with dust and moisture resistant covers.
 4. Options/Accessories Required:
 - a. Provide mounting sockets with pressure type terminal blocks rated 300 volt and 10 amps.
 - b. Provide mounting rails/holders as required.
 5. Manufacturers:
 - a. Eaton/Cutler Hammer
 - b. Schneider Electric/Square D
 - c. Allen Bradley
 - d. Approved equal
- E. Signal Isolators/Boosters/Converters
1. Type
 - a. Solid state electronic type.
 2. Functional/Performance
 - a. Accuracy - 0.15 percent.
 - b. Inputs - Current, voltage, frequency, temperature, or resistance as required.
 - c. Outputs - Current or voltage as required.
 - d. Isolation - There shall be complete isolation between input Circuitry, output circuitry, and the power supply.
 - e. Adjustments - Zero and span adjustment shall be provided.
 - f. Protection - Provide RFI protection.
 3. Physical
 - a. Mounting - Suitable for mounting in an enclosure or instrument rack.
 4. Options/Accessories Required
 - a. Mounting rack or general purpose enclosure as required.
 5. Manufacturers
-

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- a. Phoenix Contact
- b. Rochester Instrument Systems
- c. Acromag Inc.
- d. Moore Industries
- e. Or approved Equal

F. Signal Selectors, Computation, and Conditioning Relays

1. Type
 - a. Solid state electronic type.
2. Functional/Performance
 - a. Inputs - 4-20 mA
 - b. Outputs - 4-20 mA
 - c. Protection - Provide RFI protection.
 - d. Operation - The relay shall multiply, add, subtract, select, extract the square root, or perform the specified conditioning/computation function required. All inputs shall be able to be individually rescaled and biased as required.
 - e. Isolation - All inputs, outputs, and power supplies shall be completely isolated.
 - f. Accuracy - 0.35 percent of span.
 - g. Adjustments - Multiturn potentiometer for zero, span, scaling, and biasing.
3. Physical
 - a. Mounting - Suitable for mounting in an enclosure or instrument rack.
4. Options/Accessories Required
 - a. Mounting rack or general-purpose enclosure as required.
5. Manufacturers
 - a. Action Pak
 - b. Acromag Inc.
 - c. Moore Industries
 - d. Or approved Equal

G. Intrinsically Safe Relays

1. Type
 - a. Relays shall be of the solid state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe usage in hazardous areas.
2. Options/Accessories Required
 - a. Relays shall match power supply provided.
 - b. Relays shall be located in non-hazardous areas.

3. Manufacturers
 - a. Phoenix Contact
 - b. Consolidated Electric
 - c. Gems Safe-Pak
 - d. Warrick Controls
 - e. Or approved Equal

2.10 I/O DIRECT CURRENT (DC) POWER SUPPLY

- A. Redundant 24 VDC power supplies for powering analog instrument loops, discrete inputs, and discrete outputs shall be sized and provided by the ISS as a part of the system. The 24 VDC power supply shall be derived from the 120 VAC input power circuit to the PLC. If one power supply fails, the other power supply shall begin supplying the loads with no interruption in 24V DC service to the field devices.
- B. The power supplies shall provide sufficient regulation and ripple control to assure that the instruments and devices being operated can operate within their required tolerances. Output over voltage and over current protective devices shall be provided with the power supply to protect the instruments from damage due to power supply failure and to protect the power supply from damage due to external failure. Transformers shall have primary and secondary fuse protection.
- C. Output over voltage and over current protective devices shall be provided. The field side of the 24 VDC power sources(s) shall have individual or grouped (of logically associated circuits) fusing and provided with a readily visible, labeled blown fuse indicator.
- D. Power supplies shall be manufactured by Phoenix Cotnact, Sola, Power One, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The panels shall be installed at locations as shown on the Drawings.
- B. Panels shall be factory tested prior to shipment. Field installation shall consist only of setting the panel in place and making necessary electrical and conduit connections.
- C. Refer to Section 13300.

3.2 TESTS (GENERAL)

- A. Panels and panel assemblies shall be tested for proper operation at the

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Instrumentation System Supplier's factory, or other selected site, prior to the shipment of any panel to the jobsite.

- B. Prior to shipment, a Witnessed Factory Test shall be performed at the System Supplier's factory, or other selected site, on panels provided. The test shall demonstrate specified functions by simulating inputs and outputs to the panels.
- C. Acceptance of shop tests by Owner or Design-Builder shall not constitute a waiver of requirements to meet the field tests under specified operating conditions, nor does inspection relieve the manufacturer of his responsibility in any way.
- D. Refer to Section 13300.

END OF SECTION

SECTION 15052
PIPING – GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. This Section specifies the basic administrative and testing requirements for piping. Specific piping materials, systems and related installation and testing requirements are specified in other Sections of Division 2 and 15.

1.2 RELATED WORK

- A. Piping materials and systems are included in other Sections of Division 2 and 15.
- B. Valves are included in Section 15100.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 01300, general submittals for piping and piping systems are listed below. It is not intended that all submittals listed below be provided for all piping materials and systems. Refer to individual System or Piping Sections for specific submittals.
- B. Shop Drawings and Product Data
 - 1. Piping layouts in full detail.
 - 2. Location of pipe hangers and supports.
 - 3. Location and type of backup block or device to prevent joint separation.
 - 4. Large scale details of wall penetrations and fabricated fittings.
 - 5. Schedules of all pipe, fittings, special castings, couplings, expansion joints and other appurtenances.
 - 6. Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners and other accessories.
 - 7. Brochures and technical data on coatings and linings and proposed method for application and repair.
- C. Samples

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- D. Design Data
 - E. Test Reports
 - 1. Four copies of certified shop tests showing compliance with appropriate standard.
 - 2. Four copies of all field test reports.
 - F. Certificates
 - 1. Copies of certification for all welders performing work in accordance with ANSI B31.1.
 - G. Manufacturer's Installation (or application) instructions.
 - H. Statement of Qualifications
 - I. Manufacturers Field Report
 - J. Project Record Document
 - K. Operation and Maintenance Data in accordance with Section 01730.
 - L. Warranties
- 1.04 REFERENCE STANDARDS
- A. ASTM International
 - 1. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
 - B. American National Standards Institute (ANSI)
 - 1. ANSI B16.5 - Pipe Flanges and Flanged Fittings
 - 2. ANSI B31.1 - Power Piping
 - C. American Welding Society (AWS)
 - 1. AWS B2.1 - Specification for Welding Procedure and Performance Qualifications
 - D. American Water Works Association (AWWA)
 - 1. AWWA Manual M11 - Steel Pipe - A Guide for Design and Installation
 - E. American Society of Mechanical Engineers (ASME)
 - F. Underwriters Laboratories (UL)

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- G. Factory Mutual (FM)
- H. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. All materials shall be new and unused.
- B. Install piping to meet requirements of local codes.
- C. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified. Reference to standards such as ASTM and ANSI shall apply to those versions in effect at the time of bid opening.
- D. Coordinate dimensions and drilling of flanges with flanges for valves, pumps and other equipment to be installed in piping systems. Bolt holes in flanges to straddle vertical centerline.
- E. Reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner and acid solder.
- F. Pipe-joint compound, for pipe carrying flammable or toxic gas, must bear approval of UL or FM.
- G. Unless otherwise specified, pressures referred to in all Piping Sections are expressed in pounds per square in gauge above atmospheric pressure, psig and all temperature are expressed in degrees Fahrenheit (F).

1.6 DELIVERY, STORAGE AND HANDLING

- A. During loading, transportation and unloading take care to prevent damage to pipes and coating. Carefully load and unload each pipe under control at all times. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation to ensure no injury to pipe and lining.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Specific piping materials and appurtenances are specified in the respective Piping or System Sections.
- B. General installation materials shall be as specified below.
 - 1. Unions shall be brass or bronze unions for joining nonferrous pipe;
malleable brass or bronze-seated iron or steel unions for joining ferrous pipe;

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PVC unions for joining PVC pipe; CPVC unions for joining CPVC pipe.

2. Temporary Plugs shall be standard plugs or caps which are suitable for permanent service.
3. Flexible Connections shall be flanged spool type, 180 degree F maximum service, single filled arch with synthetic rubber tube and cover, steel-ring reinforced synthetic fiber carcass, with flanges drilled to 150 lb ANSI B16.5. Steel retaining rings, control rods and compression sleeves shall be provided where shown and as required for the working pressure of the system in which the joint is installed. All flexible joints shall be rated for the working pressure of the system in which they are installed.

PART 3 EXECUTION

3.1 GENERAL

- A. All dirt, scale, weld splatter, water and other foreign matter shall be removed from the inside and outside of all pipe and sub-assemblies prior to installing.
- B. All pipe joints and connections to equipment shall be made in such a manner as to produce a minimum of strain at the joint.
- C. Install piping in a neat manner with lines straight and parallel or at right angles to walls or column lines and with risers plumb. Run piping so as to avoid passing through ductwork or directly under electric light outlets and/or interference with other lines. All work shall be accomplished using recognized methods and procedures of pipe fabrication and in accordance with the latest revision of applicable ANSI Standards, ASME Codes and Pipe Fabrication Institute Standards.
 1. Use full length of pipe except where cut lengths are necessary. Do not spring or deform piping to make up joints.
 2. Pipe shall be cut square, not upset, undersize or out of round. Ends shall be carefully reamed and cleaned before being installed.
 - a. Bending of pipe is not permitted. Use fittings for all changes in direction.
 3. Do not use bushings except where specifically approved by the Engineer. Reducers shall be eccentric to provide for drainage from all liquid-bearing lines and facilitate air removal from water lines.
 4. Verify the locations and elevations of any existing piping and manholes before proceeding with work on any system. Any discrepancies between the information shown on the Drawings and the actual conditions found in the field shall be reported at once to the Engineer. No claim for extra payment will be considered if the above provision has not been complied with.

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5. Where lines of lower service rating tie into services or equipment of higher service rating the isolation valve between the two shall conform to the higher rating.
6. Mitering of pipe to form elbow is not permitted.
7. All piping interiors shall be thoroughly cleaned after installation and kept clean by approved temporary closures on all openings until the system is put in service. Closures should be suitable to withstand the hydrostatic test.

D. Test Connections

1. Provide 1/2-in female NPT test connection equipped with 1/2-in brass plug on all pump suction and discharge lines. Where indicated on the Drawings, test connections should be equipped with bar stock valve and gauge. Provide test connections at all steam traps. The connection shall be located on the discharge side of the trap between the trap and the first valve. It shall consist of a 1/2-in branch connection terminated with a gate valve.

E. Unions

1. Unions screwed or flanged shall be provided where indicated and in the following locations even if not indicated.
 - a. In long runs of piping to permit convenient disassembly for alterations or repairs.
 - b. In by-passes around equipment.
 - c. In connections to tanks, pumps and other equipment between the shut-off valve and the equipment.
 - d. In connections on both sides of traps, controls and automatic control valves.

F. Vents and Drains

1. Provide vents and drains in the following places:
 - a. Water Lines - Vents at high points and drains at low points.
 - b. Air Lines - Drains at low points.

3.2 UNIONS

- A. Use unions to allow dismantling of pipe, valves and equipment.

3.3 WELDING

- A. Welding in accordance with ANSI B31 and AWS B3.0.
- B. Install welding fittings on all welded lines. Make changes in direction and

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intersection of lines with welding fittings. Do not miter pipes to form elbows or notching of straight runs to form tees, or any similar construction. Do not employ welder who has not been fully qualified in above specified procedure and so certified by approved welding bureau or similar locally recognized testing authority.

3.4 FLANGED JOINTS

- A. Make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped. Use number and size of bolts conforming to same ANSI Standard as flanges. Before flanges pieces are assembled, remove rust resistant coating from machined surfaces, clean gaskets and smooth all burrs and other defects. Make up flanged joints tight, care being taken to prevent undue strain upon valves or other pieces of equipment.

3.5 SLEEVE COUPLINGS

- A. Install tierods, pipe clamps or bridles when sleeve type couplings or fittings are used in piping system where indicated, and at changes in direction or other places as necessary, to prevent joints from pulling apart under pressure. Use bridles and tierods at least 3/4-in in diameter, except where tierods replace flange bolts of smaller size, in which case fit with nut on each side of pair of flanges. Joint harnessing shall conform, as a minimum, to the requirements for the bolts and tie bolt lugs as set forth in AWWA Manual M11.

3.6 WALL SLEEVE SEALS

- A. Use expandable rubber segmented sealing device with corrosion-resistant fasteners to make watertight the annular space between pipe and sleeve. Determine the required inside diameter of each individual wall opening or sleeve to fit the pipe and seal it to assure a watertight joint as recommended by the manufacturer, before ordering, fabricating or installing. Install pipe concentrically through wall sleeve. Install and tighten seal per manufacturer's instructions.

3.7 TESTING

- A. Test all pipelines for water/ gas tightness as specified. Furnish all labor, testing plugs or caps, pressure pumps, pipe connections, gauges and all other equipment required. Testing shall be performed in accordance with one or more of the testing procedures. All testing shall be performed in the presence of the Engineer.
- B. Repair faulty joints or remove defective pipe and fittings and replace as approved by the Engineer. Retest.

3.8 DISINFECTION

PIPING - GENERAL REQUIREMENTS

- A. After satisfactory testing, all potable water lines shall be thoroughly disinfected with a solution of not less than 50 parts per million of available chlorine. The disinfecting solution shall be allowed to remain in the system for a period of 3 hours after which time all valves shall be opened and the system shall be flushed with clean water.
- B. Water being flushed from structures or pipelines after disinfection with a chlorine residue of 2 mg/l or greater, shall be treated with a dechlorination solution, in a method approved by the Engineer, prior to discharge.

3.9 HYDROSTATIC TEST

- A. Scope: This test shall be used to hydrostatically test piping systems for structural integrity and leaks. The test shall be performed at ambient temperature unless otherwise specified.
- B. Test Fluid
 - 1. Water should be used as the test fluid whenever possible. In those systems where water cannot be used the test fluid may be either the one to be used in the system or the one agreed upon by the Engineer.
- C. Test Equipment
 - 1. Water - Of sufficient capacity to deliver the required test pressure.
 - 2. Strainer - On inlet side of the pump to prevent foreign matter from entering the system.
 - 3. Valves - Shall be provided on the suction and discharge side of the pump.
 - 4. Heater - To allow heating of the test fluid when elevated temperatures are required for test.
 - 5. Relief Valve - Set at a pressure to relieve at 20 to 25 percent above the required test pressure.
 - 6. Pressure Gauge(s) - Capable of reaching 50 percent over the test pressure. These should be located at the pump discharge and any other place deemed convenient by the Contractor.
 - 7. Pressure gauges and relief valves shall be checked for accuracy before use in test procedures.
- D. Preparation for Test

PIPING – GENERAL REQUIREMENTS

1. Determine the fluid to be used for the test, and, if other than ambient temperature is required, what the test temperature will be.
 2. When a fluid other than water is used for a test, the equipment used for the test shall be of a material compatible with the test fluid. Normally this would be equal to the piping material.
 3. Vents shall be provided at the high points of the system and drains provided where means of venting or draining do not exist.
 4. Remove or block off, all relief valves, rupture discs, alarms, control instruments, etc., that shall not be subjected to the test pressure.
 5. All discs, balls, or pistons from check valves shall be removed if they interfere with filling of the system. Open all valves between inlet and outlet of the section to be tested.
 6. Connect pump and provide temporary closures for all of the external openings in the system. Use caution to ensure that the closures are properly designed and strong enough to withstand the test pressure.
 7. All joints, including welds, are to be left uninsulated and exposed for examination during test.
 8. A joint previously tested in accordance with this Section may be covered or insulated.
 9. Piping designed for vapor or gas shall be provided with additional temporary supports, if necessary, to support the weight of the test liquid.
 10. Expansion joints shall be provided with temporary restraint for additional pressure under test or shall be isolated from the test.
 11. Flanged joints, where blanks are inserted to isolate equipment during the test, need not be tested.
- E. Test Pressure
1. The hydrostatic test pressure shall be 1-1/2 times the design pressure unless otherwise specified in the System Section.
- F. Test Procedure
1. Allow the test fluid to enter the system. Open vents to allow displacement of all entrapped air. For all pipelines exceeding 500-ft in length, the maximum rate of filling shall be limited to that which produces a maximum nominal flow

PIPING - GENERAL REQUIREMENTS

velocity of one foot per second in the pipe to be tested.

2. Close vents and restrict personnel in the test area to those involved in the test.
3. Raise the pressure slowly with the pump until the predetermined test pressure is reached. Maintain pressure for a minimum of 6 hours, keeping personnel at a safe distance.
4. Reduce the pressure about 20 percent and hold it at that point while the entire system is carefully inspected for leaks, cracks, or other signs of defects.
5. If defects are found, the pressure shall be released, the system drained, the defects corrected and the test repeated.
6. After a satisfactory test has been completed, the line shall be drained.

G. Flushing

1. Lines tested with water shall be completely drained.
2. Lines shall be flushed, after test.

H. Test Records

1. Records shall be maintained of all tests performed.
2. Test records shall include:
 - a. Date of Testing
 - b. Identification of Piping Tested
 - c. Test Fluid
 - d. Test Pressure
3. If leaks are found, they shall be noted, on the record. After correction, retesting as specified for original test.

END OF SECTION

PIPING - GENERAL REQUIREMENTS

SECTION 15064
PLASTIC PIPE AND FITTINGS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install 1/8-in to 6-in non- buried plastic piping and appurtenances as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Concrete work is included in Division 3.
- B. Field painting is included in Section 09902.
- C. Pipe testing is included in Section 15052.
- D. Valves and appurtenances are included in Section 15100.
- E. Pipe hangers and supports are included in Section 15140.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings and product data required to establish compliance with this Section. Submittals shall include the following:
 - 1. Shop drawings including piping layouts and schedules shall be submitted to the Engineer and shall include dimensioning, fittings, locations of valves and appurtenances, joint details, methods and locations of supports and all other pertinent technical specifications for all piping to be furnished.
 - 2. Shop drawing submittals for piping under this Section shall include all data and information required for the complete piping systems. All dimensions shall be based on the actual equipment to be furnished. Types and locations of pipe hangers and/or supports shall be shown on the piping layout for each piping submittal.

1.4 REFERENCE STANDARDS

- A. ASTM International.
 - 1. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

2. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
3. ASTM D2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.
4. ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
5. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
6. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
7. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
8. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
9. ASTM D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings.
10. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
11. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
12. ASTM D3311 - Standard Specification for Drain, Waste and Vent (DWV) Plastic Fittings Patterns.
13. ASTM D3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.
14. ASTM D5260 - Standard Classification for Chemical Resistance of Poly(Vinyl Chloride) (PVC) Homopolymer and Copolymer Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
15. ASTM F437 - Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
16. ASTM F438 - Standard Specification for Socket - Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.

17. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
 18. ASTM F441 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
 19. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
 20. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
 21. ASTM F594 - Standard Specification for Stainless Steel Nuts.
- B. Plastic Pipe Institute (PPI)
1. PPI Handbook of Polyethylene Pipe
- C. Handbook of PVC Pipe Design and Construction, Uni-Bell PVC Pipe Association
- D. American National Standard Institute (ANSI)
1. ANSI B16.5 Pipe Flanges and Flanged Fittings.
- E. National Sanitation Foundation (NSF)
- F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. All plastic pipe and fittings of each type shall be furnished by a single manufacturer who is experienced in the manufacture of the items to be furnished; however, it shall not be a requirement that the pipe and fittings be manufactured by the same manufacturer, provided that the pipe and fittings are compatible in both compounding and size. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall be suitable for the intended service.

1.6 SYSTEM DESCRIPTION

- A. Piping shall be installed in those locations as shown on the Drawings.
- B. The equipment and materials specified herein are intended to be standard types of plastic pipe and fittings for use in transporting wastewater, water, air and chemicals.

C. Plastic piping systems shall be designed for the following conditions:

1. System: Plant Water (W3)
2. Material: Schedule 80 PVC
3. Pressure: Atmosphere to 100 psig
4. Temperature:
Ambient PART 2

PRODUCTS

2.1 MATERIALS

A. Poly (Vinyl Chloride) Pipe and Fittings - PVC

1. Pipe shall be manufactured from PVC compounds meeting ASTM D1784, Class 12454 in accordance with ASTM D1785, PVC 1120. The pipe shall have a minimum hydrostatic design stress of 2,000 psi at 73 degrees F and shall be suitable for field cutting and solvent welding. Pipe shall be of the sizes as shown on the Drawings and shall be Schedule 80 unless otherwise shown.
2. Fittings shall be the socket type for solvent welded joints conforming to ASTM D2467 or ASTM D2466 where Schedule 40 pipe is shown on the Drawings. Fittings shall be manufactured from PVC compound meeting ASTM D1784, Class 12454. Solvent cement shall be as specified in ASTM D2564.

B. Fittings, specials, unions and flanges shall be of the same schedule number and manufactured of the same materials as the pipe. Whenever unions are called out on the Drawings, flanged connections may be substituted, provided that dimensional controls do not preclude use of flanges.

C. Expansion joints for PVC sizes 1/2-in to 6-in shall be telescoping type as manufactured by Plastinetics, Inc.; ASAHI/America or equal. Expansion in pipes smaller than 1/2-in shall be accommodated with expansion loops.

2.2 SURFACE PREPARATION AND SHOP COATING

A. All PVC and CPVC piping and fittings exposed to view shall have its surface prepared and be painted as specified in Section 09902. Assist as required in identifying pipe contents, direction of flow and all else required for proper finish painting and marking of pipe.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The installation of plastic pipe shall be strictly in accordance with the manufacturer's technical data and printed instructions.
- B. Joints for PVC pipe shall be solvent cemented unless flanged or threaded are otherwise shown on the Drawings or are specified as other types herein. In making solvent cemented connections, clean dirt and moisture from pipe and fittings, bevel pipe ends slightly with emery cloth to remove any shoulder or burrs created by cutting of the pipe. Solvent cement joints shall be made in accordance with ASTM D2855. Primer shall be used whenever recommended by the pipe, fitting, or cement manufacturer and in all cases for joints on pipe systems 4-in in diameter or larger. Making solvent cement joints shall not be performed and the work shall stop when the temperature, measured in the shade, is 40 degrees F and falling.
- C. Installation of valves and fittings shall be in accordance with manufacturer's instructions. Particular care shall be taken not to overstress threaded connections. In making solvent cement connections, the solvent cement or primer shall not be spilled on valves. Any cement allowed to run from joints shall be cleaned from the pipe and fittings immediately.
- D. All piping shall have a sufficient number of unions to allow convenient removal of piping and shall be as approved by the Engineer. PVC pipe shall be installed with at least one expansion joint or loop near the center of each straight run of pipe which is 50-ft or longer with the maximum spacing between expansion joints or loops being 150-ft.
- E. Where plastic pipe passes through wall sleeves, the space between the pipe and sleeve shall be sealed with a mechanical sealing element.
- F. Concrete inserts for hangers and supports shall be furnished and installed in the concrete as it is placed. The inserts shall be set in accordance with the requirements of the piping layout and the Contractor shall verify these locations from approved piping layout drawings and the structural drawings. Pipe hangers and supports are specified in Section 15140.

3.2 FIELD TESTING

- A. All pipelines shall remain undisturbed for the minimum curing or cooling time specified for each type of pipe material but no less than 8 hours to develop full curing and complete strength at all joints. All pipe systems shall be flushed clean and then subjected to a hydrostatic pressure test for 12 hours at a test pressure and temperature specified below. Testing procedures shall be as specified in Section 15052. Should the temperature not be attainable under hydrostatic conditions, then the test may be performed under hydro-dynamic conditions, provided that accurate measurements for loss of the test fluid can be made, or the pressure shall be

proportionally increased to simulate the stresses of the higher temperature in relation to the lowest system temperature that is expected during the duration of the test. The proportionally higher test pressures shall be determined in accordance with the accepted temperature versus strength properties as published by the pipe manufacturer, PPI or other pipe material standards organization.

3.3 PAINTING

- A. All PVC pipe and fittings exposed to the direct sunlight shall be field painted to provide additional UV protection. This painting shall be required whether or not marking is required and shall be in accordance with Section 09902.

END OF SECTION

SECTION 15072
DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required, install, and test ductile iron pipe and fittings for plant mechanical piping as shown on the Drawings and as specified herein.
- B. Mechanical piping shall include all piping and fittings installed above grade and shall exclude pipe in valve vaults, manholes, cleanouts and similar yard structures.
- C. Mechanical piping shall be installed as shown on the Drawings. Provide pipe supports, hangers and couplings as required to achieve a complete pipe system.
- D. Where the word "pipe" is used, it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

1.2 RELATED WORK

- A. Delivery, Storage and Handling is included in Section 01600.
- B. Yard Piping is included in Section 02616.
- C. Painting is included in Section 09901 and Section 09902.
- D. General Piping Requirements are included in Section 15052.
- E. Valves and Appurtenances are included in Section 15100.
- F. Pipe Hangers and Supports are included in Section 15140.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings and product data required to establish compliance with the Section. Submittals shall include the following
 - 1. Tabulated layout drawings showing actual pipe lengths, diameters, fittings and appurtenances.
 - 2. Prior to shipment of pipe, submit a certified affidavit of compliance from the

pipe manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance AWWA and ASTM standards and requirements specified herein.

1.4 REFERENCE STANDARDS

A. ASTM International (ASTM):

1. ASTM C150 - Standard Specification for Portland Cement.

B. American National Standards Institute (ANSI):

1. ANSI B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form).
2. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125 and 250.
3. ANSI B18.2 - Square and Hex Bolts and Screws Inch Series Including Hex CapScrews and Lag Screws.

C. American Water Works Association (AWWA):

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C110 - Ductile-Iron and Gray-Iron Fittings. (3-in Through 48-in (80mm Through 1200mm) for Water).
3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
5. AWWA C116 - Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings.
6. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
7. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
8. AWWA C153 - Ductile-Iron Compact Fittings for Water Service.
9. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
10. AWWA C606 - Grooved and Shouldered Joints.
11. AWWA C651 - Disinfecting Water Mains.

- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. Each length of ductile iron pipe supplied for the project shall be hydrostatically tested at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture of the pipe wall. Certified test results shall be furnished in duplicate to the Engineer prior to time of shipment.
- B. Ductile-iron pipe and fittings to be installed under this project shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the Engineer sworn certificates of such tests and their results prior to the shipment of the pipe.
- C. Inspection of the pipe and fittings will also be made by the Engineer after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the specified requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job.
- D. Pipe and fittings shall be permanently marked with the following information:
 - 1. Manufacturer, date.
 - 2. Size, type, class, or wall thickness.
 - 3. Standard produced to (AWWA, ASTM, etc).

1.6 DELIVERY, STORAGE AND HANDLING

- A. See Section 01600 for general requirements.
- B. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe or coatings. Under no circumstances shall the pipe be dropped or skidded against each other. Slings, hooks, or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior surface or internal lining of the pipe.
- C. Materials, if stored, shall be kept safe from damage. The interior of all piping, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times.
- D. Pipe ends including flange faces shall be protected from damage. All openings shall be adequately covered to prevent entrance of dirt, water and debris, and keep the pipe interior clean.

- E. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations.

PART 2 PRODUCTS

2.1 MATERIALS

A. Pipe:

- 1. Ductile iron pipe shall conform to AWWA C115 and C110. Flanged pipe shall be the following Thickness Classes as per AWWA C150:

<u>Size</u>	<u>Thickness Class</u>
4-inch	54
6-inch	53
8-inch	52
10-inch through 48-inch	50

- 2. Pipe shall be supplied in standard lengths as much as possible.
- 3. Ductile iron pipe shall be as manufactured by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company; Clow Water System Company, or equal.

B. Joints:

- 1. Ductile iron pipe shall have flanged joints. Flange shall be flat face type, unless otherwise noted, meeting ANSI requirements.
- 2. Flange gasket shall be full face type SBR per AWWA C111 to provide positive sealing for the flanged ductile iron joints. Thickness shall be 1/8-in unless otherwise indicated. The gasket materials for potable water pipe shall be certified by NSF61.
- 3. Assembly bolts shall be square headed carbon steel machine bolts with hexagon nuts per ANSI B18.2. Thread shall conform to ANSI B1.1. Bolt length shall be such that after joints are assembled, the bolts shall protrude through the nuts, but not more than 1/2-in.
- 4. Sleeve type couplings shall be Dresser Style 38 or 138 as manufactured by Dresser Industries, or equivalent products of Smith-Blair, Romac Industries, Ford Meter Box Co or approved equal.
- 5. Flanged coupling adaptors shall be Smith-Blair Type 913, or equivalent products of Klamflex Pipe Couplings (PTY) LTD, Robar Industries LTD

or approved equal.

C. Fittings:

1. Pipe fittings shall be ductile iron with a pressure rating of 250 psi. Fittings shall meet the requirements of AWWA C110 as applicable. Fittings shall have the same pressure rating, as a minimum, of the connecting pipe.

D. Interior Lining:

1. Ductile iron pipe and fittings shall have the same type of lining as specified or indicated on the Drawings.
2. The 16-inch return sludge ductile iron pipe and fittings between the RAS Pump Station and Headworks, and 42-inch raw sewage ductile iron pipe and fittings between the Headworks and BNR Process Basins shall be epoxy lined, in accordance with ASTM A746.
3. Ductile iron pipe and fittings, other than those specified in 2.01.D.2 above, shall have a cement mortar lining and asphaltic seal coat in accordance with AWWA C104. The cement shall be Type I per ASTM C150, double thickness.
4. Interior linings for potable water use shall be certified by NSF 61.

E. Exterior Coatings:

1. Unless otherwise specified, all coatings shall be shop applied with "hold-backs" provided as required at pipe and fitting ends for satisfactory installation for joint connections in the field. Provide all necessary coating materials to perform field coating applications at joints. Unless otherwise noted, field applied coating material shall be compatible with or equal to the shop applied material.
2. Unless otherwise specified, all exposed exterior ferrous surfaces shall be painted with an applicable paint system as specified under Division 9. Surface preparation and application thereof shall be in conformance with applicable provisions of Division 9.

F. Pipe Hangers and Supports:

1. Pipe hangers and supports shall be provided at suitable distance along the pipeline regardless whether they are shown or not shown on the Drawings.
2. Pipe hangers and supports shall be as specified in Section 15140.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

A. General

1. Piping and fittings shall be installed true to alignment and rigidly supported. Anchorage shall be provided where required. Any damage to linings shall be repaired to the satisfaction of the Engineer before the pipe is installed. Each length of pipe shall be cleaned out before installation. All of manufacturer's recommendations shall be complied with.
2. Deflection at joints shall not exceed that recommended by the pipe manufacturer. Fittings, in addition to those shown on the Drawings, shall be provided, if required, in areas where conflict exists with the existing facilities.
3. When pipe cutting is acceptable to the Engineer, the cutting shall be done by abrasive saw, leaving a smooth cut at right angles to the axis of the pipe. Any damage to the lining shall be repaired to the satisfaction of the Engineer. Field cut ends shall be sealed with approved epoxy coating in accordance with manufacturer's instructions.
4. Ductile iron and fittings shall be installed in accordance with requirements of AWWA C600 modified.

B. Jointing

1. Flanged joints shall be made using gaskets, bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same ANSI Standard as the flanges.
2. Bolts in flanged joints or mechanical joints shall be tightened alternately and evenly.
3. Sleeve type couplings and grooved joints using split ring couplings shall be installed in accordance with the procedures recommended by their respective manufacturers.

C. Pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, submit a certification stating that such requirements have been complied with.

D. Sleeves of proper size shall be installed for all pipes passing through floors or walls. Sleeves shall be installed as shown on the Drawings. Where indicated on the Drawings or required for liquid or gas-tightness, the pipe shall be sealed with a mechanical seal similar to Link-Seal as manufactured by Thunderline Corporation, or equal.

- E. Sleeves and wall pipes shall have thrust collar located at the mid-depth of wall.
- F. Concrete inserts for hangers and supports shall be furnished and installed as recommended by the manufacturer as shown on the Drawings or as specified herein. The inserts shall be set in accordance with the requirements of the piping layout and their locations verified from approved piping layout drawings and the structural drawings.

3.2 CLEANING

- A. Clean the pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. All debris shall be removed from the pipeline. The lowest segment outlet shall be flushed last to assure debris removal.

3.3 DISINFECTION

- A. Ductile iron pipe used for potable water service shall be disinfected after cleaning. Provide all necessary equipment and labor for the disinfection.
- B. Disinfection shall be in accordance with AWWA C651.
- C. Discharge of chlorinated water shall comply with all Federal, State and local standards.

END OF SECTION

SECTION 15100
VALVES

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install complete and ready for operation and test all non-buried valves as shown on the Drawings and as specified herein.
- B. The equipment shall include, but not be limited to, the following; however not all items specified herein may be included in this project.
 - 1. General Requirements.
 - 2. Valve Actuators - Manual.
 - 3. Valve Actuators - Powered.
 - 4. Butterfly Valves.
 - 5. Gate Valves.
 - 6. Knife Gate Valves.
 - 7. Plug Valves.
 - 8. Check Valves.
 - 9. Ball Valves.
 - 10. Thermoplastic Valves.
 - 11. Solenoid Valves.
 - 12. Corporation Stops.
 - 13. Air Release and Vacuum Relief Valves.
 - 14. Mud Valves (Plug Drain Valves).

1.2 RELATED WORK

- A. Buried valves and appurtenances are included in Division 2.

- B. Shop and Finish painting is included in Sections 09901 and 09902.
- C. Slide and Weir Gates are included in Section 11282.
- D. Instrumentation, not specified herein, is included in Division 13.
- E. Valves on all HVAC systems are included in their respective sections of Division 15.
- F. Electrical work is included in Division 16.
- G. Certain items similar to those specified in this Section may be specified to be furnished and installed with individual equipment or systems. In case of a conflict, those individual equipment or system requirements shall govern.
- H. Electric valve operators of all types, rate of flow controllers (including modulating valves and operators) and other types of valves which are part of the automated instrumentation (such as some solenoid valves) if not included herein are included in Division 13. Valve operators shall, however, be mounted at factory on valves as specified herein, as part of the work of this Section.

1.3 SUBMITTALS

- A. Submit to Engineer, in accordance with Section 01300, materials required to establish compliance with this Section. First submittal shall be valve schedule described in Paragraph 1.09. Approval of valve schedule submittal is required prior to Contractor submitting any of equipment in this specification. Subsequent Equipment Submittals shall include at least the following:
 - 1. Valve tag number.
 - 2. Manufacturer and supplier.
 - 3. Address at which equipment will be fabricated or assembled.
 - 4. Drawings showing assembly details, materials of construction and dimensions.
 - 5. Descriptive literature, bulletins and/or catalogs of the equipment.
 - 6. Total weight of each item.
 - 7. A complete bill of materials.
 - 8. Additional submittal data, where noted with individual pieces of equipment.
 - 9. Individual electrical control schematics and wiring diagrams for each valve

operator with external interfaces, identified exactly as detailed on Electrical and Instrumentation Drawings. Standard catalogue cut sheets that show typical wiring diagrams only are not acceptable. Valve actuators shall be coordinated with electrical requirements shown on Drawings and valves as specified herein.

B. Test Reports:

1. Provide certified hydrostatic test data, per manufacturer's standard procedure or MSS-SP- 61 for valves.

C. Certificates:

1. For each valve specified to be manufactured, tested and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with appropriate standards, including certified results of required tests and certification of proper installation.

D. Manufacturer's Installation and Application Data.

E. Operating and Maintenance Data.

1. Operating and maintenance instructions shall be furnished as provided in Section 01730. Instructions shall be prepared specifically for this installation and shall include required cuts, drawings, equipment lists, descriptions and other information required to instruct operating and maintenance personnel unfamiliar with such equipment.

1.4 REFERENCE STANDARDS

A. ASTM International:

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
3. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
4. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
5. ASTM A436 - Standard Specification for Austenitic Gray Iron Castings.
6. ASTM A536 - Standard Specification for Ductile Iron Castings.
7. ASTM B30 - Standard Specification for Copper-Base Alloys in Ingot Form.

8. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
- B. American Water Works Association (AWWA):
1. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 2. AWWA C500 - Metal-Seated Gate Valves Supply Service.
 3. AWWA C504 - Rubber-Seated Butterfly Valves.
 4. AWWA C507 - Ball Valves, 6-in through 48-in (150mm through 1200mm).
 5. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-in (50mm through 24-in (600mm) NPS.
 6. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
 7. AWWA C511 - Reduced-Pressure Principle Backflow-Prevention Assembly.
 8. AWWA C540 - Power-Actuating Devices for Valves and Sluice Gates.
 9. AWWA C541 - Hydraulic and Pneumatic Cylinder and Vane Type Actuators for Valves and Slide Gates.
 10. AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants.
 11. AWWA C800 - Underground Service Line Valves and Fittings.
- C. American National Standards Institute (ANSI):
1. ANSI B1.20.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).
 2. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 3. ANSI B16.10 - Face-to-Face and End-to-End Dimensions of Valves.
 4. ANSI B16.104 - Butterfly Valves.
- D. American Iron and Steel Institute (AISI).
- E. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):
1. MSS-SP-61 - Pressure Testing of Steel Valves.

2. MSS-SP-67 - Butterfly Valves.
 3. MSS-SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 4. MSS-SP-71 - Cast Iron Swing Check Valves, Flanges and Threaded Ends.
 5. MSS-SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Services.
 6. MSS-SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
 7. MSS-SP-80 - Bronze Gate, Globe, Angle and Check Valves.
 8. MSS-SP-82 - Valve Pressure Testing Methods.
 9. MSS-SP-98 - Protective Coatings for the Interior of Valves, Hydrants and Fittings.
- F. National Electrical Manufacturers Association (NEMA).
- G. Underwriters Laboratories (UL).
- H. Factory Mutual (FM).
- I. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Valves and appurtenances shall be products of well-established firms who are fully experienced, minimum ten years, reputable and qualified in manufacture of particular equipment to be furnished.
2. Equipment shall be designed, constructed and installed in accordance with best practices and methods and shall comply with this Section as applicable.
3. Units of the same type shall be the product of one manufacturer.

B. Certifications:

1. Manufacturers shall furnish an affidavit of compliance with Standards referred to herein as specified in Paragraph 1.03C above. Refer to Part 3 for testing required for certain items in addition to that required by referenced standards.

C. Inspection of units may also be made by Engineer after delivery. Equipment shall be subject to rejection at any time due to failure to meet any of specified

requirements, even though submittal data may have been accepted previously. Equipment rejected after delivery shall be marked for identification and shall be removed from job site at once.

1.6 SYSTEM DESCRIPTION

- A. Equipment and materials specified herein are intended to be standard for use in controlling flow of water, wastewater, sludge, and air as noted on Drawings.
- B. Valves, appurtenances and miscellaneous items shall be installed as shown on Drawings and as specified, so as to form complete workable systems.
- C. Unless otherwise noted, powered valve operators shall have:
 - 1. Valves larger than 3-in: electric operators 460 Volt, 3 Phase, 60Hz.
 - 2. Valves 3-inch and under: electric operators, 120 Volt, 1 Phase, 60Hz.
 - 3. Solenoid valves: 120 volt, single phase, 60 Hz, NEMA 4 enclosure, continuous duty Class F coils and manual operator. Solenoid valves for seal water systems shall be "fail open" design; others shall be "fail closed" unless otherwise noted on Drawings or in the Instrumentation specifications.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Reference is made to Section 01600 for additional information.
- B. Packing and Shipping:
 - 1. Care shall be taken in loading, transporting and unloading to prevent injury to the valves, appurtenances, or coatings. Equipment shall not be dropped. Valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Damage to the coatings shall be repaired as acceptable to Engineer.
 - 2. Prior to shipping, ends of valves shall be acceptably covered to prevent entry of foreign material. Covers shall remain in place until after installation and connecting piping is completed.
 - a. Valves 3-in and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.
 - b. Valves smaller than 3-in shall be shipped and stored as above except that heavy cardboard covers may be used on the openings.
 - c. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until the valve is installed and put into use.
 - d. Corrosion in evidence at the time of acceptance by the Owner shall be removed, or the valve shall be removed and replaced.

C. Storage and Protection:

1. Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation. See the individual piping sections and manufacturer's information for further requirements.

1.8 MAINTENANCE

- A. Special tools and the manufacturer's standard spare parts, if required for normal operation and maintenance, shall be supplied with the equipment in accordance with Section 01730 and where noted, as specified herein. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.
- B. Provide one operations and maintenance manual for each type of valve and operator supplied under this specification in accordance with Section 01730.
- C. Included within operations and maintenance manuals, provide a list of all spare and replacement parts with individual prices and location where they are available.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT - GENERAL

- A. Use of a manufacturer's name and/or model or catalog number is for purpose of establishing standard of quality and general configuration desired.
- B. Valves and appurtenances shall be of size shown on the Drawings or as noted and as far as possible equipment of same type shall be identical and from one manufacturer.
- C. Valves and appurtenances shall have name of maker, nominal size, flow directional arrows, working pressure for which they are designed and standard referenced, cast in raised letters or via riveted stainless steel nameplate upon some appropriate part of the body.

- D. Unless otherwise noted, items shall have a minimum working pressure of 150 psi or be of same working pressure as pipe they connect to, whichever is higher and suitable for pressures noted where they are installed.
- E. Joints, size and material - unless otherwise noted or required by Engineer:
 - 1. Except where noted, joints referred to herein shall be of same type, nominal diameter, material and with a minimum rating equal to pipe or fittings they are connected to.
 - 2. Valves and appurtenances shall be of same nominal diameter as pipe or fittings they are connected to.
 - 3. Valves exposed to view, or in vaults:
 - a. Plastic valves in chemical service - solvent cement, or flanged ends.
 - b. 3-in and smaller - threaded ends- unless noted otherwise herein or on Drawings.
 - c. 4-in and larger - flanged ends.
- F. Provide special adaptors as required to ensure compatibility between valves, appurtenances, and adjacent pipe.
- G. No alternative materials will be considered for approval unless complete documentation is provided regarding their satisfactory long-term use in similar conditions; in addition, the consideration of any substitution will be considered only if superiority of proposed materials is the intent of substitution, and only if sufficient evidence is provided to document that superiority.

2.2 VALVE ACTUATORS - GENERAL/ MANUAL

- A. Geared actuators shall be suitable for all weather service, with mechanical shaft seals, shall be permanently greased, or shall have provisions for greasing. Actuators for submerged duty shall be so rated, with certification by manufacturer for submerged service.
- B. Valve manufacturer shall supply, mount, and test all actuators on valves at factory. Valves and their individual actuators shall be shipped as a unit.
- C. Unless otherwise noted on Drawings, valves shall be manually actuated; non-buried valves shall have an operating wheel, handle or lever mounted on operator; those with operating nuts shall have a non-rising stem with an AWWA 2-in nut; At least two tee handles shall be provided for operating nuts. Unless otherwise noted, operation for valves shall be CCW open.
- D. Manually actuated butterfly valves 6 inches and smaller for fluid service shall have

a 10 position, spring retained ratcheting handle. Handle shall be fusion bonded epoxy coated steel or cast iron, hardware, spring and ratcheting plate shall be Type 316 stainless steel. Manually actuated butterfly valves for air service 6 inches and smaller shall have a memory stop handle with infinite throttling position capability. Memory stop plate and hardware shall be Type 316 stainless steel.

- E. Except as otherwise shown on Drawings or specified herein, valves 3-in diameter or larger, with valve hand wheel center line located 7-ft or more above operating floor, shall be provided with chain wheel operators complete with chain guides and hot dipped galvanized steel chain, which loop within 4-ft of operating floor. These requirements shall supersede positioning lever actuator requirements of manual butterfly valves 6 inch and smaller.
- F. Actuators shall be capable of moving valve from full open to full close position and in reverse and holding valve at any position part way between full open or closed.
- G. Each operating device shall have cast on it the word "OPEN" and an arrow indicating direction of operation.
- H. Floor boxes for operating nuts recessed in concrete shall be standard cast iron type, cast-in- place, with fastening top, and Type 316 stainless steel hardware.
- I. Stem guides shall be of the adjustable wall bracket type, bronze bushed, with maximum spacing of 10-ft as manufactured by Clow; Rodney Hunt or equal. Extended operating nuts and/or stems shall have universal joints and pin couplings, if longer than 10-ft and a rating of at least five times the maximum operating torque. Stem adaptors shall be provided.
- J. Where required by installation, or as specified, provide the following: extended stem; floor stand and handwheel; position indicator and etched or cast arrow to show direction of rotation to open the valve; resilient, moisture-resistant seal around stem penetration of slab.
- K. Gear Actuators:
 - 1. Unless otherwise noted, gear actuators shall be provided for the following: plug and ball valves larger than 3-in diameter; butterfly valves larger than 6 inch diameter; where specified and/or indicated on Drawings; where manual operator effort is greater than 40 lbs rim pull.
 - 2. Actuators shall be capable of being removed from valve without dismantling the valve or removing valve from the line.
 - 3. Gear actuators for quarter turn valves shall be of worm or helical worm gear type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on output shaft. Where shown on Drawings, a two inch cast

iron operating nut shall be provided. Actuators shall conform to AWWA C504 except where more stringent requirements are provided hereinafter. Gearing shall be machine cut steel designed for smooth operation. Bearings shall be permanently lubricated, with bronze bearing bushings provided to take thrusts and mechanical shaft seals to contain lubricants. Housings shall be sealed to exclude moisture and dirt, allow reduction mechanisms to operate in lubricant and be constructed of cast iron, ASTM A 126, Grade B, or of ductile iron, ASTM A 536. Gear housing bodies for thermoplastic valves may be cast aluminum or fabricated steel to reduce weight. Gear actuators shall indicate valve position and have adjustable stops.

4. Where indicated on Drawings, gear actuators for butterfly valves shall be of travelling nut type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on output shaft. Unless noted they shall conform to AWWA C504. Stem shaft shall be machine cut alloy steel, nut and cross head shall be bronze, lever shall be ductile iron. Nut Actuators for valves 24-in and smaller shall be slotted lever design, actuators for valves greater than 24 inch shall be link and lever design. Mechanism shall be lubricated with water resistant extreme pressure NLGI No. 2 grease. Bevel gear reduction box shall be mounted on the actuator when required to meet specified manual operating effort requirements Gear actuators shall have mechanical, external indication of valve position and have adjustable threaded stops secured to the stem with spring pins. Stop shall be capable of withstanding 450-ft-lb of input torque. Stop adjustment requiring shims are not acceptable.
5. Manual Input torque to produce required valve operating torque for worm and travelling nut gear operators shall not exceed 80 ft-lbs. In addition, hand wheel rim pull shall not exceed 20 lbs for valve sizes up to 12 inches, 40 lbs for valve size between 14 and 20 inches, 60 lbs for valve size 24 and greater. Minimum hand wheel size shall be 8 inches for up to 12 inch valve size, 12 inches for up to 16 inch valve size, 18 inches for up to 20 inch size.
6. Gear actuators for multi turn valves shall be of bevel or spiral bevel type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on output shaft. Gearing shall be machine cut steel designed for smooth operation. Bearings shall be permanently grease lubricated, with dual anti-friction ball bearings on output shaft and mechanical shaft seals to contain lubricants. Output flange of primary gear reducer shall be designed to meet an appropriate MSS or ISO standard to allow mounting to secondary gear reducer. Ring gear shall ride on ball bearings. Stem nut shall be bronze alloy, shouldered, and ride on needle bearings. Housing components shall be O-ring sealed to exclude moisture and dirt, constructed of cast iron, ASTM A 126, Grade B, or of ductile iron, ASTM A 536. Gear housing bodies for thermoplastic valves may be cast aluminum or fabricated steel to reduce weight. Manual operator input effort to the hand wheel shall be a maximum of 30 lbs for operating the valve from full open to full close, under any conditions.

Maximum hand wheel size shall be 24-in diameter.

- L. Additional valve actuator requirements are included with the individual valve types and as noted in Paragraph 1.02 above.
- M. Position indication and direction of opening arrows shall be embossed, stamped, engraved, etched, or raised castings. Decals or painted indications shall not be allowed.
- N. Unless otherwise noted, valves larger than 3-in nominal diameter shall be provided with position indicators at the point of operation.

2.3 VALVE ACTUATORS - POWERED

A. General:

1. Electric actuators for 1/4 turn valves three inches and under, which do not have submergence requirements, and which exhibit a maximum torque specified below shall be operated on 120 volt single phase power as specified below. Other actuators shall be operated on 480 volt power.
2. Actuators shall conform to AWWA Standard C540, insofar as applicable and as herein specified. Actuators shall be O-ring sealed, watertight to standard NEMA 4X/6, submersion to 6 feet for 30 minutes. Actuators installed in vaults below grade and elsewhere subject to submergence shall be watertight to standard NEMA 6P/IP68, 15 ft for 72 hours minimum. Actuators installed in hazardous locations as noted on the Electrical Drawings and/or area classification sheets of the Architectural Drawings shall be FM certified explosion proof for Class 1 Division 1 & 2, Groups C & D and also meet the standard NEMA 4X/6 rating.
3. 480 Volt powered actuators shall be Rotork IQ/IQM; Limitorque MX; EIM TEK 2000; AUMA SA/SAR. Actuators shall be configured as required to provide for part turn or multi-turn and be coupled with gearboxes as required to obtain the speed and operating torque as required for the valve or gate it controls.
4. Modulating actuators shall contain proportional control unit and be capable of 1200 starts per hour, open-closed valve actuators shall not require a proportional control unit, and be capable of 60 starts per hour.
5. Where shown on Instrumentation Drawings, actuators shall have a digital control module, to allow valves or gates to be positioned remotely via a 2-wire non-proprietary field bus protocol. Digital control module shall be equipped with serial communication ports to allow actuation to be linked by a two wire local area network utilizing Modbus function code (report by exception) and

arranged in a self-healing ring configuration, with multi- drop taps to each actuator.

- B. 120 Volt Single Phase Reversing, Non Spring Return Electric Actuators for 1/4 Turn Valves, 100 to 1000 in-lb Torque Range
1. Valve actuators shall be sized by valve supplier meeting requirements of AWWA C540. Actuators shall be mounted on valves in valve supplier's facility, and factory tested.
 2. Actuators shall operate on 120 volt, 60 hz single phase, power supply. Enclosure rating shall be NEMA 4X, constructed of cast aluminum or steel alloy, powder coated or fusion bonded epoxy finish.
 3. Power train shall be self-locking planetary epicyclical gear design, consisting of hardened steel and or hardened bronze alloy gears with bronze bearings. Housing penetrations shall be sealed with mechanical seals. Housing shall be equipped with space heaters. Valve mounting system shall be ISO 5211.
 4. Actuator shall be designed for open/close/jog reversing service. Proportional/modulating service shall be provided where required in the equipment specifications or Instrumentation Drawings. Actuators shall have visual mechanical indication of position. Manual override shall be direct worm drive with minimum 5 inch diameter hand wheel. Hand wheel size shall be provided such that a maximum 40 lb rim pull is required.
 5. Motors shall be designed specifically for valve actuation service, with Class F insulation, with split phase capacitor protection. Duty cycle shall not be less than 40% at 100 degrees F. for open/close duty, and 100% for modulating duty. 90 degree travel time shall vary from 10 to 20 seconds depending on actuator size. Actuators shall have SPDT contacts for remote valve position indication.
 6. Actuators shall be P Series as manufactured by Promation Engineering, Brooksville, FL, or equal.
- C. 480 Volt Powered Actuators for Part Turn or Multi-Turn Valve Operation:
1. Operation:
 - a. Capabilities shall be provided to position valve (or gate) locally via Local/Off/Remote selector switch and Open/Stop/Close push buttons.
 - b. For on/off service, when in remote, actuator shall accept one remote signal to open valve or gate and a second remote signal to close valve or gate.
 - c. For modulating service, when in remote actuator shall accept a 4-20mADC position control signal, and shall position valve 0-90 degrees or gate 0-100% of travel in proportion to control signal.

- d. Unless stated otherwise in valve specifications, actuator and gearing size shall be designed to operate valve at a disc speed of one foot travel per minute of operation. For quarter turn valves, valves shall rotate from stop to stop in 30 seconds per foot of throat diameter.
2. Functional:
 - a. Motor operated valve controller shall include motor, operator unit gearing, limit switch gearing, limit switches, control power transformer, position transmitter (when required), torque switches, bored and key-wayed drive sleeve for non-rising stem valves, declutch lever and auxiliary handwheel as a self-contained unit. Valve contacts shall be capable of handling the current equivalent of a NEMA 1 size starter.
 - b. Reversing starters shall be integral with actuator, and shall be solid-state starters for modulating service. Electro-mechanical reversing starters shall be acceptable for open-close service and shall be mechanically and electrically interlocked.
 - c. Limit switches and gearing shall be an integral part of valve control. Limit switch gearing shall be made of bronze or stainless steel and shall be fully lubricated, intermittent type and totally enclosed to prevent dirt and foreign matter from entering gear train. Limit switches shall be of adjustable type capable of being adjusted to trip at any point between fully opened valve and fully closed valve. Limit and torque switches shall be provided for stopping valve in both directions. Mid-travel switches shall be provided as required. Set position shall not be lost if over travel occurs in either manual or electric modes of operation.
 - d. Valve position transmitter shall be a gear actuated, two-wire device, producing 4-20 mA DC signal proportional to 0-90 degree valve position or to 0-100% of valve travel. Transmitter shall be provided with easily accessible zero and span adjustment potentiometers. Valve actuator shall be provided with a local digital or mechanical indicator integral with operator with a 0-100 percent scale. DC power supply shall be provided integral with operator and powered from 110 volt AC internal transformer. Positioner board shall provide repeatable accuracy to 0.25% of span. There shall be separate trim pots on positioner board for zero, span and dead band adjustment.
 - e. Speed of actuator shall be responsibility of system supplier with regards to hydraulic requirements and response compatibility with other components within control loop. Each valve controller shall be provided with a minimum of two limit switch functions, one for opening and one for closing. Each limit switch will have two normally open and two normally closed contacts. Gear limit switches shall be geared to driving mechanism and in step at all times whether in motor or manual operation. Provision shall be made for two extra sets of limit switches as described above, each to have two normally open and two normally closed contacts. Each valve controller shall be equipped with a double torque switch. Torque switch shall be adjustable and responsive to load encountered in either direction of travel. Limit and torque switch contacts shall be silver inlay type.

- f. Each actuator shall include monitor relays to remotely indicate fault signal for indication of power failure, phase failure, thermal switch tripped, torque switch tripped between travel stops and Local-Off-Remote selector switch position.
3. Physical:
 - a. Operator shall be equipped with open-stop-close push-buttons, a local-off-remote selector switch and indicating lights mounted on operator. Where operator will not be situated between 2-ft-0-in and 7-ft-0-in above operator platform, and where shown on Drawings provide a separate remote valve operating station.
 - b. Motor shall operate on 460 volt, 60 hertz, 3 phase power and shall be sized by actuator manufacturer to provide the required output torque for service intended. Motor shall have Class F insulation, with a duty rating of at least 15 minutes at 40 degrees C ambient temperature. Motor shall be specifically designed and built by actuator manufacturer for electric actuator service. Commercially available motors shall not be acceptable. Actuator shall include a device to ensure that motor runs with correct rotation for required direction of valve travel regardless of connection sequence of the power supply.
 - c. Operators utilizing multiple reduction power gearing shall consist of spur, helical, or bevel gearing and worm of hardened alloy steel, and the worm gear shall be alloy bronze. Operators utilizing single-stage reduction shall be single-stage worm gear totally enclosed in a fully lubricated gearcase, with filling and drain plugs. Non-metallic, aluminum, or cast gearing shall not be allowed. Output shaft shall incorporate thrust bearings of the ball or roller type at the base of the actuator.
 - d. An operating wheel shall be provided for manual and/or emergency operation, engaged when motor is declutched by a lever or similar means, the drive being restored to power automatically by starting the motor. Operating wheel drive shall be mechanically independent of motor drive, and any gearing shall be such as to permit emergency manual operation, using a 40 pound force in a reasonable time. Clockwise operation of handwheel shall give closing movement of valve unless otherwise stated.
 - e. Each actuator shall be supplied with a start-up kit including installation instructions, wiring diagrams, and spare cover screws and seals to provide for losses during commissioning.
 - f. Continuous mechanical dial indication of valve and position shall be provided. Mechanical dial position indicator shall be in step with actuator at all times in both hand wheel and motor operation. For modulating applications, mechanical dial position indicator shall include graduations of 0-100 percentscale.
 4. Wiring and Terminals:
 - a. Internal wiring shall be of tropical grade PVC insulated stranded cable of 5 amp minimum rating for control circuits and of appropriate size for the motor 3 phase power. Each wire shall be clearly identified at

- each end.
- b. Terminals shall be of stud type embedded in a terminal block of high tracking- resistance compound. The 3-phase power terminals shall be shrouded from control terminals by means of an insulating cover.
 - c. Terminal compartment shall be separated from inner electrical components of actuator by means of a watertight seal. Terminal compartment of actuator shall be provided with three threaded cable entries.
 - d. Each actuator shall be provided with a commissioning kit consisting of a wiring diagram and installation and operation manual. A separate wiring diagram shall be provided inside the terminal cover. No special tools, devices or parts shall be required for commissioning.
 - e. Actuators shall have separately sealed motor and control compartments. Operators shall have space heaters in their limit switch, motor, and control compartments.
5. Remote Control Stations:
- a. Where shown on Drawings, or where specified in Equipment Specifications, valve actuators shall be furnished with control stations suitable for mounting remotely from, but, in vicinity of actuator. Remote mount control station shall include a Local - Off - Remote selector switch, Open - Stop - Close pushbuttons and Open - Close indicating lights. Control station operators shall be heavy duty devices mounted in a cast iron, cast aluminum, or stainless steel NEMA 4X enclosure suitable for wall mounting. Wire gage and device quality shall meet or exceed the requirements of Division 16. Local - Off - Remote selector switch shall have auxiliary contacts for remote indication of switch position. Local - Off - Remote selector switch shall have provisions for padlocking in the "Off" position. Additional functionality and/or devices to those specified above are detailed on Instrumentation P&IDs and/or Electrical Control Schematic drawings. Refer to Drawings for confirmation of scope of the Remote Control Stations.
6. Performance Test:
- a. Each actuator shall be shop performance tested, and individual test certificates shall be supplied without additional charge to Owner. Test certificates shall be submitted prior to shipment of valve actuators. Test equipment shall simulate a typical valve load, and the following parameters shall be recorded:
 - 1) No load current.
 - 2) Current at maximum torque setting.
 - 3) Stall current.
 - 4) Torque at maximum torque setting.
 - 5) Stall torque.
 - 6) Test voltage and frequency.
 - 7) Flash test voltage.
 - 8) Actuator output speed.

2.4 BUTTERFLY VALVES

A. AWWA Butterfly Valves for Clear Water Service

1. Butterfly valves and operators up to 72-in diameter shall conform to AWWA C504, Class B, except as specified herein. Manufacturer shall submit an affidavit of compliance stating that valves have been manufactured and tested in accordance with AWWA C504 and specifically listing all exceptions. Valves shall have a minimum 150 psi pressure rating or higher as noted on Drawings or in this Section and be manufactured by M&H; Dezurik; Val-Matic; Henry Pratt; or equal.
2. Butterfly valves for above grade service shall be flanged end with face to face dimensions in accordance with Table 2 of AWWA C504 for short-body valve. Valves for dead end shut off service shall be flanged type.
3. Valve seats shall be full resilient seats retained in body or on disc edge in accordance with AWWA C504. Valve discs shall be constructed of cast iron, ASTM A 48, Class 40; Ni-resist, ASTM A 436, Type 1; or ductile iron, ASTM A 536, Grade 65-45-12.
 - a. When resilient seats are attached to body, discs shall have Type 316 stainless steel seating edges. When resilient seat is attached to disc, it shall be fastened with a one piece Type 316 stainless steel retaining ring, Type 316 stainless steel Nylock set screws and a mating Type 316 stainless steel ring shall be installed in valve body. Resilient seats shall be EPDM. Seats shall be fully adjustable and replaceable with valves in place using no special tools.
4. Valve body shall be constructed of close grain cast iron per ASTM A 126, Class B with integrally cast hubs for shaft bearing housings of through boss-type. Permanently self-lubricating body bushings shall be provided and shall be sized to withstand bearing loads. Stuffing box of liberal dimensions shall be provided at operator end of vane shaft.
 - a. Packing shall be of self-compensating V-type. A sealing element utilizing O-rings shall also be acceptable for up to and including 24-in valves. Over 24-in, pull down seals using a square braid of graphite fiber is an acceptable alternate.
 - b. Packing shall be held in place by a bolted corrosion resistant retainer plate or gland; retainer clips are not acceptable. Valves 30-in or larger shall use a stuffing box with follower gland.
 - c. Replacement of seals, for all size butterfly valves, shall not require removal of valve from the line. In addition adjustment or replacement of seals on valves of 30-in or larger shall not require disturbing any part of valve or operator assembly, except any packing follower gland.
5. Valve shaft shall be of Type 316 stainless steel and designed for both torsional

and shearing stresses when valve is operated under its greatest dynamic or seating torque. No reductions of shaft diameter will be allowed except at operator connection. Any reduction shall have a full radius fillet.

6. Butterfly valve actuator shall conform to requirements of AWWA C504, insofar as applicable and as specified herein. Gearing for actuators where required shall be totally enclosed in a gear case in accordance with AWWA C504. Actuators shall have permanent indicators with raised or engraved marks to show position of valve disc.

B. Blower Isolation and Pressure Relief (Blow Off) Valves: Tag Type BFV2.

1. Valves shall be high performance type, soft seat, offset disc, wafer style, except for dead end service, where fully lugged valves shall be used. Body class shall be 150 psi max differential pressure. Body shall be carbon steel, cast or ductile iron. Disc shall be ASTM B 148, C958 aluminum bronze or CF8M stainless steel. Stem shall be 17-4 PH stainless steel. Seat shall be reinforced Teflon/silicon. Stem packing shall be Teflon. Retaining ring and gland assembly shall be Series 18-8 stainless steel, gland nuts shall be silicon bronze. Bearings shall be Type 316 stainless steel backed Teflon.
2. Valves shall be DeZurik or Pratt HP, Crane Flowseal, Bray Series 40, or equal.

2.5 GATE VALVES

A. General Requirements:

1. Unless otherwise specified below, these requirements shall apply to gate valves.
2. Gate valves shall meet requirements of AWWA C500, AWWA C509 and AWWA C515 as applicable to type of valve specified.
3. Submerged valves shall be furnished with mechanical joints and Type 316 stainless steel hardware; non-rising stem design. Flanges shall be provided if so indicated on Drawings.
4. Exposed valves shall be furnished with Class 125 flanged ends; provide valves with bolted bonnet, outside screw and yoke, unless otherwise noted on Drawings. Fasteners shall be Type 304 stainless steel.
5. Rising stem valves shall be sealed with adjustable and replaceable packing; valve design must permit packing replacement under operating system pressures with only moderate leakage.
6. Non-rising stem valves shall utilize a minimum of two O-ring stemseals.
7. Unless otherwise specified, valves shall be rated at or above for the

following working water pressures:

Valve Size	Pressure
3-in to 12-in	200
14-in to 30-in	150
36-in and greater	as specified

- a. Valve bodies shall be hydrostatically tested to at least twice the rated working water pressure. In addition, valves shall be seat-tested, bi-directional at rated working pressure, with seat leakage not to exceed one fluid ounce per inch of valve diameter per hour. Provide certificates of testing.
8. Flanged valves to have face-to-face dimensions per ANSI B16.10 and flanges per ANSI B16.1.
 9. Exposed valves 18-in and larger shall have valve by-pass. By-pass valves shall be of same disc type as main valve and shall meet these specifications.
 10. Bonnet and packing gland bolts shall be Type 316 stainless steel; packing gland bolts shall have bronze nuts.
 11. Exposed valves 16-in and greater indicated for horizontal stem installation shall be furnished with rollers, tracks and scrapers and enclosed bevel gear grease case.
 12. Provide geared operator and chain wheel, chain and chain guides for valves with handwheel centerline more than 7-ft above operating level.
 13. Valves shall be marked per AWWA Standards, including name of manufacturer, valve size, and working pressure and year of manufacture.
 14. Unless otherwise indicated, valves 12-in and smaller shall be capable of installation in vertical or horizontal position, and sealing in both directions at rated pressure.
- B. Valve Applications:
1. Valves for Potable Water Service:
 - a. Double disc design manufactured by Kennedy/ M&H/ Clow Valve.
 - b. Double revolving disc manufactured by American R/D Valve; Anchor Darling.
 - c. Solid wedge-resilient seated design as manufactured by Mueller Co; J & H Valve; M&H/Clow Valve; American Flow Control; American R/D Valve.
 2. Valves for Wastewater Service:

- a. Solid wedge metal seated design manufactured by M&H Valve; American R/D Valve; Stockham Valve, or Walworth.
- b. Resilient seated design manufactured by American Flow Control; Kennedy/M&H/Clow Valve; J & S Valve; US Pipe; Mueller or American R/D.

C. Valve Requirements:

1. Double Disc:
 - a. Conform to AWWA C500.
 - b. Wedging surfaces shall be bronze, Monel or stainless steel.
2. Double Revolving Disc:
 - a. Conform to applicable provisions of AWWA C500.
 - b. Wedging surfaces shall be Monel or hardened stainless steel.
 - c. Discs fully free to rotate, guided in travel by cast surfaces.
 - d. Disc rotation shall produce a self-cleaning action during opening or closing.
 - e. Wedging forces applied only when discs are in seating position.
3. Solid Wedge:
 - a. All-metal valves shall be manufactured of ASTM A 126 Cast Iron, Class B. Wedge seating surfaces and body seat rings shall be cast from B62 bronze, and shall conform to AWWA C500.
 - b. Shall be coated internally and externally with an asphaltic varnish, per AWWA C500.
 - c. Body shall have tongue and grooved guides for wedges.
4. Resilient Seated:
 - a. Resilient seated valves shall be manufactured of ASTM A 536 ductile iron, vulcanized rubber disc per AWWA C509, manganese bronze or Type 316 stainless steel stem and trim, full port design, Type 304 or Type 316 stainless steel fasteners as required in general requirements. Valves shall conform to AWWA C509 and be UL and FM approved.
 - b. Shall have internal and external fusion bonded epoxy coating of valve body, including bonnet, per AWWA C550.
 - c. Gate shall be encapsulated with EPDM according to ASTM D 2000. It shall be bonded and vulcanized in accordance with ASTM B 429 Method B.
 - d. Shall have no recesses in valve body.

D. Gate Valves 3 inch and Smaller:

1. Gate valves 2.5-in diameter and smaller shall have screwed ends and shall be bronze body. Gate valves 3-in diameter shall be flanged end, iron or bronze body. Gate shall be brass, bronze, or Type 304 stainless steel solid wedge; union bonnet; silicon bronze rising-stem; equal to Jenkins Figure 47CUJ, division of Crane Valve Group; Lunkenheimer Figure 3127,

Cincinnati Valve Co, Fairbanks Figure U-0252, or equal. Model numbers referenced above are for screwed ends, flanged shall be equal construction with appropriate end connections. Iron body valves shall be installed in steel or iron pipelines.

E. Tapping Valves and Sleeves:

1. Under no circumstances shall a standard gate valve be used for a tapping valve. Tapping valves shall comply with same requirements as solid wedge, resilient seat or double disc gate valves except they shall have flanged end and port opening modified for tapping service. Tapping valves shall be provided with plugged flush port at bottom of gate guide and plugged tap for pressure/leak testing. Valves shall be capable of passing a full nominal sized cutter without damage to the valve. Tapping sleeve shall be gray cast iron or ductile iron mechanical joint type with outlet flange conforming to MSS-SP-60.

2.6 KNIFE GATE VALVES

A. Open Bonnet Metal Seat Design:

1. Knife gate valves shall be lugged, one-piece cast Type 316 stainless steel body rated for 150 psi working pressure. Valves shall be marked for direction of flow with cast wedges and gate guides in body to force gate against the seat. Gate shall be a beveled knife edge. Valves shall have metal to metal seating, with a raised seat face with a relief groove to allow gate to push solid particles aside to prevent material packing in seat area. Gate shall be Type 316 stainless steel, polished with a surface finish of 32 micro-inch RMS or better. Valve body shall be full port for up to 12-in pipe size and minimum 95% port for 14 through 30-in pipe size. Seats shall be solid stainless steel. Body flanges shall be raised face, ANSI 125/150 drilling according to ANSI B16.5. Flange faces shall be machined and grooved according to MSS SP-6. Flange bolt holes shall be threaded.
2. Valve shall be open bonnet design, stem shall be 1/4-in pitch, 1/4-in lead, constructed of Type 304 stainless steel. Stem nut shall be acid resistant bronze. Valve yoke shall be Type 304 stainless steel, designed to support operator and without any movement or twisting at stall thrust capability of operator. Gate shall be seated with 4 rows of packing, packing gland shall be Type 304 stainless steel, energized by Belleville springs to provide a constant force on the packing. Packing gland bolts shall be Type 304 stainless steel with type 17-7 ph SS self-locking nuts. Sealing packing shall be Chevron type Acrylic/PTFE/silicone. Bottom row of packing shall be comprised of Teflon impregnated Kevlar to act as a gate wiper and protect the sealing packing.
3. For hand wheel operated valves hand wheel shall be sized to seat and unseat knife gate valve at specified operating pressure with a maximum rim pull of 40 lb. If necessary, a bevel gear operator shall be supplied. Bevel gear operators shall be fully enclosed and permanently lubricated, with a sealed

housing to prevent contamination. Bevel gear operators shall meet the requirements of Paragraph 2.02 K. Bevel gear operators shall be provided with a stem cover to protect stem when valve is in open position. Stem cover shall be removable for inspection and maintenance. Electric operators shall be installed where shown on the Drawings.

4. V Port knife gate valves (VPKGV) shall be as specified above and shall include a 45 degree V-port welded in place of same material as body. V-Port plate shall be fully seal welded.
5. Valves shall be ITT Fabri-Valve Model C37, Hilton Model H 200-SC, SCV, Orbinox or equal.

B. Open Bonnet Perimeter Seat Design:

1. Knife gate valves shall have a one-piece cast Type 304 stainless steel body with a recessed dovetail elastomer seat capable of providing bubble tight shutoff to the full rated pressure. Use of O-Ring seals on face of disc or body will not be acceptable. Body flanges shall be raised face, ANSI 125/150 drilling according to ANSI B16.5. Flange faces shall be machined and grooved according to MSS SP-6. Valve body shall be full port for up to 12- in pipe size and minimum 95% port for 14 through 30-in pipe size.
2. Gate shall be Type 316 stainless steel, polished with a surface finish of 32 RMS or better. Gate edges shall be radiused to mate with seat. Valve seat shall be an elastomeric seal mechanically retained in a trapezoidal groove around perimeter of valve body. Seat groove shall be relieved to minimize compression set of seat material. Seat material shall be EPDM. Valve shall have a positive travel stop to prevent seat damage.
3. Valve shall be open bonnet design, stem shall be 1/4-in pitch, 1/4-in lead, constructed of Type 304 stainless steel. Stem nut shall be acid resistant bronze. Gate shall be seated with 4 rows of packing, packing gland shall be Type 304 stainless steel, energized by Belleville springs to provide a constant force on packing. Sealing packing shall be Chevron type Acrylic/PTFE/silicone. Bottom row of packing shall be comprised of Teflon impregnated Kevlar to act as a gate wiper and protect the sealing packing.
4. For hand wheel operated valves, hand wheel shall be sized to seat and unseat knife gate valve at specified operating pressure with a maximum rim pull of 40 lb. If necessary, a bevel gear operator shall be supplied. Bevel gear operators shall be fully enclosed and permanently lubricated, with a sealed housing to prevent contamination. Bevel gear operators shall meet requirements of Paragraph 2.02 K. Bevel gear operators shall be provided with a stem cover to protect stem when the valve is in open position. Stem cover shall be removable for inspection and maintenance. Electric operators shall be installed where shown on the Drawings.

5. V Port knife gate valves (VPKGV) shall be as specified above and shall include a 45 degree V-port welded in place of same material as body. V-Port plate shall be fully seal welded.
6. Valves shall be ITT Fabri-Valve Model C67, Hilton Model H 202-SC, SCV, Orbinox or equal.

C. Bonneted Metal Seat Design:

1. Knife gate valves shall be lugged body rated for 150 psi working pressure. Valves shall be marked for direction of flow, and bar wedges and gate guides shall be installed in liner body to force gate against the seat. Gate shall be a beveled knife edge. Valves shall have metal to metal integral stainless steel seat, with a raised seat face with a relief groove to allow gate to push solid particles aside to prevent material packing in seat area. Wetted surfaces shall be Type 304 stainless steel with Type 304 stainless steel trim. Packing gland bolts shall be Type 304 stainless steel with naval bronze nuts. Body flanges shall be raised face, ANSI 125/150 drilling according to ANSI B16.5. Flange faces shall be machined and grooved according to MSS SP-6. Flange bolt holes shall be threaded.
2. Valves shall have a pressure-retaining bonnet that fully encloses the gate. Bonnet shall be rated at same pressure as valve body and shall not include any type of internal gate packing or gate wiper. A packing gland shall be located at top of bonnet to provide a tight seal around stem.
3. Wetted parts of body and bonnet shall be Type 304 SS, including fasteners. Exterior flanges and stiffeners shall be cast or fabricated carbon steel. Provide 2 inch flush and drain ports in bonnet, and ports shall be of same material as wetted parts. Provide 3/4 inch flush and drain ports in body and ports shall be of same material as wetted parts. Type 304 SS body cladding and face rings shall be fully welded to carbon steel body - "floating" body liners are not acceptable. Stainless steel welding shall be pickled and passivated. Gate shall be Type 304 SS, suitable for service conditions, and shall be ground and polished to a minimum surface finish of 32 micro-inch/inch R.M.S. to prevent damage to seat. For valves 20 inches and larger, hardened gate support strips shall be provided for valve gates oriented on edge, constructed of Stellite or equal material.
4. Stem shall be constructed of Type 304 SS, with Acme threads. Stem nut shall be of acid-resisting Bronze. Packing shall be Teflon-impregnated synthetic fiber, without included asbestos. Packing shall be replaceable without disassembling valve or removing valve from pipeline.
5. Valve yoke shall be carbon steel, designed to support operator and without any movement or twisting at stall thrust capability of operator.

6. For hand wheel operated valves, hand wheel shall be sized to seat and unseat knife gate valve at specified operating pressure with a maximum rim pull of 40 lb. If necessary, a bevel gear operator shall be supplied. Bevel gear operators shall be fully enclosed and permanently lubricated, with a sealed housing to prevent contamination. Bevel gear operators shall meet requirements of Paragraph 2.02 K. Bevel gear operators shall be provided with a stem cover to protect the stem when valve is in open position. Stem cover shall be removable for inspection and maintenance. Electric operators shall be installed where shown on the Drawings.
7. V Port knife gate valves (VPKG) shall be as specified above and shall include a 45 degree V-port welded in place of the same material as the body. V-Port plate shall be fully seal welded.
8. Valves shall be Hilton Model H-200-BV-T304, Fabri-Valve CF134R, Orbinox, or equal.

2.7 PLUG VALVES

- A. Plug valves shall be of offset disc type, 1/4 turn, non-lubricated, serviceable (able to be repacked) under full line pressure and capable of sealing in both directions at rated pressure. Disc shall be completely out of flow path when open. Plug valves specified herein shall be manufactured by DeZurik; M&H Valve; or approved equal. Manufacturers named or otherwise, shall comply completely with this Section.
 1. Minimum port area shall be 80 percent when measured by percent cross-sectional area of equivalent size (nominal same diameter) pipe.
 2. Plug valves shall be capable of passing "pigging" cleaning equipment (using a Girard or similar cleaning pig of full nominal pipeline diameter) in either direction and manufacturer shall so certify that this may be done without use of special equipment.
- B. Valves shall be rated at minimum 175 psi WOG (Water, Oil and Gas) working pressure for sizes 4-in to 12-in inclusive and at minimum 150 psi WOG working pressure for sizes 14-in and larger and shall be capable of providing drop tight shut-off to full valve rating with pressure on either side of plug.
 1. Plug valves under this Paragraph shall be performance, leakage and hydrostatically tested in accordance with AWWA C517, except as modified herein.
 2. At above rated minimum working pressures, valves shall be certified by manufacturer as permitting zero leakage for a five-minute duration with full pressure applied in either direction.

3. At direction of Engineer, valve manufacturer may be requested to perform a valve seat leakage test, witnessed by Engineer to prove compliance with this Section.
- C. Valve bodies shall be of cast iron, 30,000 psi tensile strength, ASTM A 126, Grade B, or of ductile iron, ASTM A 536 and of top entry, bolted bonnet design, cast with integral flanges conforming to connecting piping. Exposed bolts, nuts, and washers shall be zinc or cadmium- plated, except for submerged valves, which shall have Type 316 stainless steel hardware.
1. Valve bodies shall be glass lined for plug valves installed in glass lined ductile iron pipelines. Glass lining shall be as specified in piping specification.
- D. Valve Plug:
1. Shall be Buna N coated, cast iron ASTM A 126, Grade B, or ductile iron, ASTM A536, Grade 65-45-12.
 2. Shall be removable without removing valve from the line.
 3. Shall have an integral upper and lower shaft which shall have seals on upper and lower journals to prevent entrance of solids into journals.
 4. Shall be one piece for all valves.
- E. Shaft bearings shall be permanently lubricated stainless steel or bronze at both upper and lower stem journals. Operator shaft shall have easily replaceable seals, which shall be externally adjustable and repackable without removing bonnet from valve, or shall have self-adjusting packing.
- F. Valve seating surface shall provide full 360 degree seating by contact of a resilient seating material on plug mating with welded-in high nickel content overlay seating surface in body.
1. Seating design shall be resilient and of continuous interface type having consistent opening and closing torques and shall be non-jamming in closed position. Screw-in seats shall not be acceptable.
 2. Plugs shall have a full resilient facing of neoprene or Buna-N.
- G. Valves 6 inch and larger shall be actuated via gearbox and hand wheel, unless mechanized, which shall require gearbox and actuator. A suitably sized steel actuator mounting bracket shall be provided to provide an air gap between actuator and valve stem seal. Under no circumstance shall gear box be mounted directly to top body flange such that leakage could directly enter gear box.

- H. Unless otherwise required due to location or mechanized operation, each valve 4-in and smaller shall be provided with its own securely attached lever. Provide adjustable limit stops for both opening and closing and a clearly marked position indicator.
- I. Plug valves shall be installed so that direction of flow through valve and shaft orientation is in accordance with manufacturer's recommendations. Unless otherwise noted, shaft shall be horizontal, with plug opening up.

2.8 CHECK VALVES

A. Iron Swing Check Valves for Metallic Lines of 4-in to 30-in Diameter:

1. Check valves shall be swing type and shall meet the requirements of AWWA C508. Valves shall be iron body, bronze mounted, single disc, minimum 175 psi working pressure for 4 to 12 inch, 150 psi working pressure for 14 to 30 inch, non-shock and hydrostatically tested at 300 psi. When there is no flow through line, disc shall hang lightly against its seat in practically a vertical position. When open, disc shall swing clear of waterway. Valves shall be so constructed that disc and body seat may easily be removed and replaced without removing valve from line.
2. Check valves shall have bronze seat and body rings, bronze or ductile clapper arm and bronze nuts on the bolts of bolted covers. Shaft assembly and key shall be ASTM A 582 Type 416 stainless steel. Hinge shaft shall extend from body of valve, sealed with stuffing box, packing and gland. Shaft side plug bearing, stuffing box and gland shall be bronze, packing shall be reinforced Teflon, both side plug and stuffing box shall be provided with grease fittings.
3. Valves 6 inch and larger shall be fitted with an extended hinge arm with outside lever and weight. Position of weight shall be adjustable. Various weights shall be provided and installation approved by Engineer. Lever shall be installed to horizontal in closed position, for both horizontal and vertical pipeline installations.
 - a. Swing check valves for DAF sludge pump discharge shall be outside lever and weight with a 12 inch lever arm and 12 lbs weight to impart a 120 lb-in closing moment on check valve to prevent siphoning from DAF sludge trough.
4. Where check valve position switches are required as shown on Instrumentation Drawings, check valves shall be furnished complete with position switch mounting bracket and actuation lever mounted to stem shaft. Where outside lever and weights are required, stem shaft shall extend both sides of valve body and position switch assembly shall be mounted on opposite side of lever and weight assembly.

5. Where position switches are to be supplied for existing check valves with external shaft and lever, supply mounting brackets and hardware required to mount position switches to existing valves. Contractor shall use existing bolting where possible to mount brackets. If bolting is not available in required area, Contractor shall drill and tap valve body if required to mount position switches. Drill location and depth shall be reviewed with, and approved by Engineer.
6. Position switches shall be lever type, NEMA 7 enclosure, SPST, 120VAC, 6A, Square D Type 9007CR or equal. Hardware shall be Type 316 stainless steel.
7. Check valves shall be manufactured by American Flow Control; M&H/Clow/Kennedy; Golden Anderson; Mueller; or equal.

B. Dual Disc Check Valves:

1. Blower Discharge Service: Tag Type DDCV1.
 - a. Check valve shall be wafer style dual shaft design with torsion spring induced closure. Valve body shall be pressure class 125, Class 35 cast iron or steel; shafts shall be Type 316 stainless steel, Discs shall be Type 316 stainless steel or aluminum bronze; spring shall be INCONEL. Seat shall be resilient, vulcanized, Viton A. Double disc check valve shall be Titan CV41, Cameron Valve, Techno Check, Style 5051 or equal.

C. Rubber Flapper Check Valves:

1. Body shall be cast iron, ASTM A 126, Class B, or ASTM A 536 Gr 65 Ductile iron, 150 lb flanged. Body shall be fusion bonded epoxy coated. Disc shall be Nylon reinforced EPDM encapsulated steel. Valve body and open disc shall provide full flow at least equal to nominal pipe diameter. Seating surface shall be on a 45-degree angle. Top access port shall be full size, allowing disc removal without removing valve body from pipeline. Disc shall be one piece construction, precision molded with and integral O-ring sealing surface and contain steel and nylon reinforcements in both the flex and central disc areas.
2. Rubber flapper check valves shall be as manufactured by Crispin Multiplex Series 500, equal by Val-Matic or equal.

2.9 BALL VALVES:

A. General Service Ball Valves:

1. Valves shall be bronze, resilient seated, full port, threaded two piece bolted body type valves. Manual valves shall have locking levers. Body and cap shall be of brass, ASTM B 30, ball and stem of Type 316 stainless steel and seats and seals of glass filled TFE. Balls shall be full floating, non-lubricated. Valve seats shall be easily accessible and replaceable.

2. Valves shall be Jamesbury Series 2000 Style 21 as manufactured by Metso Automation; or equal.

2.10 GLOBE VALVES:

- A. Globe valves 3-in diameter and smaller shall have flanged, or screwed ends as required and shall be bronze body, union or bolted bonnet, renewable full plug stainless steel disc, renewable hardened stainless steel seat ring, rising silicon bronze stem, pressure class 200. Globe valves shall be Figure 3245P as manufactured by Walworth Co.; Valley Forge, PA; Jenkins Figure 592J, division of Crane Valve Group; Stockham Figure B-62; Lunkenheimer Figure 73-PS, Cincinnati Valve Co, Fairbanks Figure 0505, or equal. Model numbers referenced above are for screwed ends, flanged ends shall be provided where shown on Drawings and shall be equal construction with appropriate end connections. Iron body valves shall be installed in steel or iron pipelines.

2.11 THERMOPLASTIC VALVES TAG TYPE NOTED BELOW

A. General:

1. Valves shall be certified as completely compatible with intended and specified service; compatibility shall apply to material of valve and internal components, including seals, gaskets, O-rings and washers; solvents and primers used in valve joint make-up shall be specifically in conformance with written instructions of valve supplier. Service chemicals and service conditions are shown in the piping sections in Division 15.
2. Except as otherwise specified, valve ends shall be socket-type designed for solvent welding. Solvent and primer shall be as specified in piping specifications, except that valves installed in systems carrying strong oxidizing, high alkalinity, and strong acid solutions shall contain NO fumed silica, and shall be Weld-On 724 for CPVC pipe as manufactured by IPS Corp., Compton, CA and Oatey Industrial Grade Low VOC Heavy Duty Gray for PVC pipe as manufactured by Oatey Corp., Cleveland OH.
3. Valve body material shall be same as piping system in which valve will be installed, unless explicitly stated otherwise on Drawings or in valve specification.
 - a. PVC shall have a cell classification 12454 according to ASTM D 1784, made from unplasticized polymer, and generally suitable for service to 120 degrees F.
 - b. CPVC shall have a cell classification 23447 according to ASTM D 1784, generally suitable for service to 180 degrees F.
 - c. Polypropylene (PP) shall conform to material requirements of ASTM D 4101 for copolymer polypropylene.
 - d. PVDF (polyvinylidene fluoride) shall be manufactured from high

- e. Manufacturer of valves shall retain material source quality documentation and shall furnish it to Engineer upon request.
4. Unless otherwise specified:
 - a. Valve seats shall be Teflon, or Teflon encapsulated elastomer. Alternative materials shall not be substituted without complete documentation provided to Engineer of service suitability.
 - b. Flange Gaskets shall be low torque, full face ANSI B16.5 with two concentric convex rings between ID and bolt hole diameter, constructed of EPDM, PTFE-bonded EPDM or PVDF-bonded EPDM as manufactured by Asahi of America or equal. Documentation shall be provided to show compatibility of bonded surface material for fluid service intended.
 - c. Valve external hardware shall be Type 316 stainless steel. No internal metallic components shall be exposed to service fluid.
 - d. No factory or field coatings shall be applied to valves.
 5. Valves, except butterfly valves, shall have a non-shock service pressure rating of not less than 120 psig at 70 degrees F.
 6. Valves from 1/2-in to 2-in shall have a snap-on fit handle attaching to valve stem to prevent handle from falling off. Valves from 2-1/2-in to 6-in shall have a handle mechanically attached to valve stem to prevent handle from falling off. Valves shall have limit stops at full open and full close to limit handle rotation.
 7. Valves shall be given hydrostatic and pressure and leakage tests at factory. Provide certified copy of test results.
 8. Valves shall be the standard, catalogued products of the following manufacturers:
 - a. Chemtrol.
 - b. Asahi/America.
 - c. Plast-O-Matic.
 - d. George-Fischer.
 - e. IPEX.
 9. Valves specified as furnished with equipment or equipment systems shall comply with these requirements.
- B. Ball Valves:
1. Ball valves shall be double-union type, unless otherwise specified, full-port, adjustable seats.
 2. Provide quarter-turn manual valve operator unless mechanized actuators are specified on Drawings.

3. Shall be PVC body, furnished with socket ends, EPDM O-rings and stem seals, PTFE seats with EPDM O-ring backup.

C. Ball Check Valves:

1. Ball check valves shall be double-union style with socket ends, solid and completely spherical ball, EPDM seals, PTFE seat, capable of either horizontal or vertical mounting. Ball check valves shall be SXE Series as manufactured by IPEX or equal.

D. Diaphragm Check Valves:

1. Diaphragm check valves shall be union PVC, CPVC or PVDF body, thread or socket weld ends, EPDM or FKM diaphragms. Acid service valves shall be PVDF body with FKM diaphragm, and shall be furnished with PVDF flanges to connect to flanged piping. Valves shall be mountable in any position, and shall be Plast-O-Matic model CKM or equal.

2.12 NEEDLE VALVES:

- A. Needle valves shall have a cast bronze or 18-8 stainless steel body, minimum pressure class 200. Ends shall be ANSI B2.1 threaded. Valves shall have a rising bronze stem and non-slip resilient rubber-coated malleable iron hand wheel.
- B. Needle valves shall be Figure 1976 as manufactured by the William Powell Company, Cincinnati, OH, or Figure 88 as manufactured by Crane Company, Valve Division, Chicago, IL; Lunkenheimer Figure 906-BS or equal.

2.13 PRESSURE REGULATING VALVES:

- A. Pressure regulating valves shall be factory tested. Outlet pressure shall be easily field-adjustable over pressure ranges and criteria noted on Drawings.
- B. Threaded pressure regulating valves shall have unions mounted in pipe on each side of valve.
- C. Strainers shall be provided up stream of pilot valves and hydraulic components associated with main valve. Pressure regulating valve manufacturer shall specify screen mesh or size of perforations that are required to protect regulating valve or hydraulic component. Strainers shall be constructed of Type 316 stainless steel.
- D. Pressure Regulating Valves - 3-in and larger:
 1. Valves 3-in and larger and for pressure regulating shall be flanged with globe body, fully bronze mounted, external pilot operated, spring-loaded

diaphragm type single seat with seat base equal to size of valve and shall be equal to Figure x-4500D (with an industrial chrome finish) Pressure Reducing Valve as manufactured by GA Industries Inc., Pittsburgh, PA; Clayton Model 90 by Cla-Val Company, Newport Beach, CA; Bailey, Fresno, CA; similar models by Ross; OCV; Watts/Muesecos or equal.

2. Valve shall be packed with leather material acceptable to Engineer to ensure tight closure and prevent metal to metal friction and sticking. Valve shall be furnished with indicator rod, to show position of opening of the piston, and pet cocks for attachment to valve body for receiving gauges for testing purposes.
 3. Pilot valve, controlling operation of main valve, shall be easily accessible and so arranged to allow for its removal from main valve, while main valve is under pressure. Pilot valve shall be easily adjustable without removal of springs, weights or use of special tools. Control piping on valves shall have strainers to prevent plugging of control mechanisms.
 4. Design shall be such that repairs and dismantling internally of main valve may be made without its removal from line.
 5. Unit shall be flanged. Valve body shall be constructed of cast iron.
 6. Valve shall maintain pre-adjusted downstream pressure for varying rates of flow through positioning of diaphragm by pilot without causing: water hammer or waste of water and without cavitation.
- E. Pressure Regulating Valves - 2-in and Smaller:
1. Pressure regulating valves 2-in and smaller shall be rated 150 psig working pressure, with bronze and brass body; renewable stainless steel seat and flexible diaphragm of suitable material. Outlet pressure shall be easily field-adjustable over pressure ranges tabulated.
 2. Pressure regulating valves 2-in and smaller shall be Figure No. 43D as manufactured by GA Industries, Inc.; Watts Muesco Regulator Co. Series 115 for 1-1/4-in and larger and Model 223-S for units smaller than 1-1/4-in or equal with strainer and of size noted on Drawing. Shall be diaphragm type, pressure reducing globe valves designed for an inlet pressure of approximately 110 psig, and outlet pressures in range of 20 to 60 psig.

2.14 SOLENOID VALVES:

- A. Solenoid valves shall be packless piston type direct acting for sizes less than 1-in and internal pilot operated for sizes 1-in and larger, 2-way or 3-way, valves and shall be ASCO Valve; Red Hat by Automatic Switch Co., similar by Circle Seal Controls-Atkomatic Valve Co. or equal for air and water service.

- B. Valves shall be energized to open, except for valves on water seal lines to pumps which shall be energize to close.
- C. Valves shall have forged brass bodies, NPT end connections of connected piping Type 304 stainless steel internal parts, and Buna-N or Ethylene Propylene valve seats. Valves shall have a minimum 150 psig safe working pressure and zero minimum operating pressure differential. Connections shall be threaded.
- D. Solenoid valves size 2-inch and larger shall be full bore bronze body, Type 430 stainless steel plunger, copper coil class A encapsulated, Type 302 stainless steel spring, wash-down safe, equal to type A as manufactured by Magnatrol Valve Corp., Hawthorne, NJ or equal. Solenoid valves shall have a manual override actuated by a handle levered plunger mounted on bottom of valve body. These valves shall be mounted in a horizontal run of piping, with solenoid up in vertical position.
- E. Note that solenoid valves may be shown on Electrical and/or Mechanical Drawings, or may only be specified, but if so specified or shown, shall be provided. Solenoid valves located in hazardous classified areas shall be provided with electrical enclosures which satisfy electrical classification as specified or shown on Electrical Drawings.

2.15 CORPORATION STOPS:

- A. Corporation Stops 3/4-in through 2-in shall be ball valve type, meeting AWWA Standard C800- 01, Sec. 4.2.3 (High Pressure), withstanding working pressures up to 300 psi. Body, ball, operating stem, T-head, and service line connector shall be manufactured from red brass and conform to ASTM B 62 and/or ASTM B 584, UNS No. C83600. Ball shall be fluorocarbon coated and shall float on two EPDM seats and be watertight in both directions. Operating stem and nut shall be one piece, held in place by a mating machined flange on stem and in body. Operating stem shall have an EPDM O-ring to provide a watertight seal against the body.
- B. Inlet threads shall be AWWA Taper, except where used with service clamps, where threads shall be IPS threads. Thread types and diameters shall conform to AWWA C800. Inlet threads will be integral to body. Waterway diameter shall be approximately equivalent to nominal size of stop, and shall accommodate maximum cutter size established by AWWA C800. Outlet shall be a compression connection meeting AWWA C800 Sec. 4.4.9.
- C. Corporation Stops shall be FB Style Ballcorp, as manufactured by The Ford Meter Box Company, Inc., Wabash, Indiana, or equal. Where corporation stops are used with plastic pipe, a brass companion flange shall be provided on outlet of each corporation stop.

2.16 AIR RELEASE AND VACUUM RELIEF VALVES:

- A. Pipeline air and vacuum valves shall be supplied with shutoff gate or ball valves with operator handle or lever removed. Valves shall be properly vented and piped to drain.
- B. Valve pressure rating shall be at least equal to attached pipe's rating.
- C. Valves for sewage service shall have connections for draining and flushing with isolation ball valves for connection size up to 3 inch, and solid wedge gate valves for size 4 inch and larger.
- D. Air Release Valves:
 - 1. Small orifice assembly air release valves shall automatically release air accumulations from pipe while under positive pressure. When valve body fills with air, float mechanism shall fall to open small orifice and exhaust air to atmosphere. When air has been exhausted, float mechanism shall be buoyed up and shall tightly close small orifice. Small orifice assembly shall be furnished with Type 304 stainless steel body and cover, and shall use Type 316 stainless steel hardware. Float mechanism shall be constructed of polypropylene or Type 316 stainless steel. Wetted components shall be polypropylene, Buna-N or Type 316 stainless steel. A resilient, Buna-N seat shall provide drop-tight closure.
 - 2. Separate air release valves shall be Vent-O-Mat Model RBXb, equal as manufactured by APCO; Val-Matic; GA; Crispin or equal of the special type for use with non-clean water.
- E. Vacuum Relief Valves:
 - 1. Large orifice assembly vacuum valves shall automatically allow air to enter pipeline when pressure falls below atmospheric pressure. Vacuum relief valves shall not be configured to release air.
 - 2. Vacuum relief valves shall be constructed as specified in subparagraph F below, except providing vacuum relief only, as manufactured by Vent-O-Mat.
- F. Combination Air and Vacuum Relief Valves:
 - 1. Valves shall be designed to release large amounts of air during pipeline filling, release small amounts of air accumulated during pipeline operation, and allow large volume of air during pipeline drainage or pipe break. Combination double orifice air/vacuum valve for general service in sizes 1 to 6 inches housed in a tubular stainless steel body with epoxy powder coated cast iron or steel ends secured by means of stainless steel tie rods. Valve shall have an intake orifice area equal to nominal size of valve.

2. Air release/vacuum valves shall be compact single cylindrical chamber design with multiple solid cylindrical HDPE control floats. Discharge of pressurized air shall be controlled by seating and unseating of a small orifice nozzle on a natural rubber seal affixed into control float. Nozzle shall have a flat seating land surrounding orifice so that damage to rubber seal is prevented. Venting of large quantities of air during pipeline filling shall be accomplished through large orifice at top of valve. Large orifice sealing shall be affected by flat face of control float seating against an "O" ring housed in a dovetail groove circumferentially surrounding orifice. Valve shall feature integral 'Anti-Shock' Orifice mechanism in op float which shall operate automatically to limit transient pressure rise or shock induced by closure to twice valves rated working pressure. Vacuum relief shall be accomplished through large orifice when control floats fall due to negative pressure in pipeline. Valve design shall incorporate an over pressure safety feature that will fail without an explosive effect, such as is normally the case when highly compressed air is released suddenly. Feature shall consist of easily replaceable gaskets.
3. Valves shall be rated for 230 psi service. Materials of construction shall be as follows: barrel- Type 304L stainless steel; top and bottom flanges- fusion bonded epoxy steel; upper/lower floats and anti-shock orifice- UHMW PE; small orifice nozzle seat and O- rings- Buna-N; nozzle, baffle plate, tie rods, studs, nuts, washers- Type 304 stainless steel. End Connections shall be NPT up to 2 inch, 125 lb flange 3 to 6 inch.
4. Valves shall be as manufactured by Vent-O-Mat, Model RBX 2521 or 1631.

2.17 MUD VALVES (PLUG DRAIN VALVES):

- A. Mud valves shall non- rising stem type, with cast iron body. Stem, stem nut, stop collar, disc ring shall be bronze. Seat ring shall be bronze with a tapered, accurately machined seating face. Plug seat shall be a seamless molded ring of Buna-N tapered to accurately mate with seat. Bolts and nuts shall be stainless steel.
- B. Valves shall be equipped with extension stem and floor box with operating nut or floor stand and hand wheel operators. Stop nut and shaft supports (stem guides) shall be provided as recommended by manufacturer to prevent damage to valve or shaft, but at no greater spacing than noted in Paragraph 2.02 above.
 1. Where shown on Drawings, mud valve operators shall consist of vertical extension stems, stem guides, wall mount floor stand bracket, floor stand, 90 degree bevel gear box, horizontal extension stem, extension stem support bearing, and hand wheel. Shafting shall be Type 316 stainless steel; gearboxes shall be ductile or cast iron body, bronze bearing, steel gearing, grease lubricated, with mechanical lip shaft seals; floorstands brackets shall be heavy fabricated steel or cast iron, primed and finish painted per Section 09902.

Operator assemblies shall be as manufactured by Roto Hammer Company, Tulsa OK, or equal.

- C. Mud valves shall be flanged, Waterman Figure MV-11; Clow Style F3075, similar by Mueller; M&H or equal.

2.18 SURFACE PREPARATION AND SHOP COATINGS

- A. Notwithstanding any of these specified requirements, coatings and lubricants in contact with potable water shall be certified as acceptable for use with that fluid.
- B. If not specified herein, coatings shall comply with the requirements of Section 09901 and 09902. In case of a conflict, requirements of this Section govern.
- C. If manufacturer's requirement is not to require finished coating on interior surfaces, then manufacturer shall so state and no interior finish coating will be required, if acceptable to Engineer.
- D. Exterior surface of various parts of valves, operators, floor-stands and miscellaneous piping shall be thoroughly cleaned of all scale, dirt, grease or other foreign matter and thereafter one shop coat of an approved rust-inhibitive primer such as Inertol Primer No. 621 shall be applied in accordance with instructions of paint manufacturer or other primer compatible with finish coat provided.
- E. Unless otherwise noted, interior ferrous surfaces of valves shall be given a shop finish of an asphalt varnish conforming to AWWA C509, (except mounting faces/surfaces) or epoxy conforming to AWWA C550 with a minimum thickness of 6 mils.
- F. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating. Mounting surfaces shall be especially coated with a rust preventative.
- G. Special care shall be taken to protect uncoated items and plastic items, especially from environmental damage.

2.19 FACTORY INSPECTION AND TESTING

- A. Factory inspection, testing and correction of deficiencies shall be done in accordance with the referenced standards and as noted herein.
- B. See Division 1 for additional requirements. Also refer to Part 1, especially for required submission of test data to Engineer.
- C. In addition to tests required by referenced standards, the following shall also be factory tested:

1. Pressure regulating valves shall be factory tested at specified pressures and flows.
2. Butterfly valves shall be factory tested to demonstrate drop tight closure at specified conditions.
3. All types of air and vacuum valves.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- A. Valves and appurtenances shall be installed per manufacturer's instructions in locations shown, true to alignment and rigidly supported. Damage to above items shall be repaired to satisfaction of Engineer before they are installed.
- B. Install brackets, extension rods, guides, various types of operators and appurtenances as shown on Drawings, or otherwise required. Before setting these items, check Drawings and figures which have a direct bearing on their location. Contractor shall be responsible for proper location of valves and appurtenances during construction of the work.
- C. Materials shall be carefully inspected for defects in construction and materials. Debris and foreign material shall be cleaned out of openings, etc. Valve flange covers shall remain in place until connected piping is in place. Operating mechanisms shall be operated to check their proper functioning and nuts and bolts checked for tightness. Valves and other equipment which do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to Engineer.
- D. Where installation is covered by a referenced standard, installation shall be in accordance with that standard, except as herein modified, and Contractor shall certify such. Also note additional requirements in other parts of this Section.
- E. Unless otherwise noted, joints for valves and appurtenances shall be made up utilizing same procedures as specified under applicable type connecting pipe joint and valves and other items shall be installed in proper position as recommended by manufacturer. Contractor shall be responsible for verifying manufacturers' torqueing requirements for all valves.

3.2 INSTALLATION OF MANUAL OPERATIONAL DEVICES

- A. Unless otherwise noted, operational devices shall be installed with units of factory, as shown on Drawings or as acceptable to Engineer to allow accessibility to operate and maintain item and to prevent interference with other piping, valves, and appurtenances.

- B. For manually operated valves 3-in in diameter and smaller, valve operators and indicators shall be rotated to display toward normal operation locations.
- C. Floor boxes, valve boxes, extension stems and low floor stands shall be installed vertically centered over operating nut, with couplings as required and elevation of box top shall be adjusted to conform to elevation of finished floor surface or grade at completion of Contract. Boxes and stem guides shall be adequately supported during concrete placement to maintain vertical alignment.

3.3 INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

- A. See also Division 1. Take care not to over pressure valves or appurtenances during pipe testing. If unit proves to be defective, it shall be replaced or repaired to satisfaction of Engineer.
- B. Functional Test: Prior to plant startup, items shall be inspected for proper alignment, quiet operation, proper connection and satisfactory performance. After installation, manual valves shall be opened and closed in presence of Engineer to show valve operates smoothly from full open to full close and without leakage. Valves equipped with electric, pneumatic or hydraulic actuators shall be cycled five times from full open to full closed in presence of Engineer without vibration, jamming, leakage, or overheating. Pressure control and pressure relief valves shall be operated in presence of Engineer to show they perform their specified function at some time prior to placing piping system in operation and as agreed during construction coordination meetings
- C. Various pipe lines in which valves and appurtenances are to be installed are specified to be field tested. During these tests any defective valve or appurtenance shall be adjusted, removed, and replaced, or otherwise made acceptable to Engineer.
- D. Various regulating valves, strainers, or other appurtenances shall be tested to demonstrate their conformance with specified operational capabilities and deficiencies shall be corrected or device replaced or otherwise made acceptable to Engineer.

3.4 CLEANING

- A. Items including valve interiors shall be inspected before line closure, for presence of debris. At option of Engineer, internal inspection of valve and appurtenances may be required any time that likelihood of debris is a possibility. Pipes and valves shall be cleaned prior to installation, testing disinfection and final acceptance.

END OF SECTION

SECTION 15140
 PIPE HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals and install a complete system of pipe hangers, supports, concrete inserts and anchor bolts including all metallic hanging and supporting devices for supporting non-buried piping as shown on the Drawings and as specified herein.
- B. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of the responsibility for providing them. Pipe supports indicated on the Drawings are shown only to convey the intent of the design for a particular location and are not intended to represent a complete system.

1.2 RELATED WORK

- A. Concrete is included in Division 3.
- B. Miscellaneous metal is included in Section 05500.
- C. Pipe and fittings are included in respective sections of Divisions 2 and 15.
- D. Valves and appurtenances are included in Section 15100.
- E. Hangers and supports pertaining to HVAC systems are included in their respective Sections.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 01300, complete sets of shop drawings of all items to be furnished under this Section. Submittals shall include complete layouts, schedules, location plans and complete total bill of materials for all pipe support systems.
- B. Submittals shall include a representative catalog cut for each different type of pipe hanger or support indicating the materials of construction, important dimensions and range of pipe sizes for which that hanger is suitable. Where standard hangers and/or supports are not suitable, submit detailed drawings showing materials and details of construction for each type of special hanger and/or support. Provide detailed information on anti-seize compound.
- C. Submittals shall include complete piping drawings as submitted for each piping

submittal indicating type of hanger and/or support, location, magnitude of load transmitted to the structure and type of anchor, guide and other pipe supporting appurtenances including structural fasteners.

- D. Types and locations of pipe hangers and/or supports shall also be shown on the piping layouts for each piping submittal as specified in the respective Divisions 2 and 15 pipe sections. Service conditions for each piping system, including service temperatures, and operating and test pressures, are tabulated in the piping sections.
- E. Submit complete design data for pipe support systems to show conformance with this Section.
- F. Support System Design
 - 1. Engage the services of an independent registered professional engineer ordinarily engaged in the business of pipe support systems analysis, to analyze system piping and service conditions and to develop a detailed support system, specific to the piping material, pipe joints, valves and piping appurtenances proposed for use.
 - a. The proposed support system engineer shall have at least five years of experience in the analysis and design of similar systems, including the use of commercial and custom pipe support and in the use of commercial pipe stress software programs. Provide a detailed resume, including references from projects within the past five years. The use of support systems engineer shall be subject to the approval of the Engineer.
 - 2. The support system engineering services shall be provided by J. Blanco, Inc., Fairlawn, NJ or Waterford Associate Inc., East Providence, RI.
 - 3. The proposed systems engineer shall attend a conference with the Engineer, scheduled prior to any support systems design.
 - 4. The support system design shall include:
 - a. Criteria by piping system.
 - b. Summary of Contractor-selected related components including joints, class, valves appurtenances, etc, and commercial supports and especially including pipe materials.
 - c. Dead weight and dynamic analysis, including system thermal effects and pressure thrusts. Computer-based software system equivalent to ADLPIPE.
 - 1) Each system shall be presented in an isometric graphic and shall show the resolved and resultant force and moment systems, as well as all recommended hangers, supports, anchors, restraints and expansion/flexible joints.
 - d. Submit a draft report to the Engineer for approval.
 - 1) After the work is installed, but before it is filled for start-up and testing, the support system design engineer shall inspect the work

- and shall certify its complete adequacy. Each system shall be inspected and certified in the same way.
- 2) Submit a report, including all field modifications and including all certificates.
 - 3) The report shall bear the stamp of a registered professional engineer and shall be subject to the approval of the Engineer.
- e. All aspects of the analysis and design shall comply with the provisions of ANSI B31.1 and the referenced standards.
 - f. Support arrangements shall be coordinated to eliminate interference with similar systems to be installed under HVAC, Plumbing and Electrical; to account for structural expansion joints and to maintain access for both personnel and for the removal of equipment. Support systems shall not include the use of monorail or bridge crane support. Nor shall they rely on the horizontal structural struts.
 - g. Commercial hardware and custom supports shall comply with the requirements of this Section.
5. Prepare for and attend a post-analysis review and presentation, after the Engineer's review of the report. Revise per the comments and issue as FINAL REPORT.

1.4 REFERENCE STANDARDS

- A. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):
 1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
 2. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.
- B. ASTM International:
 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
 2. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- C. American National Standards Institute (ANSI):
 1. ANSI B31.1 - Power Piping.
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. All hangers, supports and appurtenances shall conform to the latest applicable

requirements of ANSI B31.1, except as supplemented or modified by the requirements of this Section.

- B. All hangers, supports and appurtenances shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for all supporting equipment, with the exception of springs, shall be five times the ultimate tensile strength of the material, assuming 10-ft of water-filled pipe being supported.
- C. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, submit certification stating that such requirements have been complied with.

1.6 DELIVERY, STORAGE AND HANDLING

- A. All supports and hangers shall be crated, delivered and uncrated so as to protect against any damage.
- B. All parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.
- C. Finished metal surfaces not galvanized, that are not of stainless steel construction, or that are not coated, shall be grease coated, to prevent rust and corrosion.

PART 2 PRODUCTS

2.1 GENERAL

- A. All of the equipment specified herein is intended to support the various types of pipe and piping systems shown on the Drawings. It shall be the responsibility of the Contractor to develop final details and any details associated with special conditions not already covered to meet the system conditions (in particular system temperatures and pressures) specified in the respective Division(s) 2 and 15 pipe sections.
- B. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, fittings and other pipe appurtenances and to support and secure the pipe in the intended position and alignment. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces and all probable external forces such as equipment, pipe and personnel contact. Structural steel members

required to brace any piping from excessive dislocation shall conform to the applicable requirements of Section 05500 and shall be furnished and installed under this Section.

- C. The Contractor may propose minor adjustments to the piping arrangements in order to simplify the supports, or in order to resolve minor conflicts in the work. Such an adjustment might involve minor change to a pipe centerline elevation so that a single trapeze support may be used.
- D. Where flexible couplings are required at equipment, tanks, etc, the end opposite to the piece of equipment, tank, etc, shall be rigidly supported, to prevent transfer of force systems to the equipment. No fixed or restraining supports shall be installed between a flexible coupling and the piece of equipment.
- E. All pipe and appurtenances connected to the equipment shall be supported in a manner to prevent any strain from being imposed on the equipment or pipingsystem.
- F. All rods, clamps, hangers, inserts, anchor bolts, brackets and components for interior pipe supports shall be furnished with galvanized finish, hot dipped or electro-galvanized coated, except where field welding is required, where cold-applied galvanizing may be used. Interior clamps on plastic pipe shall be plastic coated. Supports for copper pipe shall be copper plated or shall have a 1/16-in plastic coating. All rods, clamps, hangers, inserts, anchor bolts, brackets and components for exterior pipe, submerged pipe and pipe within outdoor structures shall be of Type 316 stainless steel.
- G. Supports shall be sufficiently close together such that the sag of the pipe is within limits that will permit drainage and avoid excessive bending stresses from concentrated loads between supports.
- H. All uninsulated non-metallic piping such as PVC, CPVC, etc, shall be protected from local stress concentrations at each support point. Protection shall be provided by galvanized steel protection shields or other method as approved by the Engineer. Where pipes are bottom supported 180 degrees, arc shields shall be furnished. Where 360 degree arc support is required, such as U bolts, protection shields shall be provided for the entire pipe circumference. Protection shields shall have an 18 gauge minimum thickness, not be less than 12-in in length and be securely fastened to pipe with stainless steel or galvanized metal straps not less than 1/2- in wide.
- I. All insulated pipe shall be furnished with a rigid foam insulating saddle at each pipe support location as specified under respective pipe insulation. Provide protection shields as specified in at each support location.
- J. Where pipe hangers and supports come in contact with copper piping provide protection from galvanic corrosion by; wrapping pipe with 1/16-in thick neoprene

sheet material and galvanized protection shield; isolators similar to Elcen, Figure No. 228; or copper plated or PVC coated hangers and supports. All stainless steel piping shall be isolated from all ferrous materials, including galvanized steel by use of neoprene sheet material and protection shields, similar to above methods.

K. Pipe supports shall be provided as follows:

1. Cast iron and ductile iron, steel and stainless steel piping shall be supported at a maximum support spacing of 10-ft with a minimum of one support per pipe section at the joints.
2. Insofar as is possible, floor supports shall be given preference. Typical concrete supports are shown on the structural drawings. Base elbow and base tees shall be used where possible.
3. Support spacing for steel and stainless steel piping 2-in and smaller diameter and copper tubing shall not exceed 5-ft.
4. For all stainless steel piping, provide neoprene isolators between the pipe and support components.
5. Supports for multiple PVC plastic piping shall be continuous wherever possible. Individually supported PVC pipes shall be supported as recommended by the manufacturer except that support-spacing shall not exceed 3-ft. Multiple, suspended, horizontal plastic PVC pipe runs, where possible, shall be supported by ladder type cable trays such as the Electray Ladder by Husky-Burndy; the Globetray by the Metal Products, a Division of United States Gypsum, or equal. Ladder shall be of galvanized steel construction. Rung spacing shall be 12-in. Tray width shall be approximately 6-in for single runs and 12-in for double runs. Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc, required for a complete support system. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners similar to Globe, Model M-CAC; Husky-Burndy, Model SCR or equal. Spacing between clamps shall not exceed 9-ft. The cable trays shall provide continuous support along the length of the pipe. Individual clamps, hangers and supports in contact with plastic PVC pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.
6. All vertical pipes shall be supported at each floor or at intervals of not more than 12-ft by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to insure rigid construction. All vertical pipes passing through pipe sleeves shall be secured using a pipe collar.

7. Pipe supports shall not induce point loadings but shall distribute pipe loads evenly along the pipe circumference.
 8. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or as specified herein. No piping shall be supported from other piping or from metal stairs, ladders and walkways, unless specifically directed or authorized by the Engineer.
 9. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings and sleeve type couplings and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.
 10. Effects of thermal expansion and contraction of the pipe shall be accounted for in the pipe support selection and installation.
- L. Unless otherwise specified herein, pipe hangers and supports shall be standard catalogued components, conforming to the requirements of MSS-SP-58 and -69; and shall be as manufactured by Grinnell Co., Inc., Providence, RI; Carpenter & Patterson, Inc., Woburn, MA; F&S Central, Brooklyn NY; Elcen Metal Products Co., Franklin Park, IL and Unistrut Northeast, Cambridge, MA or equal. Reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary.
- M. Required pipe supports for which the supports specified in this Section are not applicable shall be fabricated or constructed from standard structural steel shapes, concrete and anchor hardware similar to items previously specified herein and shall be subject to the approval of the Engineer.
- N. Expansion anchors shall be equal to Kwik-Bolt as manufactured by the McCulloch Industries, Minneapolis, MN or Wej-it by Wej-it Expansion Products, Inc., Bloomfield, CO. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1-in behind the steel reinforcement.
- O. Hanger rods shall be hot rolled steel, machine threaded and galvanized after fabrication. The strength of the rod shall be based on its root diameter. Hanger rods shall be attached to concrete structures using concrete inserts similar to F&S, Figures 180, 571 or 150; or continuous concrete inserts per F&S. Inserts shall be malleable iron, or steel with galvanized finish. Beam clamps, C clamps or welded beam attachments shall be used for attaching hanger rods to structural steel members. Where necessary and approved by the Engineer, expansion anchors shall be used for attaching to concrete structures.

2.2 SINGLE PIPE HANGERS

- A. Single pipes shall be supported by hangers suspended by hanger rods from structural steel members, concrete ceilings, bottom of trapeze hangers and wall mounted steel angle brackets.
- B. Except as otherwise specified herein, pipe hangers shall be steel, of the adjustable clevis type similar to Grinnell, Figure No. 65, 260 and 590 as required.
 - C. Where pipes are near walls, beams, columns, etc, and located an excessive distance from ceilings or underside of beams, welded steel wall brackets similar to Carpenter and Patterson, Figure No. 69-68, 84 or 139 shall be used for hanging pipe. Where single pipes rest on top of bracket pipe supports, attachments shall meet requirements as specified under multiple pipe hangers.

2.3 MULTIPLE PIPE HANGERS

- A. Suspended multiple pipes, running parallel in the same horizontal plane, which are adjacent to each other shall be suspended by trapeze type hangers or wall brackets. Trapeze hangers shall consist of galvanized structural steel channel supported from galvanized threaded rod or attached to concrete walls, columns or structural steel support members as required to meet the intent of this Section. Channel shall be similar to F&S, Figure 710, rods, concrete inserts, "C" clamps, beam clamps, welded beam attachments and expansion shields shall be as specified in Paragraph 2.02 above.
- B. Except as otherwise specified herein pipe anchors used for attaching pipe to trapeze or multiple pipe wall brackets shall be anchor or pipe chairs similar to F&S, Figures 158, 419, 160A, 160B as required. Material of construction shall be galvanized steel. Chair "U" bolts shall be tightened to allow freedom of movement for normal expansion and contraction except where pipe must be anchored to control direction of movement or act as a thrust anchor.

2.4 SINGLE AND MULTIPLE PIPE SUPPORTS

- A. Single pipes located in a horizontal plane close to the floor shall be supported by one of the methods as shown on the Drawings and as specified herein.
- B. Pipes 3-in in diameter and larger shall be supported by adjustable stanchions similar to F&S, Figure 427. Stanchions shall provide at least 4-in adjustment and be flange mounted to floor.
- C. Pipes less than 3-in in diameter shall be held in position by supports fabricated from steel "C" channel, welded post base similar to Unistrut, Figure P2072A and pipe clamps similar to Unistrut, Figures P1109 thru P1126. Where required to assure adequate support, fabricate supports using two vertical members and post bases connected together by horizontal member of sufficient load capacity to support pipe. Wherever possible supports shall be fastened to nearby walls or other

structural member to provide horizontal rigidity. More than one pipe may be supported from a common fabricated support.

- D. Where shown on the Drawings, pipe shall be supported using concrete anchor posts. Pipe shall be securely fastened to the posts using suitable metal straps as required and as approved.

2.5 WALL SUPPORTED PIPES

- A. Single or multiple pipes located adjacent to walls, columns or other structural members, whenever deemed necessary, shall be supported using welded steel wall brackets similar to Carpenter and Patterson, Figure No. 69-78, 84, or 134; or "C" channel with steel brackets similar to Unistrut pipe clamps. All members shall be securely fastened to wall, column, etc, using double expansion shields or other method as approved by the Engineer. Additional wall bearing plates shall be provided where required.
- B. Pipe shall be attached to supports using methods specified herein to meet the intent of this Section.

2.6 BASE ANCHOR SUPPORT

- A. Where pipes change direction from horizontal to vertical via a bend, a welded or cast base bend support shall be installed at the bend to carry the load. The base bend shall be fastened to the floor, pipe stanchion, or concrete pedestal using expansion anchors or other method as approved by the Engineer.
- B. Where shown on the Drawings, pipe bends shall be supported using concrete anchor posts. Pipes shall be securely fastened to the concrete supports with suitable metal bands as required and approved by the Engineer. A felt insert shall be used to isolate the piping from the poured concrete.

2.7 VERTICAL PIPE SUPPORTS

- A. Where vertical pipes are not supported by a Unistrut system as specified in Paragraph 2.08 below, they shall be supported in one of the following methods.
 - 1. For pipes 1/4-in to 2-in in diameter, an extension hanger ring shall be provided with an extension rod and hanger flange. The rod diameter shall be as recommended by the manufacturer for the type of pipe to be supported. The hanger ring shall be steel or PVC clad depending on the supported pipe. The hanger ring shall be equal to Carpenter & Paterson, Figure No. 81 or 81CT. The anchor flange shall be galvanized malleable iron similar to Carpenter and Patterson, Figure No. 85.
 - 2. For pipes equal to or greater than 2-in in diameter extended pipe clamps similar to Carpenter and Patterson, Figure No. 267 may be used. The

hanger shall be attached to concrete structures using double expansion shields, or to steel support members using welding lugs similar to Carpenter and Patterson, Figure No. 220.

3. Pipe riser clamps shall be used to support all vertical pipes extending through floor slabs. Riser clamps shall be steel similar to Carpenter and Patterson, Figure No. 126. Copper clad or PVC coated clamps shall be used on copper pipes. Insulation shall be removed from insulated pipes prior to installing riser clamps. Insulation shall not be damaged by clamp installation.
4. Unless otherwise specified, shown, or specifically approved by the Engineer, vertical runs exceeding 12-ft shall be supported by base elbows/tees, clamps, brackets, wall rests and pipe collars, all located as required to ensure a rigid installation.

2.8 SPECIAL SUPPORTS

- A. Pipe supports shall be provided for closely spaced vertical piping systems required to provide a rigid installation. The interval of vertical support spacing shall be as specified, but in no case shall vertical interval exceed 10-ft. The support system shall consist of a framework suitably anchored to floors, ceilings or roofs.
- B. Vertical and horizontal supporting members shall be U shaped channels similar to Unistrut, Series P1000. Vertical piping shall be secured to the horizontal members by pipe clamps or pipe straps. All components shall be of steel.
- C. For piping 3-in and smaller, the framework shall be as manufactured by the Unistrut Corporation; Globe-Strut as manufactured by the Metal Products Division of U.S. Gypsum or equal. For piping larger than 3-in, the support frame shall be fabricated from structural steel shapes and secured through the use of expansion anchors.
- D. The assemblies shall be furnished complete with all nuts, bolts and fittings required for a complete assembly including end caps for all unistruts members.
- E. The design of each individual framing system shall be the responsibility of the Contractor. Shop drawings, as specified above shall be submitted and shall show all details of the installation, including dimensions and types of supports. In all instances the completed frame shall be adequately braced to provide a complete rigid structure when all the piping has been attached.
- F. Supports not otherwise described in this Section shall be fabricated or constructed from standard structural steel shapes in accordance with applicable provisions of Section [05500] [05 50 00], or unistrut-type frame; have anchor hardware similar to items previously specified herein, shall meet the minimum requirements listed below and be subject to the approval of the Engineer.

1. Pipe support systems shall meet all requirements of this Section and all related Sections.
2. Complete design details of the pipe support system and system components shall be submitted for review and approval as specified in PART 1. No hanger or support shall be installed without the written approval of the Engineer.
3. The pipe support system shall not impose loads on the supporting structures in excess of the loads for which the supporting structure is designed.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Proceed with the installation of piping and supports only after any building structural work has been completed and new concrete has reached its 28-day compressive strength.
- B. The installation of pipe support systems shall in no way interfere with the operation of the overhead bridge cranes, monorails, access hatches, etc.
- C. The installed systems shall not interfere with maintenance and operational access to any equipment installed under this Section, or any other related Section.
- D. All pipes horizontal and vertical, requiring rigid support shall be supported from the building structure by approved methods. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or as specified herein. No piping shall be supported from metal stairs, ladders and walkways unless specifically directed or authorized by the Engineer.
- E. All pipe supports shall be designed with liberal strength and stiffness to support the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement and pressure forces, thermal expansion and contraction, vibrations and all probable externally applied forces. Prior to installation, all pipe supports shall be approved by the Engineer.
- F. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings and sleeve type couplings (within four pipe diameters) and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.
- G. Inserts for pipe hangers and supports shall be installed on forms before concrete is placed. Before setting these items, all Drawings and figures shall be checked which have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under this Section.

- H. Continuous metal inserts shall be embedded flush with the concrete surface.
- I. Apply anti-seize compound to all nuts and bolts. Supports installed without the approved compound shall be dismantled and correctly installed, at no additional cost to the Owner.

3.2 TESTING

- A. All pipe support systems shall be tested for compliance with this Section. After installation, each pipe support system shall be tested in conjunction with the respective piping pressure tests. If any part of the pipe support system proves to be defective or inadequate, it shall be repaired or augmented under this Section to the satisfaction of the Engineer.

END OF SECTION

SECTION 16000
ELECTRICAL - GENERAL PROVISIONS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install complete and make operational, electrical and process instrumentation systems at the Okaloosa County Arbennie Pritchett Water Reclamation Facility, as shown on the Drawings and as specified herein.
- B. The work shall include furnishing, installing and testing the equipment and materials specified in other Sections of the Division 16 Specifications and shown on the Drawings.
- C. The work shall include furnishing and installing the following:
 - 1. Electrical service from the Power Company.
 - 2. Conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions of these specifications.
 - 3. Conduit, wiring and terminations for all field-mounted instruments furnished under other Divisions of these specifications, including process instrumentation primary elements, transmitters, local indicators and control panels. Lightning and surge protection equipment wiring at process instrumentation transmitters. Install vendor furnished cables specified under other Divisions of these specifications.
 - 4. A complete raceway system for the Data Highway Cables and specialty cable systems. Install the Data Highway Cables and other specialty cable systems (furnished under Division 13) in accordance with the system manufacturers' installation instructions. Review the raceway layout, prior to installation, with the computer system supplier and the cable manufacturer to ensure raceway compatibility with the systems and materials being furnished. Where redundant cables are furnished, install cables in separate raceways.
 - 5. Conduit, wiring and terminations for variable frequency drives, harmonic filters, transformers and power factor correction capacitors furnished under other Divisions of these specifications.
 - 6. Power wiring for all heating, ventilating, and air conditioning (HVAC)

equipment furnished under other Divisions of these Specifications, including power wiring for 120V unit heater motors, thermostats, fan motors, dampers and other HVAC inline unit wiring shown on the Drawings.

7. Furnish and install precast manholes, precast handholes and light pole bases.
 8. Furnish and install manhole and handhole frames and covers.
 9. It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material and all work which may be reasonably implied as being incidental to the work of this Section shall be furnished at no extracost.
 10. Modifications to existing control systems including installation of auxiliary motor starter contacts, relays, switches, etc., as required to provide the control functions or inputs as shown on the Drawings. Obtain the existing equipment shop drawings from the Owner before attempting to make any modifications to the existing equipment wiring. Verify all existing wiring and connections for correctness. If record drawings are not available, trace all circuits in the field and develop the wiring diagrams necessary for completion of the work. Document all changes made to the wiring diagrams and return a marked-up set of Record Drawings to the Owner after the work is complete.
 11. Modifications to existing motor control centers, switchboards, panelboards and motor controllers including installation of circuit breakers, etc., or disconnection of circuits as required to provide the power supplies to new and existing equipment to maintain the facility in operation.
- D. All power interruptions to electrical equipment shall be at the Owner's convenience with 72 hours (minimum) notice. Each interruption shall have prior approval.
- E. The Contractor shall maintain existing facility in operation at all times. Temporary power connections as required shall be provided by the Contractor at no additional expense to the Owner. All temporary wiring shall be in accordance with the NEC. Any temporary equipment feeders (120V, 208V, 240V, 480V) shall be installed in conduit. The Contractor shall provide to the Engineer details, methods, materials etc. prior to making temporary connections. Furnish and install all equipment and materials including control equipment, motor starters, branch and feeder circuit breakers, panelboards, transformers, etc., for temporary power.
- F. Field verify all existing underground electrical conduit, concrete duct banks, manhole, pull boxes, etc. and mechanical piping. The Contractor shall include in his bid all cost associated with relocation or removal of underground equipment as required for construction of the new facilities.
- G. The Contractor shall prepare and furnish electrical and instrumentation conduit

layout shop drawings for yard electrical, within and under all roads, buildings and structures to the Engineer for approval prior to commencing work. Layouts shall include but not be limited to equipment, pull boxes, manholes, conduit routing, dimensioning, methods and locations of supports, reinforcing, encasement, materials, conduit sizing, equipment access, potential conflicts, building and yard lighting, and all other pertinent technical specifications for all electrical and instrumentation conduits and equipment to be furnished. All layouts shall be drawn to scale on 24 x 36 sheets. Refer to Division 16000, 1.03, H for additional requirements.

- H. The work shall include complete testing of all equipment and wiring at the completion of work and making any minor correction changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; substandard work will be rejected.
- I. A single manufacturer shall provide automatic transfer switches, motor control centers, transformers, disconnect switches, panel boards, etc. This manufacturer shall also provide a short circuit/coordination study as specified herein.
- J. Contractor shall provide their own temporary power for miscellaneous power (drills, pumps, etc.). No facility circuits shall be used unless approved in writing by the Engineer. Any temporary added shall be removed at job completion.
- K. Complete coordination with other contractors. Contractor shall coordinate with all other contractors' equipment submittals and obtain all relevant submittals.
- L. Mount control panels, transmitters, process instruments, operator's stations, etc. furnished under other Divisions of these specifications.
- M. Concrete electrical duct encasement, including but not limited to excavation, concrete, conduit, reinforcement, backfilling, grading and seeding is included in Division 16. All work shall be done in accordance with Divisions 2 and 3 of these specifications.
- N. Excavation, bedding material, forms, concrete and backfill for underground raceways; forms and concrete for electrical equipment furnished herein is included in Division 16. All work shall be done in accordance with Divisions 2 and 3 of these specifications.
- O. The contractor shall include in the base bid the following miscellaneous wiring, including installation costs. (Assume all conduit to be exposed at elevations up to 20 feet and include all necessary pullboxes, supports, etc.):
 - 1. 3,000 feet of 4 No. 12 - ¾ inch PVC coated galvanized rigid steel conduit
 - 2. 3,000 feet of 2 No. 14 - ¾ inch PVC coated galvanized rigid steel conduit

3. 1,000 feet of 2/C No. 16 shielded – ¾ inch PVC coated galvanized rigid steel conduit

1.2 RELATED WORK

- A. Excavation and backfilling, including gravel or sand bedding for underground electrical work is specified in Division 2.
- B. Cast in place concrete work, including concrete encasements for electrical duct banks, equipment pads, light pole bases and reinforcing steel, is specified in Division 3.

1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings for equipment, materials and other items furnished under Division 16.
- B. Shop drawings shall be submitted for the following equipment:
 1. Raceways, Boxes, Fittings and Hangers
 2. Wires and Cables
 3. Miscellaneous Equipment (as specified in Section 16191)
 4. Panelboards
 5. Motor Control Centers
 6. Automatic Transfer Switches
 7. Lighting Fixtures and Lamps
 8. Switches, Receptacles and Covers
 9. Lightning Protection System
 10. Precast Manholes and Handholes, Frames and Covers
 11. Grounding Hardware and Connections
 12. Heat Tracing
 13. Diesel Engine Driven Generators
 14. The Manufacturers name and product designation or catalog numbers shall

be submitted for the following material utilized:

15. Testing Equipment
 16. Ground System Resistance Test Equipment
- C. Check shop drawings for accuracy and contract requirements prior to submittal. Shop drawings shall be stamped with the date checked and a statement indicating that the shop drawings conform the Specifications and the Drawings. This statement shall also list all exceptions to the Specifications and the Drawings. Shop drawings not so checked and noted shall be returned.
 - D. The Engineer's check shall be for conformance with the design concept of the project and compliance with the Specifications and the Drawings. Errors and omissions on approved shop drawings shall not relieve the Contractor from the responsibility of providing materials and workmanship required by the Specifications and the Drawings.
 - E. All dimensions shall be field verified at the job site and coordinated with the work of all other trades.
 - F. Material shall not be ordered or shipped until the shop drawings have been approved. No material shall be ordered or shop work started if shop drawings are marked "APPROVED AS NOTED - CONFIRM", "APPROVED AS NOTED - RESUBMIT" or "NOT APPROVED".
 - G. In addition to Manufacturer's equipment shop drawings, submit electrical installation working drawings containing the following:
 1. Concealed and buried conduit layouts, shown on floor plans drawn at not less than 1/4-in = 1-ft-0-in scale. The layouts shall include locations of process equipment, motor control centers, transformers, panelboards, control panels and equipment, motors, switches, motor starters, large junction or pull boxes, instruments and any other electrical devices connected to concealed or buried conduits.
 2. Plans shall be drawn on high quality reproducible, double sided mylar, size 36-in by 24-in and shall be presented in a neat, professional manner.
 3. Concrete floors and/or walls containing concealed conduits shall not be poured until conduit layouts are approved.
 4. Layout drawings shall be drawn utilizing approved equipment submittals.
 - H. Operation and Maintenance Data
 1. Submit operations and maintenance data for equipment furnished under this

Division, in accordance with Section 01730. The manuals shall be prepared specifically for this installation and shall include catalog data sheets, drawings, equipment lists, descriptions, parts lists, etc., to instruct operating and maintenance personnel unfamiliar with such equipment.

2. Manuals shall include the following as a minimum:
 - a. A comprehensive index.
 - b. A complete "As-Built" set of approved shop drawings.
 - c. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.
 - d. A table listing of the "as left" settings for all timing relays and alarm and trip setpoints.
 - e. System schematic drawings "As-Built", illustrating all components, piping and electric connections of the systems supplied under this Section.
 - f. Detailed service, maintenance and operation instructions for each item supplied.
 - g. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
 - h. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.
 - i. Complete parts list with stock numbers, including spare parts.

1.4 REFERENCE STANDARDS

- A. Electric equipment, materials and installation shall comply with the latest edition of National Electrical Code (NEC) and with the latest edition of the following codes and standards:
 1. National Electrical Safety Code (NESC)
 2. Occupational Safety and Health Administration (OSHA)
 3. National Fire Protection Association (NFPA)
 4. National Electrical Manufacturers Association (NEMA)
 5. American National Standards Institute (ANSI)
 6. Insulated Cable Engineers Association (ICEA)
 7. Instrument Society of America (ISA)
 8. Underwriters Laboratories (UL)
 9. Factory Mutual (FM)

10. International Electrical Testing Association (NETA)

11. Institute of Electrical and Electronic Engineers (IEEE)

- B. All electrical equipment and materials shall be listed by Underwriter's Laboratories, Inc., and shall bear the appropriate UL listing mark or classification marking. Equipment, materials, etc. utilized not bearing a UL certification shall be field or factory UL certified prior to equipment acceptance and use.
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 PRIORITY OF THE CONTRACT DOCUMENTS

- A. If, during the performance of the work, the Contractor finds a conflict, error or discrepancy between or among one or more of the Sections or between or among one or more Sections and the Drawings, furnish the higher performance requirements. The higher performance requirement shall be considered the equipment, material, device or installation method which represents the most stringent option, the highest quality or the largest quantity.
- B. In all cases, figured dimensions shall govern over scaled dimensions, but work not dimensioned shall be as directed by the Engineer and work not particularly shown, identified, sized, or located shall be the same as similar work that is shown or specified.
- C. Detailed Drawings shall govern over general drawings, larger scale Drawings take precedence over smaller scale Drawings, Change Order Drawings shall govern over Contract Drawings and Contract Drawings shall govern over Shop Drawings.
- D. If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or association, the provisions of the Contract Documents will take precedence if they are more stringent or presumptively cause a higher level of performance. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization or association, or between Laws and Regulations, the higher performance requirement shall be binding on the Contractor, unless otherwise directed by the Engineer.
- E. In accordance with the intent of the Contract Documents, the Contractor accepts the fact that compliance with the priority order specified shall not justify an increase in Contract Price or an extension in Contract Time nor limit in any way, the Contractor's responsibility to comply with all Laws and Regulations at all times.

1.6 ENCLOSURE TYPES

- A. Unless otherwise specified herein or shown on the Drawings, electrical enclosures shall have the following ratings:
1. NEMA 1 for dry, non-process indoor locations.
 2. NEMA 12 for "DUST" locations.
 3. NEMA 4X for outdoor locations, rooms below grade (including basements and buried vaults), "DAMP" and "WET" locations.
 4. NEMA 4X for "CORROSIVE" locations.
 5. NEMA 7 (and listed for use in the area classifications shown) for "Class I Division 1 Group D", "Class I Division 2 Group D" and "Class II Division 1" hazardous locations shown on the Drawings.

1.7 SERVICE AND METERING

- A. The power company serving this project is Gulf Power. One (1) service will be obtained at 480 Volts, 3 Phase, 4 Wire, 60 Hz, grounded wye to the service entrance equipment as shown on the drawings. Pay all fees and charges as required to obtain temporary and permanent services. Coordinate with Gulf Power to provide and meet requirements for these services.
- B. Furnish and install the primary conduits as required and secondary service conduit, wire, bus duct, connectors, etc. to extend the services to the main switchgear locations.
- C. The Contractor shall be responsible for the following work:
1. Obtain an estimate from the power company for the work described in Paragraph 1.07B above and include the cost of the power company work in the Bid Price.
 2. Make all arrangements with the power company for obtaining electrical service, pay all power company charges and furnish all labor and material required for the electrical service.
 3. Furnishing and installing the primary conduits and cables.
 4. Furnishing and installing the transformer pad and grounding.
 5. Furnishing and installing the transformer.
 6. Termination of underground primary cables at the riser pole.
 7. Termination of underground primary cables at the transformer.

8. Furnishing secondary conduits and cables.
 9. Furnishing and installing a power company approved metering current transformer enclosure.
 10. Installing meter base.
 11. Furnishing and installing an empty conduit with pull line from the metering C.T. enclosure to the meter enclosure. Conduit size and type shall be approved by the power company.
- D. Submit shop drawings for the following items to the Engineer and Power Company for approval:
1. Meter base.
 2. Primary cable.
 3. Metering instrument and installation.
- 1.8 HAZARDOUS AREAS
- A. Equipment, materials and installation in areas designated as hazardous on the Drawings shall comply with NEC Articles 500, 501, 502 and 503.
 - B. Equipment and materials installed in hazardous areas shall be UL listed for the appropriate hazardous area classification.
- 1.9 CODES, INSPECTION AND FEES
- A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction.
 - B. Obtain all necessary permits and pay all fees required for permits and inspections.
- 1.10 TESTS AND SETTINGS
- A. Test systems and equipment furnished under Division 16 and repair or replace all defective work and equipment. Refer to the individual equipment sections for additional specific testing requirements.
 - B. Make adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.
 - C. In addition to the specific testing requirements listed in the individual Sections, the following minimum tests and settings shall be performed. Submit test reports

upon completion of testing in accordance with Section 01300.

1. Mechanical inspection, testing and settings of circuit breakers, disconnect switches, motor starters, overload relays, control circuits and equipment for proper operation.
2. Check the full load current draw of each motor. Where power factor correction capacitors are provided the capacitor shall be in the circuit at the time of the measurement. Check ampere rating of thermal overloads for motors and submit a typed record to the Engineer of the same, including MCC cubicle location and driven load designation, motor service factor, horsepower, and Code letter. If incorrect thermal overloads are installed replace same with the correct size overload.
3. Check power and control power fuse ratings. Replace fuses if they are found to be of the incorrect size.
4. Check settings of the motor circuit protectors. Adjust settings to lowest setting that will allow the motor to be started when under load conditions.
5. Check motor nameplates for correct phase and voltage. Check bearings for proper lubrication.
6. Check rotation of motors prior to testing the driven load. Disconnect the driven equipment if damage could occur due to wrong rotation. If the rotation is incorrect for the driven equipment correct motor connections at the motor terminal box.
7. Check interlocking, control and instrument wiring for each system and/or part of a system to prove that the system will function properly as indicated by control schematic and wiring diagrams.
8. Inspect each piece of equipment in areas designated as HAZARDOUS to ensure that equipment of proper rating is installed.
9. Verify all terminations at transformers, equipment, panels and enclosures by producing a 1, 2, 3 rotation on a phase sequenced motor when connected to "A", "B" and "C" phases.
10. Check all wire and cable terminations. Verify to the Engineer connections meet the equipment's torque requirements.
11. Field set all transformer taps as required to obtain the proper secondary voltage.
12. Infra-red hot spot inspection shall be made of all electrical equipment including but not limited to switchgear, motor control centers, transformers, switches, power and control panels, etc. This shall be done under representative load

conditions before the equipment is used by the Owner and again 3 months before expiration of the 1-year warranty period.

- D. Testing shall be scheduled and coordinated in writing with the Engineer at least 2 weeks in advance. Provide qualified test personnel, instruments and test equipment. Provide certified calibration sheets including dates for all equipment to be used for testing with notice of scheduled testing. Calibration sheets shall also indicate that the units have been calibrated within six months of the testing date. The Contractor shall have qualified personnel present during the testing.
- E. Test systems and equipment furnished under Division 16 and repair or replace all defective work and equipment. Refer to the individual equipment sections for additional specific testing requirements. Employ the services of an independent recognized power systems testing company, other than the Manufacturer of the switchgear or motor control centers, to perform the tests specified herein.
- F. Field testing and commissioning shall be performed in accordance with the latest revisions of NETA Standard ATS "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" unless otherwise modified by these Sections.
- G. A typed test report for each component tested shall be submitted to the Engineer for the project record files. The firm doing the testing shall include, in the report, their opinion whether or not the equipment being tested complies with the specification. Any discrepancies shall be noted in the concluding summary of the report. Test report forms shall be in compliance with NETA standards. A minimum of three complete copies shall be provided. Reports shall be signed by the person in responsible charge of the field testing, an officer of the firm performing the tests and an officer of the Electrical Contractor.
- H. Make adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.
- I. Make the following minimum tests and checks prior to energizing electrical equipment. Submit test reports upon completion in accordance with Section 01300.
 - 1. Test and calibrate protective relays and circuit breakers.
 - 2. Mechanical inspection of air interrupter switches and circuit breakers to assure proper operation.

1.11 PROTECTIVE DEVICES COORDINATION STUDY

A. General:

- 1. The major electrical equipment manufacturer (i.e. automatic transfer switches, motor control centers, panelboards, etc.) shall provide a

computerized Power System Study for the electrical power distribution and motor control equipment. The study shall verify adequacy of all of the existing equipment as well as new additions being implemented under these Specifications.

2. The study shall also include the utility company's protective devices, the emergency generators, the automatic transfer switches, all feeders from the automatic transfer switches, all distribution and all associated MCC's. Graphic indication of coordination shall be furnished in the form of a clearly labeled and identified composite drawing showing time-current curves of system protective devices. Time-current curves of each device shall also be furnished.
3. The Contractor/Manufacturer shall be responsible for obtaining and verifying with the Power Company in writing all information needed to conduct this study. Provide this correspondence and information including contacts and phone numbers with the study submittal.
4. The Contractor shall set all protective devices and relays based on this coordination study to provide coordinated, selective protection for all equipment supplied or affected by the installation under this Contract.
5. The Contractor/Manufacturer shall provide data necessary to perform the study. This includes feeder cable sizes, approximate feeder length, motor data, switchgear data, existing protective relay settings and any other information relevant to the study.
6. A summary of the short circuit analysis shall be provided to the Contractor at the time shop drawings for all of the new equipment is submitted for approval.
7. The Manufacturer shall be made aware that there is no available up-to-date single line diagram for the existing facilities. The Contractor/Manufacturer shall provide and/or update the existing single line diagram as required in order to perform the coordination and short-circuit study.

B. Scope

1. The short circuit study shall be in accordance with ANSI Standard C37.010 and C37.13, shall be performed to check the adequacy, and to verify the correct application of circuit protective devices and other system components specified. The study shall address the case when the system is being powered from the normal source as well as from the on-site generating facilities. Minimum as well as maximum possible fault conditions shall be adequately covered in the study.
2. Fault contribution of all motors shall be considered. The Contractor shall be responsible for obtaining all required data of equipment. All back-up calculations shall become part of the final report. The Calculations shall be in sufficient detail to allow easy review.

C. Contents:

1. The study shall include representation of the power company's systems, the base quantities selected, impedance source-data, calculation methods and tabulations, one-line and impedance diagrams, conclusions and recommendations. Short circuit momentary duties, shall be calculated on the basis of an assumed bolted three-phase short circuit at each medium voltage bus, low voltage switchboard bus, switchboards, motor control centers, distribution panelboards, pertinent branch circuit panelboards, and other significant locations through the systems. The short-circuit tabulations shall include significant X to R ratios, asymmetry factors, KVA, and symmetrical fault current.
2. A protective device time current coordination study shall be included with coordination plots of key and/or limiting devices, tabulated data, rating, and/or settings selected. The study shall present an engineering balance between the competing objectives of protection and continuity of service for the system specified, taking into account the basic factors of sensitivity, selectivity and speed.
3. Separate plots shall be provided for each mode of "normal" and "stand-by" operation. Maximum fault values shall be shown in each case. Both power sources shown in one plot will not be accepted.
4. Existing protective device settings shall be reviewed to ensure selectivity under the new conditions. Recommended changes shall be indicated in the report. The Contractor shall be made aware of required changes immediately.
5. Transformer damage curves in accordance with ANSIC57.109.
6. Feeder cable damage curves.
7. Required settings for breakers and relays shall be maximized to provide the most effective protection possible whether the system is fed from the normal or emergency source.
8. Tabulations indicating recommended set points for all protective devices shall be provided. This shall include the normal as well as the emergency source.
9. Generator short circuit decrement curves and thermal limit curves shall be included.

D. Motor Current-Time Characteristic Curves:

1. A complete independent set of current-time characteristic curves for all medium voltage motor drives indicating coordination between the protective

relays and the thermal characteristics of the motor shall be provided.

2. The Contractor shall obtain from the motor supplier, the necessary information to perform the study. Certified curves for "safe time versus current at 100 percent voltage" and "accelerating time versus current at 100 percent voltage" shall become part of the final report.
- E. Motor Starting Study:
1. A motor starting study for all large electric drives (100 horsepower and above) to determine voltage dip or power inrush limitations at selected locations due to starting of motors shall be provided. This applies to both the normal and the emergency mode.
- F. General Information for Time-Current Curves Presentations:
1. The coordination plots shall include complete titles, representative one-line diagrams, legends, associated power company's relay or system characteristics, significant motor starting characteristics, complete parameters for power, and substation transformers, and complete operating bands for low-voltage circuit breaker trip devices.
 2. The coordination plots shall define the types of protective devices selected, together with the proposed coil taps, time-dial settings and pick-up settings required.
 3. The short-time region shall indicate the medium voltage relay instantaneous elements, the magnetizing in-rush, and ANSI withstand transformer parameters, the low-voltage circuit breaker instantaneous trip devices, fuse manufacturing to tolerance bands, and significant symmetrical and asymmetrical fault currents.
 4. Each primary protective device required for a delta-to-wye connected transformer shall be selected so that the characteristic or operating band is within the transformer parameters; which, where feasible, shall include a parameter equivalent to 58 percent of the ANSI withstand point to afford protection for secondary line-to-ground faults.
 5. Low-voltage power circuit breakers shall be separated from each other and the associated primary protective device, where feasible, by a 16 percent current margin for coordination and protection in the event of secondary line-to-line faults.
 6. Protective relays shall be separated, where feasible, by a 0.3 second time margin when the maximum three-phase fault flows, to assure proper selectivity.

- G. Generator(s) Protective Devices:
1. The study shall address all of the new and existing protective devices provided for generator protection.
 2. Protective relays requiring settings shall include, but not necessarily limited to:
 - a. Differential
 - b. Overcurrent with voltage restraint
 - c. Ground
 - d. Undervoltage
 - e. Reverse power
 - f. Unbalanced loading and open phase
 - g. Loss of excitation
 3. Contractor shall obtain all necessary new and existing generator information to perform this study.
- H. The coordination study shall be bound in a standard 8-1/2" x 11" size report and submitted in accordance with Section 01300. The final selection of all protective devices shall be based on a preliminary draft of the coordination study which shall be submitted with the equipment shop drawings for review. The completed study shall be submitted to and approved by the Engineer before any of the equipment is shipped. All protective devices shall be adjusted, tested, and calibrated in the field, prior to energizing the equipment, per the settings listed in the study. This work shall be performed by the Manufacturer as described in this section and prior to final acceptance by the Owner.
- I. All protective devices, existing and new shall be calibrated and tested as recommended by and under the supervision of the distribution gear manufacturer's representative as specified in this section.
- J. The coordination study shall be stamped and signed by a professional engineer registered in the state in which the equipment is to be installed.

1.12 INTERPRETATION OF DRAWINGS

- A. The Drawings are not intended to show exact locations of conduit runs. Coordinate the conduit installation with other trades and the actual supplied equipment.
- B. Install each 3 phase circuit in a separate conduit unless otherwise shown on the Drawings.
- C. Install circuits in individual conduits (i.e., no combining of circuits will be permitted unless otherwise shown) as shown on the drawings.
- D. Unless otherwise approved by the Engineer, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.

- E. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.
- F. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation. Any adjustments required in the field shall be provided at no additional cost to the Owner and coordinated and approved by the Engineer.
- G. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the Contractor and approved by the Engineer during construction. Obtain information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.
- H. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the approved equipment at no additional cost to the Owner.
- I. Redesign of electrical or mechanical work, which is required due to the Contractor's use of an alternate item, arrangement of equipment and/or layout other than specified herein, shall be done by the Contractor at his/her own expense. Redesign and detailed plans shall be submitted to the Engineer for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.
- J. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by 1/4-inch spacers to provide a clearance between wall and equipment.
- K. All floor mounted electrical equipment shall be placed on 4-inch thick (3/4-inch, 45-degree chamfer at all exposed edges) concrete pads, provide reinforcement, anchors, etc.
- L. The Contractor shall harmonize the work of the different trades so that interferences between conduits, piping, equipment, architectural and structural work will be avoided. All necessary offsets shall be furnished so as to take up a minimum space and all such offsets, fittings, etc., required to accomplish this shall be furnished and installed by the Contractor without additional expense to the Owner. In case interference develops, the Engineer is to decide which equipment, piping, etc., must be relocated, regardless of which was installed first.
- M. Raceways and conductors for the fire alarm, security system and lightning protection

system are not shown on the Drawings. Provide raceways and conductors as required by the system manufacturer for a complete and operating system. Raceways shall be installed concealed in all finished spaces and may be installed exposed or conducted in process spaces.

- N. Raceways and conductors for miscellaneous low voltage power and signal systems as specified are not shown on the Drawings. Raceways and conductors shall be provided as required for a complete and operating system. Homeruns, as shown on the Drawings, are to assist the Contractor in identifying raceways to be run exposed and raceways to be run concealed. Raceways shall be installed concealed in all finished spaces. Raceways installed exposed shall be near the ceiling or along walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes hoists, monorails, equipment hatches, doors, windows, etc. Raceways installed concealed shall be run in the center of concrete floor slabs, above suspended ceilings, or in partitions as required.

1.13 PHASE BALANCING

- A. The Drawings do not attempt to balance the electrical loads across the phases. Circuits on motor control centers and panelboards shall be field connected to result in evenly balanced loads across all phases.
- B. Field balancing of circuits shall not alter the conductor color coding requirements as specified in Section 16120.

1.14 SIZE OF EQUIPMENT

- A. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the Manufacturer to permit safe handling and passage through restricted areas in the structure.
- B. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.

1.15 RECORD DRAWINGS

- A. As the work progresses, legibly record all field changes on a set of Project Contract Drawings, hereinafter called the "Record Drawings".
- B. Record Drawings shall accurately show the installed condition of the following items:
 - 1. One-line Diagram(s).
 - 2. Equipment elevations (front views).

3. Raceways and pullboxes.
 4. Conductor sizes and conduit fills.
 5. Panel Schedule(s).
 6. Control Wiring Diagram(s).
 7. Lighting Fixture Schedule(s).
 8. Lighting fixture, receptacle and switch outlet locations.
 9. Underground raceway and duct bank routing.
 10. Plan view, sizes and locations of switchgear, distribution transformers, substations, motor control centers and panelboards.
- C. Submit a schedule of control wiring raceways and wire numbers, including the following information:
1. Circuit origin, destination and wire numbers.
 2. Field wiring terminal strip names and numbers.
- D. In addition to the schedule, provide point-to-point connection diagrams showing the same information submitted in the schedule of control wiring raceways including all designations and wire numbers.
- E. Submit the record drawings, schedule of control wiring raceways and wire numbers and the point-to-point connection diagrams to the Engineer. The schedule of control wiring raceways and wire numbers and the point-to-point connection diagrams shall be computer generated (i.e. no hand-written or drawn schedules, drawings, or diagrams will be accepted).

1.16 EQUIPMENT INTERCONNECTIONS

- A. Review shop drawings of equipment furnished under other Divisions and prepare coordinated wiring interconnection diagrams or wiring tables. Submit copies of wiring diagrams or tables with the Record Drawings.
- B. Furnish and install all equipment interconnections.

1.17 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be new, except where specifically identified on the Drawings to be re-used.

- B. Material and equipment of the same type shall be the product of one manufacturer and shall be UL listed.
- C. Warrant all equipment furnished under Division 16 in accordance with Section 01740. Refer to individual equipment sections for additional warranty items.

1.18 EQUIPMENT IDENTIFICATION

- A. Identify equipment (disconnect switches, separately mounted motor starters, control stations, etc.) furnished under Division 16 with the name of the equipment it serves. Motor control centers, control panels, panelboards, switchboards, switchgear, junction or terminal boxes, transfer switches, etc., shall have nameplate designations as shown on the Drawings.
- B. Nameplates shall be engraved, laminated plastic, not less than 1/16-in thick by 3/4-in by 2-1/2- in with 3/16-in high white letters on a black background.
- C. Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive. Two-sided foam adhesive tape is not acceptable. Where the equipment size does not have space for mounting a nameplate, the nameplate shall be permanently fastened to the adjacent mounting surface. Cemented nameplates shall not be drilled.
- D. All voltages (e.g. 480 volts, 120 volts etc.) within pull boxes, junction boxes etc. shall be identified on the front exterior cover. Signs shall be red background with white engraved lettering, lettering shall be a minimum of 1" high.
- E. All receptacles, wall switches, lighting fixtures, photo cells, emergency lights, exit lights, etc., shall be identified with the lighting circuit to which it is connected.

1.19 SAFETY REQUIREMENTS

- A. The Contractor shall make every effort to keep all employees and/or subcontractors aware of the danger inherent in working in dangerous proximity to the existing power lines. The minimum recommended precautionary measures are as follows:
 - 1. Make sure that all persons responsible for operating cranes, draglines and other mobile equipment have a copy of, and are familiar with the State Department of Commerce Regulations for Use of Cranes, Draglines and Similar Equipment Near Power Lines, as well as the U.S. Department of Labor OSHA Regulations, before commencing operation of said equipment.
 - 2. Make sure that all cranes, draglines and other mobile equipment have attached to them the black and yellow Department of Commerce warning signs required by the said Regulations of State Department of Commerce.

3. Warn all employees on the ground, new and old employees alike, of the danger of holding on to or touching a cable or other piece of equipment or machinery that is located or working close to any overhead power line.
4. If, during the course of construction, it becomes necessary for the contractor, or subcontractor, and their employees, to operate cranes, draglines, or their mobile equipment, in dangerous proximity of any overhead power lines, or in such a manner that such equipment might come close to any overhead power lines, the Contractor shall give the Power Company or overhead power line owner prior notice of such proposed operation.

1.20 DEMOLITION

- A. Remove electrical work associated with equipment scheduled for demolition except those portions indicated to remain or be reused.
- B. Remove unused exposed conduit and wiring back to point of concealment including abandoned conduit above accessible ceiling finishes. Remove unused wiring in concealed conduits back to source (or nearest point of usage).
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide stainless steel blank covers for abandoned outlets which are not removed.
- D. Disconnect and remove abandoned panelboards, transformers, disconnect switches, control stations, distribution equipment, etc.
- E. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers and other accessories.
- F. Disconnect electrical circuits in the way of demolition work and re-establish circuits to remaining outlets, fixtures, equipment, etc. Disconnect electrical systems in walls, floors and ceilings scheduled for removal.
- G. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- H. New lighting shall be in place or safe lighting levels maintained for plant operation during the construction period.
- I. Repair adjacent construction and finishes damaged during demolition and extension work.
- J. Where electrical systems pass through the demolition areas to serve other portions of the premises, they shall remain or be suitably relocated, and the system restored to normal operation.

- K. Coordinate outages in systems with the Owner. Where duration of proposed outage cannot be allowed by the Owner, provide temporary connections as required to maintain service.
- L. Removal and relocation of existing conduit, wire and equipment have not been detailed on the Drawings. Survey the affected areas before submitting bid proposal.
- M. Trace out existing wiring that is to be relocated or removed and perform the relocation or removal work as required for a complete operating and safe system.
- N. Continuous service is required on all circuits and outlets affected by these changes, except where the Owner will permit an outage for a specific time. Obtain Owner's consent before removing any circuit from continuous service.
- O. Remove exposed conduits, wireways, outlet boxes, pull boxes and hangers made obsolete by the alterations, unless specifically designated to remain. Patch surfaces and provide stainless steel blank covers for abandoned outlets which are removed.
- P. All equipment, materials, controls, motor starters, branch and feeder breakers, panelboards, transformers, wiring, raceways, etc., furnished and installed to temporarily keep circuits energized shall be removed when the permanent installation is fully operational.
- Q. Electrical Removal
 - 1. All existing electrical equipment and fixtures to be removed shall be removed with such care as may be required to prevent unnecessary damage, to keep existing systems in operation and to maintain the integrity of the groundingsystems.
 - 2. Conduits and wires shall be abandoned or removed where shown. All wires in abandoned conduits shall be removed, salvaged and stored. Abandoned conduits concealed in floor or ceiling slabs or in walls, shall be cut flush with the slab or wall at the point of entrance. The conduits shall be suitably plugged, and the area repaired in a flush, smooth and approved manner. Exposed conduits and their supports shall be disassembled and removed from the site. Repair all areas of work to prevent rust spots on exposed surfaces.
 - 3. Wall switches, receptacles, and other miscellaneous electrical equipment shall be removed and disposed of off the site as required. Care shall be taken in removing all equipment so as to minimize damage to architectural and structural members. Any damage incurred shall be repaired.

1.21 DISPOSITION OF REMOVED MATERIALS AND EQUIPMENT

- A. In general, it is intended that material and equipment indicated to be removed and disposed of by the Contractor shall, upon removal, become the Contractor's property and shall be disposed of off the site by the Contractor, unless otherwise directed by the Owner. Any fees or charges incurred for disposal of such equipment or materials shall be paid by the Contractor. A receipt showing acceptable disposal of any legally regulated materials or equipment shall be given to the Owner.
- B. Ballasts in each existing lighting fixture shall be assumed to contain PCB's unless specifically marked with a label indicating "No PCBs". Remove ballasts from each lighting fixture and pack them in accordance with EPA PCB regulations. Ship ballasts in approved containers to an EPA approved recycling facility and pay all shipping, packaging and recycle costs.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 SLEEVES AND FORMS FOR OPENINGS

- A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.
- B. Exact locations are required for stubbing-up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors or other subcontractors and locate the concealed conduit before the floor slab is poured.
- C. Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the Engineer may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.
- D. Seal all openings, sleeves, penetration and slots as specified in Section 16110.

3.2 CUTTING AND PATCHING

- A. Cutting and patching shall be done in a thoroughly workmanlike manner and be in compliance with modifications and repair to concrete as specified in Section 03350. Sawcut concrete and masonry prior to breaking out sections.
- B. Core drill holes in existing concrete floors and walls as required.
- C. Install work at such time as to require the minimum amount of cutting and patching.
- D. Do not cut joists, beams, girders, columns or any other structural members.

- E. Cut opening only large enough to allow easy installation of the conduit.
- F. Patching to be of the same kind and quality of material as was removed.
- G. The completed patching work shall restore the surface to its original appearance or better.
- H. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.
- I. Remove rubble and excess patching materials from the premises.
- J. When existing conduits are cut at the floor line or wall line, they shall be filled with grout of suitable patching material.

3.3 INSTALLATION

- A. Any work not installed according to the Drawings and this Division or without approval by the Engineer shall be subject to change as directed by the Engineer. No extra compensation will be allowed for making these changes.
- B. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors. Electrical equipment shall be stored in dry permanent shelters. If an apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be replaced at no additional cost to the Owner, the damaged unit(s) or systems shall remain on site and returned to the Manufacturer after the replacement unit(s) or systems have been delivered to the site. Under no circumstances will electrical equipment damaged by water be rehabilitated or repaired, new equipment shall be supplied and all cost associated with replacement shall be borne by the Contractor.
- C. Equipment that has been damaged shall be replaced or repaired by the equipment manufacturer, at the Engineer's discretion.
- D. Repaint any damage to factory applied paint finish using touch-up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted per the field painting requirements Section 09902, at no additional cost to the Owner.

3.4 MANUFACTURERS SERVICE

- A. Provide Manufacturer's services for testing and start-up of the following equipment:
 - 1. 480 Volt Motor Control Centers (1 day, 1 trip minimum)
 - 2. Filter Control Panels (1 day, 1 trip minimum)

3. Field Instruments (1 day, 1 trip per manufacturer minimum)
 4. Chlorine Feed System (1 day, 1 trip minimum)
- B. Testing and startup shall not be combined with training. Testing and start-up time shall not be used for Manufacturers warranty repairs.
- C. The Manufacturers of the above listed equipment shall provide experienced Field Service Engineer to accomplish the following tasks:
1. The equipment shall be visually inspected upon completion of installation and prior to energization to assure that wiring is correct, interconnection complete and the installation is in compliance with the Manufacturer's criteria. Documentation shall be reviewed to assure that all Drawings, operation and maintenance manuals, parts list and other data required to check out and sustain equipment operation is available on-site. Documentation shall be red-lined to reflect any changes or modifications made during the installation so that the "as-built" equipment configuration will be correctly defined. Spare parts shall be inventoried to assure correct type and quantity.
 2. The Field Service Engineers shall provide engineering support during the energization and check-out of each major equipment assembly. They shall perform any calibration or adjustment required for the equipment to meet the Manufacturer's performance specifications.
 3. Upon satisfactory completion of equipment test, they shall provide engineering support of system tests to be performed in accordance with Manufacturer's test specifications.
 4. A final report shall be written and submitted to the Contractor within fourteen days from completion of final system testing. The report shall document the inspection and test activity, define any open problems and recommend remedial action. The reports after review by the Contractor shall be submitted to the Engineer.

3.5 TRAINING

- A. Provide Manufacturer's services for training of plant personnel in operation and maintenance of the equipment specified under Division 16.
1. 480 Volt Motor Control Centers (1 day 1 trip minimum)
 2. Filter Control Panels (1 day, 1 trip minimum)
 3. Field Instruments (1 day, 1 trip per manufacturer minimum)
 4. Chlorine Feed System (1 day, 1 trip minimum)
- B. The cost of training programs to be conducted with Owner's personnel shall be included in the Contract Price. The training and instruction, insofar as practicable,

shall be directly related to the system being supplied.

- C. Provide detailed O&M manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.
- D. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance including trouble-shooting of each system.
- E. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule. The training shall be conducted with record "as-built" drawings sufficient for a class of eight personnel.
- F. Within 120 days of contract award to the Contractor, submit an overview of the proposed training plan. This overview shall include, for each course proposed:
 - 1. An overview of the training plan.
 - 2. Course title and objectives.
 - 3. Prerequisite training and experience of attendees.
 - 4. Recommended types of attendees.
 - 5. Course Content - A topical outline.
 - 6. Course Duration.
 - 7. Course Location - Training center or jobsite.
 - 8. Course Format - Lecture, laboratory demonstration, etc.
 - 9. Schedule of training courses including dates, duration and locations of each class.
 - 10. Resumes of the instructors who will actually implement the plan.
- G. The Engineer will review the training plan submittal with the Owner.

3.6 POWER SYSTEM POWER

- A. Provide a complete system short circuit and selective coordination study as specified herein.

END OF SECTION

SECTION 16110
RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish and install complete raceway systems as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Refer to Section 16600 for additional requirements.

1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, the manufacturers' names and product designation or catalog numbers with cut-sheets of all materials specified. Indicate in the submittal, the areas where specific materials are used.

PART 2 PRODUCTS

2.1 MATERIALS

A. PVC Coated Rigid Steel Conduit

- 1. PVC coated rigid steel conduit shall have a minimum 0.040-in thick, black polyvinyl chloride coating permanently bonded to hot-dipped galvanized steel conduit and an internal chemically cured urethane or enamel coating. The ends of all couplings, fittings, etc., shall have a minimum of one pipe diameter in length of PVC overlap. PVC conduit and fittings shall be manufactured by Occidental Coating Company; "Plasti-Bond Red" as manufactured by Robroy Industries; Triangle PWC Inc. or equal.
- 2. Rigid steel conduit shall be for use under the provisions of NEC Article 344.

B. Electrical Metallic Tubing

- 1. Electrical metallic tubing shall be hot-dipped galvanized steel as manufactured by the Allied Tube and Conduit Corp.; Triangle PWC Inc.; Wheatland Tube Co.; Bridgeport or equal.
- 2. Electrical metallic tubing shall be for use under the provisions of NEC Article 358.

C. Rigid Nonmetallic Conduit

RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

1. PVC conduit shall be rigid polyvinyl chloride schedule 40 as manufactured by Carlon; An Indian Head Co.; Cantex; Queen City Plastics or equal.
2. PVC conduit used in underground concrete encased duct banks shall be rigid polyvinyl chloride Schedule 40 as manufactured by Carlon; An Indian Head Co.; Cantex; Queen City Plastics or equal.
3. PVC conduit shall be for use under the provisions of NEC Article 352.

D. Liquidtight Flexible Metal Conduit, Couplings and Fittings

1. Liquidtight flexible metal conduit shall be Sealtite, Type UA, manufactured by the Anaconda Metal Hose Div.; Anaconda American Brass Co.; American Flexible Conduit Co., Inc.; Universal Metal Hose Co. or equal.
2. Fittings used with liquidtight flexible metal conduit shall be of the 3-piece screw-in type malleable iron as manufactured by the O.Z. Gedney Co. or equal.
3. Liquidtight flexible metal conduit shall be for use under the provisions of NEC Article 350.

E. Flexible Metallic Tubing

1. Flexible metallic tubing shall be for use under the provisions of NEC Article 360.
2. Flexible metallic tubing shall be hot-dipped galvanized steel strips shaped into interlocking convolutions firmly joined to one another assuring a complete lock similar to Tristeel as manufactured by Triangle - PWC, Inc. or equal.
3. Flexible metallic tubing shall be used only indoors for connection to lighting fixtures in NEMA 1 administration and office areas.
4. Furnish and install insulated bushings at terminations for conductor protection.

F. Flexible Couplings

1. Flexible couplings shall be type ECGJH as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; Killark Electric Manufacturing Co. or equal.

G. Boxes and Fittings

1. Pressed steel switch and outlet boxes shall be hot-dipped galvanized with hot-dipped galvanized tile rings as manufactured by the Racor

RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

Manufacturing Co.; Adalet Co.; O.Z. Manufacturing Co. or equal.

2. NEMA 1 and NEMA 12, junction boxes, pull boxes etc., shall be sheet steel unless otherwise shown on the Drawings. Boxes shall be galvanized and have continuously welded seams. Welds shall be ground smooth and galvanized. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be gasketed and fastened with stainless steel screws. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets (refer to Section 16191 for additional requirements). Boxes shall be as manufactured by Hoffman Engineering Co.; Lee Products Co.; ASCO Electrical Products Co., Inc., or equal. All boxes shall be shop primed and painted by the box manufacturer.
3. NEMA 4X stainless steel, junction boxes and pull boxes shall be 316 stainless steel with 316 stainless steel hardware and gasketed covers. Boxes shall have continuously welded seams and welds shall be ground smooth. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be gasketed and fastened with stainless steel screws. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets (refer to Section 16191 for additional requirements.) Boxes shall be as manufactured by Hoffman Engineering Co.; Lee Products Co.; ASCO Electrical Products Co., Inc., or equal.
4. Explosion-proof boxes shall be designed for Class 1, Group D, Division 1 hazardous locations. They shall be cast iron with cadmium-zinc or hot-dipped galvanized finish, stainless steel hardware and bolts; Type EJB as manufactured by the Crouse-Hinds Company; Appleton Electric Co.; The Pyle-National Co. or equal.
5. Cast malleable iron device boxes shall be Type FD. All cast malleable iron boxes and fittings shall be PVC coated with PVC coated cast covers and stainless steel screws as manufactured by the Crouse-Hinds Co. or equal.
6. Cast malleable iron fittings (C's, T's, LB's, etc.) shall be PVC coated and of the mogul design (with rollers) as manufactured by Appleton Electric Co.
7. All boxes and fittings used with PVC coated conduit shall be furnished with a PVC coating bonded to the metal, the same thickness and color as used on the coated steel conduit. The ends of couplings and fittings shall have a minimum of one pipe diameter PVC overlap to cover threads and provide a seal.
8. Multi-Outlet Assembly
 - a. Multi-Outlet Assembly shall only be used where specifically indicated on the drawings. The assembly enclosures shall consist of two piece, all

RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

- steel or anodized aluminum raceways which shall allow for field installation of wiring and standard receptacles.
- b. Multi outlet assemblies shall be UL Listed as a Multi-outlet assembly.
 - c. Raceway bases and removable covers shall be .040-in steel, minimum of 2-1/8-in high by 1-5/8-in deep. Entrance fittings shall be sized for 3/4-in conduit.
 - d. Raceways shall include all fittings, couplings, etc., for the complete installation of a finished system.
 - e. Device covers shall be the 1702 Series by Walker, similar by Isoduct; Wiremold or equal.
 - f. The multi-outlet assembly shall be the 1700 Series by Walker, similar by Isoduct; Wiremold or equal.
9. Conduit hubs shall be of the grounding type as manufactured by Myers Electric Products, Inc. or equal.
 10. Conduit wall seals for new concrete walls below grade shall be O.Z./Gedney Co., Type WSK; Spring City Electrical Manufacturing Co., Type WDP or equal.
 11. Conduit wall seals for cored holes shall be Type CSML as manufactured by the O.Z./Gedney Co. or equal.
 12. Conduit wall and floor seals for sleeved openings shall be Type CSMI as manufactured by the O.Z./Gedney Co. or equal.
 13. Combination expansion-deflection fittings embedded in concrete shall be Type XD as manufactured by the Crouse-Hinds Co.; O.Z./Gedney Co.; Spring City Electrical Mfg. Co. or equal.
 14. Combination expansion-deflection fittings installed exposed shall be Type XJ as manufactured by Crouse-Hinds Co.; O.Z. Gedney Co.; Spring City Electrical Mfg. Co. or equal.
 15. Explosion proof fittings shall be as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; O.Z./Gedney Co. or equal.
 16. Conduit sealing bushings shall be O.Z./Gedney, Type CSB or equal.
 17. Steel elbows and couplings shall be hot-dipped galvanized. Elbows and couplings used with PVC coated conduit shall be furnished with a PVC coating bonded to the steel, the same thickness as used on the coated steel conduit.
 18. Electrical metallic tubing fittings shall be of the steel, raintight, concrete-tight, insulated throat (connectors), compression type as manufactured by the Appleton Electric Co.; Crouse-Hinds Co. or equal.

H. Conduit Mounting Equipment

1. In dry indoor non-process areas, hangers, rods, backplates, beam clamps, channel, fasteners, anchors, nuts, washers, etc., shall be hot-dipped galvanized steel.
2. 316 Stainless steel channel with 316 stainless steel hardware (hangers, rods, backplates, beam clamps, fasteners, anchors, nuts, washers, etc.) shall be used in process areas, as shown on the drawings, in areas designated "WET", "DAMP" and "CORROSIVE" on the Drawings and in outdoor locations. All channel and hardware shall be resistant to the chemicals present in the area in which it is used.
3. Expansion anchors (minimum 3/8" diameter) shall be equal to Kwik-Bolt as manufactured by the McCulloch Industries, Minneapolis, MI; Wej-it by Wej-it Expansion Products, Inc., Bloomfield, CO; or Kwik-Bolt II as manufactured by the Hilti Fastening Systems, Inc, Tulsa, OK. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1-in behind the steel reinforcement. Apply anti-seize compound to all nuts and bolts. Supports installed without the approved compound shall be dismantled and correctly installed, at no cost to the Owner.

I. Wall and Floor Slab Opening Seals

1. Wall and floor slab openings shall be sealed with "FLAME-SAFE" as manufactured by the Thomas & Betts Corp.; Pro Set Systems; Neer Mfg. Co.; Specified Technologies, Inc. or equal.

J. Cold Galvanizing Compound

1. Cold galvanizing compound shall be 95% zinc rich paint as manufactured by ZRC Products Company, a Division of Norfolk Corp. or equal.

PART 3 EXECUTION

3.1 RACEWAY APPLICATIONS

- A. Except where otherwise shown on the Drawings, or specified, all wiring shall be in PVC coated rigid galvanized steel conduit.
- B. PVC coated rigid galvanized steel conduit shall be used at all locations (underground and within structures) as raceways for shielded process instrumentation wiring, shielded control wiring, data highway wiring and I/O wiring.

- C. PVC coated rigid galvanized steel conduit shall be used where shown on the Drawings and in chemical rooms, chlorinator rooms and chlorine storage areas or areas designated "CORROSIVE" on the Drawings.
- D. PVC coated rigid galvanized conduit or Schedule 40 PVC shall be used underground where concrete encasement is not called for or as specified in Paragraph 3.01B above. Where schedule 40 PVC is used all elbows shall be PVC coated rigid galvanized steel.
- E. PVC conduit shall be used for concrete encased underground duct banks except as specified in Paragraph 3.01B above and except as specified in Section 16600.
- F. Electrical metallic tubing and fittings may be used only in NEMA 1 administration and office areas. Electrical metallic tubing and fittings shall not be embedded in concrete, installed outdoors, in process areas, shops, maintenance areas, electrical rooms, etc.
- G. All conduit of a given type shall be the product of one manufacturer.

3.2 BOX APPLICATIONS

- A. Unless otherwise specified herein or shown on the Drawings, all boxes shall be metal.
- B. Exposed switch, receptacle and lighting outlet boxes and conduit fittings shall be PVC coated rigid galvanized steel with the coating thickness the same as used on the coated galvanized steel conduit.
- C. Concealed switch, receptacle and lighting outlet boxes shall be pressed steel. Welded seamed boxes will not be permitted.
- D. Terminal boxes, junction boxes and pull boxes shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 16000.
- E. Where PVC coated rigid galvanized steel conduit is provided, the boxes, couplings, fittings, etc. shall be PVC coated with the coating thickness the same as used on the coated galvanized steel conduit.

3.3 FITTINGS APPLICATIONS

- A. Combination expansion-deflection fittings shall be used where conduits cross structure expansion joints. Refer to Structural Drawings for expansion joint locations. Provide bonding jumpers around fittings.
- B. Conduit wall seals shall be used where underground conduits penetrate walls or at other locations shown on the Drawings.

- C. Conduit sealing bushings shall be used to seal conduit ends exposed to the weather and at other locations shown on the Drawings.

3.4 INSTALLATION

- A. No exposed conduit smaller than 3/4 inch electrical trade size shall be used, and no concealed conduit smaller than 1 inch shall be used, nor shall any have more than the equivalent of three 90 degree bends in any one run. Pull boxes shall be provided as required or directed.
- B. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.
- C. The ends of all conduits shall be tightly plugged to exclude dust and moisture during construction.
- D. Conduit supports, other than for underground raceways, shall be spaced at intervals of 8-ft or less, as required to obtain rigid construction.
- E. Single conduits shall be supported by means of PVC coated malleable iron one-hole pipe clamps in combination with PVC coated malleable iron one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on trapeze type hangers with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8-in diameter. Surface mounted panel boxes, junction boxes, conduit, etc, shall be supported by spacers to provide a minimum of 1/2-in clearance between wall and equipment.
- F. Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete expansion anchors shall be provided.
- G. All conduits on exposed work, within partitions and above suspended ceilings, shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduit shall be run perfectly straight and true.
- H. Conduit terminating in pressed steel boxes shall have double locknuts (malleable iron) and insulated grounding bushings.
- I. Conduit terminating in gasketed enclosures shall be terminated with grounding type conduit hubs.
- J. Conduits containing equipment grounding conductors and terminating in sheet steel boxes shall have insulated throat grounding bushings with lay-in type lugs.

- K. Conduits shall be installed using threaded fittings unless otherwise specified herein.
- L. Liquidtight flexible metal conduit shall be used for all motor terminations, the primary and secondary of transformers, generator terminations and other equipment where vibration is present.
- M. Flexible couplings shall be used in hazardous locations for all motor terminations and other equipment where vibration is present.
- N. Where conduits pass through openings in walls or floor slabs, the remaining openings shall be sealed against the passage of flame and smoke.
- O. PVC conduit to non-metallic and metallic box connections shall be made with sealing rings, with a stainless steel retainer as manufactured by Thomas & Betts Co.
- P. Conduit ends exposed to the weather shall be sealed with conduit sealing bushings.
- Q. Expansion fittings shall be used on exposed runs of PVC conduit where required for thermal expansion. Installation and number of fittings shall be as provided per the NEC and approved by the PVC conduit manufacturer.
- R. All conduit entering or leaving a motor control center, switchboard or other multiple compartment enclosure shall be stubbed up into the bottom horizontal wireway or other manufacturer designated area, directly below the vertical section in which the conductors are to be terminated.
- S. Conduit sealing and drain fittings shall be installed in areas designated as NEMA 7.
- T. Spare conduits and conduit stubouts for future construction shall be provided with threaded PVC end caps at each end.
- U. No unbroken run shall exceed 300 feet in length. This length shall be reduced by 75 feet for each 90 degree elbow.
- V. PVC coated galvanized steel conduit entering manholes and below grade pull boxes shall be terminated with grounding type bushings and connected to a 3/4" x 10' rod with a #6 bare copper wire.
- W. Underground circuits shall be installed directly to the respective motor control centers, lighting panels, etc., except stainless steel pull boxes shall be wall mounted on structures to eliminate excessive bends. With prior written approval, below grade pull boxes may be used. Splices shall not be made in above or below grade pull boxes unless otherwise indicated on the plans and approved in writing by the Engineer.

RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

- X. All conduits shall have a 4-inch concrete housekeeping pad at all slab and grade penetrations. The housekeeping pad shall have 45 degree, 3/4-inch chamfer at all exposed edges.
- Y. All field cut threads on PVC coated galvanized steel conduit shall be cleaned and painted with cold galvanizing compound before installation.
- Z. All tools, (benders, threading machines, etc.) used with PVC coated conduit shall be designed and approved by the conduit manufacturer for use with PVC coated conduit. Tools shall not damage the PVC coating of the conduit. No patching of damaged PVC coated conduit will be permitted. Any damaged conduit shall be removed and replaced without exception. Strap wrenches shall be used for tightening PVC coated conduits. Pipe wrenches, channel locks, chain wrenches, pliers, etc. shall not be used.
- AA. Mandrels shall be pulled through all existing conduits which will be reused and through all new conduits 2-in in diameter and larger prior to installing conductors.
- BB. 3/16-in polypropylene pull lines shall be installed in all new conduits noted as spares or designated for future equipment.
- CC. Where no size is indicated for junction boxes, pull boxes or terminal cabinets, they shall be sized in accordance with the requirements of NEC Article 314.
- DD. Conduits shall not cross pipe shafts, access hatches or vent duct openings. They shall be routed to avoid such present or future openings in floor or ceiling construction.
- EE. The use of running threads is prohibited. Where such threads are necessary, a 3-piece PVC coated union shall be used.
- FF. Conduits passing from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc., shall be sealed with "Duxseal" as manufactured by Manville or seal fitting to prevent the accumulation of condensation.
- GG. All field cut ends of hot dipped galvanized mounting channel shall be cleaned and painted with cold galvanizing compound before installation.
- HH. All underground control and instrumentation conduits shall be separated from power conduits by a minimum of 12 inches unless specifically noted otherwise. Crossing of control and instrumentation conduits with power conduits shall be kept to a minimum and where they must cross they shall cross at 90 degree angles.

END OF SECTION

RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

SECTION 16120
WIRES AND CABLES

PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Furnish, install and test all wire, cable and appurtenances as shown on the Drawings and as specified herein.
- B. Install data highway, fiber optic, coaxial and I/O cables furnished under Division 13.

1.2 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, samples of proposed wire. Each sample shall have the size, type of insulation and voltage stenciled on the jacket.
- B. Approved samples will be sent to the project location for comparison by the Resident Engineer with the wire actually installed.
- C. Installed unapproved wire shall be removed and replaced at no additional cost to the Owner.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Carefully handle all conductors to avoid kinks and damage to insulation.

PART 2 PRODUCTS

2.1 GENERAL

- A. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper.
- B. All conductors shall be stranded, except that lighting and receptacle wiring may be solid.
- C. Except for control, signal and instrumentation circuits, wire smaller than No. 12 AWG shall not be used.
- D. All wire of a given type shall be the product of a single manufacturer.

2.2 MATERIALS

- A. 600 Volt or Less Wire and Cable

1. Wire for lighting, receptacles, and other circuits not exceeding 150 volts to ground shall be NEC type THHN/THWN.
2. Wire for circuits over 150 volts to ground shall be NEC type THHN/THWN up to 6 AWG and shall be XHHW for wire 4 AWG and larger.
3. Wire for control circuits shall be #14 AWG minimum NEC type THHN/THWN stranded.
4. Equipment grounding conductors shall be installed in all raceways. Conductors shall be NEC type THHN/THWN, green and sized per NEC Table 250.122. Ground grid conductors shall be uninsulated unless shown otherwise on the Drawings.
5. Types XHHW and THHN/THWN wire shall be as manufactured by the Southwire Co., Cablec Corp., Okonite Corp., or equal.
6. Multi-conductor control cable shall be stranded, #14 AWG, 600 V, cross-linked polyethylene insulated w/PVC jacket. Type "XLP" as manufactured by the Southwire Co., American Insulated Wire Corp., or equal.
7. Telephone cable shall be #22 AWG, 4-pairs, solid copper PVC insulation and PVC jacket. UL rated Type CMR as manufactured by American Insulated Wire Corp., or equal.
8. Multi-conductor power cable shall be stranded, 600V, cross-linked polyethylene insulated with PVC jacket, Type "TC" (XLP) with ground as manufactured by Southwire Co., Rockbestos Co., American Insulated Wire Corp., or equal.

2.3 INSTRUMENTATION WIRE

- A. Process instrumentation wire shall be twisted pair, 600 V, cross linked polyethylene insulated, aluminum tape shielded, polyvinyl chloride jacketed type "XLP" as manufactured by the Rockbestos Co., or equal.
- B. Cable for 4-20 mA instrumentation, potentiometer, RTD and similar analog circuits shall be multi-conductor twisted and shielded.
 1. Single pair cable:
 - a. Conductors: 2 No. 16 AWG stranded and twisted
 - b. Insulation: XLP
 - c. Shield: 100 percent tape with drain wire
 - d. Jacket: PVC with UL and manufacturers identification

2. Three conductor (triad) cable:
 - a. Conductors: 3 No. 16 AWG stranded and twisted
 - b. Insulation: XLP
 - c. Shield: 100 percent tape with drain wire
 - d. Jacket: PVC with UL and manufacturers identification
3. Multiple pair cables (where shown on the Drawings):
 - a. Conductor: Multiple 2 No. 16 AWG stranded and twisted
 - b. Insulation: XLP
 - c. Shield: Individual pairs and overall shielded with 100 percent tape and drain wire
 - d. Jacket: PVC with UL manufacturers identification

2.4 TERMINATIONS AND SPLICES (POWER CONDUCTORS)

- A. Unless otherwise indicated on the plans, no splices may be made in the cables without prior written approval of the Engineer. Where splicing is approved, then splicing material shall be approved by the Engineer and cable manufacturer. Splicing materials for all 600 volt splices shall be made with long barrel tin plated copper compression (hydraulically pressed) connectors and insulated with heavy wall heat shrinkable tubing. The conductivity of all completed connections shall be not less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.
- B. 600 volt wire lugs shall be tin plated copper, long barrel compression type (hydraulically pressed) for wire sizes No. 8 AWG and larger. Lugs for No. 10 AWG and smaller wire shall be locking spade type with insulated sleeve. Lugs shall be as manufactured by the Thomas and Betts Co., or equal.

2.5 TERMINATION AND SPLICES (CONTROL CONDUCTORS)

- A. A. Unless otherwise indicated on the plans, no splices may be made in the cables without prior written approval of the Engineer. Where splicing is approved, then splicing material shall be approved by the Engineer and cable manufacturer. Splicing materials and installation shall be as required by the Engineer. The conductivity of all completed connections shall be not less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.
- B. Termination connectors shall be of the expanded vinyl insulated locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or equal.

2.6 TERMINATIONS (INSTRUMENTATION CABLES)

- A. Termination connectors shall be of the expanded vinyl insulated locking fork-end

(upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or equal.

2.7 MOTOR CONNECTIONS

- A. For wire sizes #8 AWG and larger, long barrel tin plated copper compression (hydraulically pressed) type connections (Bundy Co., or equal) shall be installed on the branch circuit wires and the motor leads. Bolted connections shall utilize products which are rated for vibration applications (bolt, nut and spring washer). All connections shall be insulated with heavy duty heat shrinkable material (Raychem Corp. or equal).

2.8 WIRE AND CABLE MARKERS

- A. Wire and cable markers shall be type written, heat shrinkable type as manufactured by the W.H. Brady Co., Thomas & Betts Co., 3M Co., or equal.
- B. Wire and cables with diameters exceeding the capacity of the heat shrinkable markers shall be marked with pre-printed, self-adhesive vinyl tapes as manufactured by the W.H. Brady Co., Panduit Corp., or equal.

2.9 WALL AND FLOOR SLAB OPENING SEALS

- A. Wall and floor slab openings shall be sealed with "FLAME-SAFE" as manufactured by the Thomas & Betts Corp. or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Uniquely identify all wires, cables and each conductor of multi-conductor cables (except lighting and receptacle wiring) at each end with wire and cable markers.
- B. Use lubrications to facilitate wire pulling. Pulling compound shall be nontoxic, nonflammable, noncombustible and noncorrosive. The material shall be UL listed and compatible with the cable insulation and jacket.
- C. All wire and cable shall be continuous and without splices between points of connection to equipment terminals, except a splice will be permitted by the Engineer if the length required between the points of connection exceeds the greatest standard shipping length available from the Manufacturer specified or approved by the Engineer as the Manufacturer of the particular item or wire and cable.
- D. Seal openings in slabs and walls through which wires and cables pass.

- E. Steel fish tapes and/or steel pulling cables shall not be used in PVC conduit runs.
- F. Pull cable from direction that requires the least tension.
- G. Feed cable into raceway with zero tension and without cable crossover at raceway entrance.
- H. Use a feed-in tube and sheave designed for cable installation. Use sheaves with radii that exceed the cable manufacturer's recommended minimum bending radius.
- I. Use a dynamometer and constant velocity power pulling. Velocity should not be less than 15- ft./min or more than 50-ft/min. Do not exceed the cable manufacturer's maximum recommended tension.
- J. If cable cannot be terminated immediately after installation install heat shrinkable end caps.
- K. Uniquely identify all cable at supply and receiving ends and in all manholes, handholes or pullboxes. Use embossed brass tags and tywrap fasteners.
- L. Hydraulically or manually operated cable benders shall not be used unless approved in writing by the Engineer.
- M. Instrumentation cables shall be installed in rigid steel conduits as specified. All circuits shall be installed as twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required.
- N. Install shielded instrumentation wire from terminal to terminal with no splicing at any intermediate point. Shielded instrumentation wire, coaxial, data highway, I/O and fiberoptic cables shall be run without splices between instruments, terminal boxes, or panels.
- O. Terminal blocks shall be provided at all instrument cable junctions, and all circuits shall be identified at such junctions.
- P. Ground shielding on instrumentation wire at one end only as recommended by the instrument manufacturer and isolated at all other locations. Terminal blocks shall be provided for inter- connecting shield drain wires at all junction boxes. Where individual circuit shielding is required, each shield circuit shall be provided with its own terminal block.
- Q. Install shielded instrumentation wire in conduit and pull boxes that contain only shielded instrumentation wire. Instrumentation cables shall be separated

from all other (i.e. power, control, etc.) cables in manholes.

- R. All shielded cable terminations at each end shall be provided with heat shrinkable tubing placed over the exposed shield and conductors. The tubing shall extend 1" minimum over the jacket end and extend 1/2" minimum from the jacket end over the exposed conductors.

3.2 WIRE COLOR CODE

- A. All wire shall be color coded or coded using electrical tape in sizes where colored insulation is not available. Where tape is used as the identification system, it shall be applied in all junction boxes, manholes and other accessible intermediate locations as well as at each termination.
- B. The following coding shall be used:

<u>System</u>	<u>Wire</u>	<u>Color</u>
240/120 Volts Single-Phase, 3 Wire	Neutral	White
	Line 1	Black
	Line 2	Red
208Y/120, Volts 3 Phase, 4 Wire	Neutral	White
	Ph A	Black
	Ph B	Red
	Ph C	Blue
240/120 Volts 3 Phase, 4 Wire delta, center tap ground on phase coil A-C	Neutral	White
	Ph A	Black
	Ph B (High)	Orange
	Ph C	Blue
480Y/277 Volts 3 Phase, 4 Wire	Neutral	White
	Ph A	Brown
	Ph B	Orange
	Ph C	Yellow
Control (Individual Conductors)	ac	Red
	dc	Blue

3.3 FIELD TESTING

- A. Test all 600 volt wire insulation with a megohm meter after installation and prior to termination. Make tests at not less than 1000 volts DC. Submit a written test report of the results to the Engineer. Notify Engineer in writing 48 hours prior to testing.

- B. Field testing and commissioning shall be done in accordance with the latest revision of the "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" published by the International Electrical Testing Association (NETA Standard ATS-2013) unless otherwise modified by this Section. Minimum wire insulation resistance shall not be less than 250 Megohms.
- C. All service conductors shall be tested as in paragraph A above with the Engineer present.

END OF SECTION

SECTION 16150
MOTORS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. All motors shall be furnished as called for in other Sections of these Specifications and shall be in conformance with the requirements of this section.

1.2 QUALIFICATIONS

- A. Routine tests shall be performed on representative motors, and shall include the information described on NEMA MG1-12.54 "Report of Test Form for Routine Tests on Induction Motors". Efficiency shall be determined in accordance with IEEE Publication No. 112, Method B. Power factor shall be measured on representative motors.

1.3 SUBMITTALS

- A. Submittal of motor data for acceptance shall include complete nameplate data and test characteristics in accordance with NEMA Standard MG1-12.54 "Report of Test Form for Routine Tests on Induction Motors" and, in addition, the following for motors typical of the units furnished:
 - 1. Efficiency at $\frac{1}{2}$, $\frac{3}{4}$ and full load
 - 2. Power factor at $\frac{1}{2}$, $\frac{3}{4}$ and full load
 - 3. Motor outline, dimensions and weight
 - 4. Descriptive bulletins, including full description of insulation system
 - 5. Bearing design data
 - 6. Special features (i.e., space heaters, temperature detectors, etc.)
 - 7. Power factor correction capacitor rating and type.
- B. The motor manufacturer shall submit to the Engineer as provided in Section 01300, certified dimension prints showing nameplate data and outline dimensions within three weeks of the date they receive the order.
- C. Guarantee: All equipment furnished and installed under this Section shall be guaranteed against defects of workmanship, materials and proper installation for a period of one (1) year from date of acceptance. All such equipment or parts proven

defective, due to the above noted causes, shall be replaced in the machines by the Contractor at no expense to the Owner.

- D. Provide equipment warranty in accordance with Section 01740.

1.4 REFERENCE STANDARDS

- A. Institute of Electrical and Electronics Engineers (IEEE)
- B. National Electrical Manufacturers Association (NEMA)
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.1 GENERAL

- A. Unless otherwise noted, all motors $\frac{1}{2}$ through 100 horsepower shall be rated 230/460 volt, 3 phase, 60 Hertz A.C.; motors 125 horsepower and above shall be rated 460 volt, 3-phase, 60 Hertz, and motors below $\frac{1}{2}$ horsepower shall be rated 115/230 volt, 1 phase, 60 Hertz A.C.
- B. All motors used with variable frequency drives shall be rated for inverter duty and shall be in accordance with NEMA MG1, Part 31.
- C. All motors shall be built in accordance with current NEMA, IEEE, ANSI and AFBMA standards. Motors shall be of the type and quality described by this Section and other Divisions of the Specifications, and/or as shown on the Drawings, fully capable of performing in accordance with Manufacturer's nameplate rating, and free from defective material and workmanship.

2.2 RATINGS

- A. All motors shall be sufficient size for the duty to be performed and shall not exceed their full-rated load when the driven equipment is operating at specified capacity and over the operational range. Unless otherwise noted, motors driving pumps, blowers, etc. shall not be overloaded at any head or discharge condition. The motor shall not be required to deliver more than its rated nameplate horsepower, at the 1.0 service factor, under any condition of mechanical or hydraulic loading (i.e. although a 1.15 service factor is required, it may not be used under any condition).
- B. Each motor shall develop ample torque for its required service throughout its acceleration range at a voltage 10 percent below nameplate rating. Where shown on the Electrical Drawings to be operated on a reduced voltage starter, the motor shall develop ample torque under the conditions imposed by the reduced voltage starting method.

- C. All motors shall be continuous time rated suitable for operation in a [40]degrees C ambient unless noted otherwise.
- D. Specific motor data such as Hp, rpm, etc., is specified under the detailed specification for the equipment with which the motor is supplied.

2.3 NAMEPLATES

- A. The motor manufacturer's nameplates shall be engraved or embossed on stainless steel and fastened to the motor frame with stainless steel screws or drive pins. Nameplates shall indicate clearly all of the items of information enumerated in NEMA Standard MGI-10.38 or MGI- 20.60, as applicable.

2.4 CONDENSATION HEATERS

- A. Condensation heaters, where specified herein or under the detailed mechanical specifications shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to core iron. Heaters shall be rated for 120 Volt, single phase with wattage as required. The heater wattage and voltage shall be embossed on the motornameplate.

2.5 WINDING TEMPERATURE DETECTORS

- A. Winding temperature detectors, unless specified otherwise herein shall be a factory installed, embedded, switch type with leads terminating in the main conduit box. Temperature detectors in motors smaller than 100 HP shall be thermostat type, 100 HP and larger motors shall have thermistors. These devices shall protect the motor against damage from overheating caused by single phasing, overload, high ambient temperature, abnormal voltage, locked rotor, frequent starts or ventilation failure. The switch shall have normally open contacts. Not less than three detectors shall be furnished with each motor.
- B. All motors operating with variable frequency drives shall be equipped with winding temperature detectors.

2.6 POWER FACTOR CORRECTION CAPACITORS

- A. The operating power factor of the motors shall range from 93 to 95 percent at full load and 95 to 98 percent when partially loaded. The capacitor current shall not exceed the motor no-load magnetizing current.
- B. Capacitors shall be oil insulated or dry type (600 volt capacitors shall be of the dry type) with three high interrupting capacity current limiting integral fuse protection, blown fuse indicators, and discharge resistor and shall be hermetically sealed in steel enclosures. The insulating medium shall be nonflammable and meet the U.S. Environmental Protection Agency Standards. Covers shall be gasketed, bolt-on type.

Capacitors shall be UL listed and NEMA rated and tested. Oil insulated type shall be non-PCB dielectric, biodegradable and low toxicity.

- C. Units shall be designed to provide power factor correction in applications subject to the effects of harmonics as required for each installation. Where required, units shall consist of power factor correction capacitors as specified above and equipped with series inductors. The units shall be tuned to just below the 5th harmonic frequency on systems with predominately 3 Phase loads. Inductors shall have low flux density and distributed gaps, copper windings, brazed connections, winding varnish impregnated and baked, Class 220 degrees C insulation with 80 degrees C rise.

2.7 THREE PHASE INDUCTION MOTORS

- A. Motors 25 horsepower and larger shall have a 120-volt space heater for moisture control.
- B. Unless specifically noted in other Sections of these Specifications, all motors shall have minimum efficiencies as listed below:

<u>Horsepower</u>	<u>NEMA Nominal Efficiency, %</u>
1-2	84.0
3-5	88.5
7-1/2	89.5
10	90.2
15	91.0
20	92.0
25	92.2
30	92.4
40-50	94.0
60-100	94.5
Over 100	95.0

- C. All motors 30 horsepower and larger shall be furnished with power factor correction capacitors located in the motor starter enclosure as outlined in Sections 16480. The motor manufacturer shall provide suitable capacitors to the motor control center manufacturer unless otherwise noted. Power factor correction capacitors shall be provided only for the high-speed winding on a 2-speed motor. Power factor correction capacitors shall not be required for motors operating on variable frequency drives.

2.8 CONSTRUCTION

A. General:

1. All drip-proof and weather protected Type I and Type II motors shall have epoxy encapsulated windings. Totally enclosed motors shall be provided with an upgraded insulation by additional dips and bakes to increase moisture resistance and shall not be encapsulated. Motors for outdoor service shall have vacuum pressure impregnated (VPI) epoxy insulation for moisture resistance. Two speed motors shall be of the two winding type.
2. Squirrel-cage rotors shall be made from high-grade steel laminations adequately fastened together and to the shaft, or shall be cast aluminum or bar-type construction with brazed end rings.
3. All motors shall be of the premium efficiency and high power factor type. All motors shall be the corrosion resistant type conforming to motors designated as "Corro-Duty" by U.S. Motors or equal.
4. Vertical motors shall be hollow or solid shaft as required by the equipment furnished under other Sections of these Specifications.
5. Totally enclosed non-ventilated (TENV) motors shall include the same ratings and accessories as specified for TEFC motors. Explosion-proof motors shall be

UL listed and FM approved for Class 1, Division 1 hazardous areas.

B. Low Voltage, Three Phase Motors:

1. Motors shall be of the squirrel-cage induction type. Horizontal, vertical solid shaft, vertical hollow shaft, normal thrust and high thrust types shall be furnished as called for on the Drawings and as specified in other Sections of these specifications. Motors shall be of the type and quality described by these Specifications, and/or as shown on the schedule on the Drawings, fully capable of performing in accordance with Manufacturer's nameplate rating, and free from defective material and workmanship.
2. Motors shall have normal or high starting torque (as required), low starting current (not to exceed 650 percent full load current), and low slip.
3. Unless otherwise specified, motors shall be totally enclosed fan-cooled construction with a 1.15 service factor at the Class B Temperature-Rise.
4. The output shaft shall be suitable for direct connection or belt drive as required.
5. Motors shall have a Class F non-hygroscopic insulation system but shall be limited to Class B Temperature-Rise, at 1.15 service factor.
6. All motors shall have a final coating of chemical resistant corrosion and fungus protective epoxy fortified enamel finish sprayed over red primer over all interior and exterior surfaces. Stator bore and rotor of all motors shall be epoxy coated.
7. All fittings, bolts, nuts, and screws shall be plated to resist corrosion. Bolts and nuts shall have hex heads.
8. All machine surfaces shall be coated with rust inhibitor for easy disassembly.
9. Conduit box shall be split from top to bottom and shall be capable of being rotated to four 90 degree positions. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and sealed with a non-wicking, non-hygroscopic insulating material. A frame mounted pad with drilled and tapped hole, not less than 1/4-inch diameter, shall be provided inside the conduit box for motor frame grounding. All motor conduit boxes shall be provided with the correct number of conduit openings sized as indicated on the drawings. Boxes shall be suitably sized for conductor bending and terminations.
10. Totally enclosed motors shall be provided with condensate drain hole and epoxy coated motor windings to protect against moisture.

11. Nameplates shall be stainless steel. Lifting lugs or "O" type bolts shall be supplied on all frames 254T and larger. Enclosures shall have stainless steel screens. Motors shall be protected for corrosion, fungus and insects.
12. Low voltage, three phase motors shall be manufactured by U.S. Motors, Reliance Electric or Baldor.
13. Fractional Horsepower:
 - a. Fractional horsepower motors shall be rigid, welded-steel, designed to maintain accurate alignment of motor components and provide adequate protection. End shields shall be cast iron or heavy fabricated steel. Windings shall be of varnish-insulated wire with slot insulation of polyester film, baked-on bonding treatment to make the stator winding strongly resistant to heat, aging, moisture, electrical stresses and other hazards.
 - b. Motor shaft shall be made from high-grade, cold-rolled shaft steel with drive-shaft extensions carefully machined to standard NEMA dimensions for the particular drive connection.
 - c. For light to moderate loading, bearings shall be quiet all-angle sleeve type with large oil reservoir that prevents leakage and permits motor operation in any position.
 - d. For heavy loading, bearings shall be carefully selected precision ball bearings with extra quality, long-life grease, and large reservoir providing 10 years normal operation without re-lubrication.
14. Integral Horsepower:
 - a. Motor frames and end shields shall be cast iron or heavy fabricated steel of such design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type of enclosure employed.
 - b. Windings shall be adequately insulated and securely braced to resist failure due to electrical stresses and vibrations.
 - c. The shaft shall be made of high-grade machine steel or steel forging of size and design adequate to withstand the load stresses normally encountered in motors of the particular rating. Bearing journals shall be ground and polished.
 - d. Rotors shall be made from high-grade steel laminations adequately fastened together, and to the shaft. Rotor squirrel-cage windings may be cast-aluminum or bar-type construction with brazed end rings.
 - e. Motors shall be equipped with vacuum-degassed anti-friction bearings made to AFBMA Standards, and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent lubrication, but facilities shall be provided for adding new lubricant and draining out old lubricant without motor disassembly. The bearing housing shall have long, tight, running fits or

rotating seals to protect against the entrance of foreign matter into the bearings, or leakage of lubricant out of the bearing cavity.

- f. Bearings of high thrust motors will be locked for momentary upthrust of 30 percent downthrust. All bearings shall have a minimum B10 life rating of 5 years in accordance with AFBMA life and thrust values.
- g. Vertical hollow-shaft motors will have non-reverse ratchets to prevent backspin. Non- reverse ratchets shall be suitable for duty with variable frequency drives.

C. Low Voltage, Single Phase Motors:

1. Single phase motors shall be split-phase and capacitor-start induction types rated for continuous horsepower at the rpm indicated on the drawings or as required by the specifications. Motors shall be rated 115/230 volts, 60 Hertz, single phase, open drip-proof, or totally enclosed fan cooled as indicated on the drawings or as required by the specifications, with temperature rise in accordance with NEMA Standards for Class B insulation.
2. Totally enclosed fan cooled motors shall be designed for severe-duty.
3. Motors shall have corrosion and fungus protective finish on internal and external surfaces. All fittings shall have a corrosion protective plating.
4. Mechanical characteristics shall be the same as specified for polyphase fractional horsepower motors.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Motor Connections: All motors shall be connected to the conduit system by means of a short section 18-inch minimum of liquid tight conduit unless otherwise indicated. For all motor connections of No. 4 AWG or larger wire size, the Contractor shall install a grounding conductor in the conduit and terminate at main conduit box and at the motor control center or variable frequency drive with approved ground lugs and clamps.
- B. Low Voltage: For wire sizes #8 AWG and larger, long barrel tin-plated copper compression (hydraulically pressed) type connections (Burndy Co., or equal) shall be installed on the branch circuit wires and the motor leads. Bolted connections shall utilize products which are rated for vibration applications (bolt, nut and spring washer). All connections shall be insulated with heavy duty heat shrinkable material (Raychem Corp. or equal).

3.2 TESTS AND CHECKS

- A. The following tests shall be performed on all motors after installation but before

putting motors into service.

1. The Contractor shall megger (1000 volts DC) each motor winding before energizing the motor, and, if insulation resistance is found to be low, shall notify the Engineer and shall not energize the motor. The following table gives minimum acceptable insulation resistance in megohms at various temperatures and for various voltages with readings being taken after one (1) minute of megger test run.

Winding Temperature Degrees		Voltage		
F	C	115 V.	230 V.	460V.
37	3.9	60	108	210
50	10	32	60	120
68	20	13	26	50
86	30	5.6	11	21
104	45	2.4	4.5	8.8
122	50	1	2	3.7
140	60	0.50	0.85	1.6

2. The Contractor shall check all motors for correct clearances and alignment and for correct lubrication, and shall lubricate if required in accordance with Manufacturer's instructions. The Contractor shall check direction of rotation of all motors and reverse connections if necessary. The correction for wrong rotational direction shall be made at the motor.
 3. All tests shall meet the requirements of, but not be limited to, IEEE 43, 85 and 112. Efficiency tests for IEEE 112 shall include Method B.
 4. The Contractor shall provide to the Engineer a typed list of all motors 1 HP and larger listing the no load motor current and voltage and the full load current and voltage. Any phase current imbalance greater than 10% shall be reported to the Engineer.
- B. The following tests shall apply to the medium voltage motors:
1. All motors shall be given the standard short commercial test prior to shipment. This shall consist of no load current, check current balance, winding resistance, air gap measurement, high potential tests, and bearing inspection. Six (6) copies of the certified short commercial test shall be submitted to the Engineer prior to shipment.
- C. Field testing and commissioning shall be done in accordance with the latest revision of the "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" published by the InterNational Electrical Testing Association (NETA Standard ATS-2013).

END OF SECTION

SECTION 16191
MISCELLANEOUS
EQUIPMENT

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish and install all miscellaneous equipment as shown on the Drawings and as specified herein.
- B. This Section provides the requirements for miscellaneous equipment typically employed in a facility, however, not all components specified in this Section are necessarily utilized on this project.

1.2 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, detailed catalog information or drawings with sufficient detail to determine compliance with the specifications including describing electrical and physical characteristics of all equipment specified.

1.3 REFERENCE STANDARDS

- A. Equipment enclosures shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 16000.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Disconnect Switches
 - 1. Disconnect switches shall be NEMA 4X heavy-duty, quick-make, quick-break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange mounted operating handle unless otherwise noted. All current carrying parts shall be copper.
 - 2. NEMA 4X enclosures shall be stainless steel.
 - 3. NEMA 7 enclosures shall be cast aluminum.
 - 4. Lugs shall be copper.
 - 5. All exterior hardware shall be stainless steel.

6. Switches shall be as manufactured by Cutler Hammer, Square D Company or General Electric Company.

B. Fused Disconnect Switches

1. Fused disconnect switches shall be NEMA 4X heavy-duty, quick-make, quick-break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange mounted operating handle unless otherwise noted. All current carrying parts shall be copper.
2. Fuses shall be rejection type, 600 Volts, 200,000 A.I.C., dual element, time delay, Bussman Fusetron, Class RK-5 or equal.
3. NEMA 4X enclosures shall be stainless steel.
4. NEMA 7 enclosures shall be cast aluminum.
5. Lugs shall be copper.
6. All exterior hardware shall be stainless steel.
7. Switches shall be as manufactured by Cutler Hammer, Square D Company or General Electric Company.

C. Manual Motor Starters

1. Manual starters shall be furnished and installed for all typed of single-phase motors. Manual starters shall be non-reversing, reversing or two speed type as required. NEMA sizes shall be as required for the actual horsepower of the motor furnished. Manual starters shall have motor overload protection in each phase. Built-in control stations shall be furnished as required or as shown on the Drawings.
2. NEMA 4X enclosures shall be stainless steel.
3. NEMA 7 enclosures shall be cast aluminum.
4. Manual motor starters shall be as manufactured by Cutler Hammer, Square D Company or General Electric Company.

D. Magnetic Motor Starters

1. Motor starters shall be 2 or 3 Pole, single or 3 Phase as required, 60 Hz, 600 Volt, magnetically operated, full voltage non-reversing unless otherwise shown on the Drawings. NEMA sizes shall be as required for the horsepowers shown on the Drawings.

2. Two speed starters shall be for single or two winding motors as required by the actual motor furnished or as shown on the Drawings.
 3. Each motor starter shall have a 120 Volt operating coil, and control power transformer. Starters shall have motor overload protection in each phase. Auxiliary contacts shall be provided as required or as shown on the Drawings. A minimum of one N.O. and one N.C. auxiliary contacts shall be provided in addition to the contacts shown on the Drawings.
 4. Overload relays shall be non-adjustable, ambient compensated and manually reset.
 5. Control power transformers shall be sized for additional load where required. Transformer secondaries shall be equipped with time-delay fuses.
 6. Built-in control stations and indicating lights shall be furnished as specified herein where shown on the Drawings.
 7. NEMA 4X enclosures shall be stainless steel.
 8. NEMA Type 7 enclosures shall be cast aluminum.
 9. Magnetic motor starters shall be as manufactured by Cutler Hammer, Square D Company or General Electric Company.
- E. Combination Magnetic Motor Starters
1. Motor starters shall be a combination motor circuit protector and contactor, 2 or 3 Pole, single or 3 Phase as required, 60 Hz, 600 Volt, magnetically operated, full voltage non- reversing unless otherwise shown on the Drawings. NEMA sizes shall be as required for the horsepower shown on the Drawings. Motor circuit protectors shall be molded case with adjustable magnetic trip only. They shall be specifically designed for use with magnetic motor starters. Motor circuit protectors shall be current limiting type, with additional current limiters if required. Combination motor starters shall be fully rated for 65,000 Amps RMS symmetrical.
 2. Two speed starters shall be for single or two winding motors as required by the actual motor furnished or as shown on the Drawings.
 3. Reduced voltage starters: Auto-transformer type with closed circuit transition. Auto- transformers shall be dry type with 50, 65 and 80 percent voltage taps and over- temperature protection. Timing relays shall be pneumatic, adjustable. Relay settings shall be approximately 75 percent of relay range.
 4. Each motor starter shall have a 120 Volt operating coil, and control power

transformer. Starters shall have motor overload protection in each phase. Auxiliary contacts shall be provided as required or as shown on the Drawings. A minimum of one N.O. and one N.C. auxiliary contacts shall be provided in addition to the contacts shown on the Drawings.

5. Overload relays shall be non-adjustable, ambient compensated and manually reset.
 6. Control power transformers shall be sized for additional load where required. Transformer secondaries shall be equipped with time-delay fuses.
 7. Built-in control stations and indicating lights shall be furnished as specified herein where shown on the Drawings.
 8. NEMA 4X enclosures shall be stainless steel.
 9. NEMA Type 7 enclosures shall be cast aluminum.
 10. Combination magnetic motor starters shall be as manufactured by Cutler Hammer, Square D Company or General Electric Company.
 11. Reduced voltage starters: Auto-transformer type with closed transition. Auto-transformers shall be dry type with 50, 65 and 80 percent voltage taps and over-temperature protection. Timing relays shall be electronic, adjustable. Relay settings shall be approximately 75 percent of relay range.
- F. Control Stations and Indicators
1. Control stations shall be heavy-duty type, with full size (30.5mm) NEMA 4X or 7 operators, indicators, etc.
 2. Indicators shall be full voltage and push-to-test type. Indicators located indoors shall be LED type and indicators located outdoors shall be incandescent lamp type.
 3. NEMA 4X enclosures shall be stainless steel.
 4. NEMA 7 enclosures shall be cast aluminum.
 5. Control stations shall be Square D Company Class 9001, similar by Cutler Hammer or General Electric Company.
- G. General Purpose Dry Type Transformers
1. Transformers shall be dry type, two-winding with kVA and voltage ratings as shown on the Drawings.

2. Four full capacity taps shall be furnished, two 2-1/2 percent above and four 2-1/2 percent below rated primary voltage.
3. Maximum temperature rise shall be 80 degrees C. Windings shall be copper.
4. Transformers shall be built in accordance with ANSI C89.2 and NEMA ST-20.
5. Transformers shall be provided in NEMA 1 enclosures unless otherwise noted on the Drawings or as required by Section 16000. Where a NEMA 4X and/or stainless steel enclosure is required, the transformer shall be of the TENV type.
6. Transformers shall be furnished with hot dipped galvanized mounting hardware. Where a NEMA 4X and/or stainless steel enclosure is required, the hardware shall be 316 stainless steel.
7. Transformers shall be manufactured by the Square D Company or equal.

H. Integral Transformer and Distribution Center

1. Furnish and install, single-phase and three-phase general purpose individually mounted integral transformer and distribution centers of the two-winding type, self-cooled, with ratings and voltages as indicated on the drawings. Integral transformer and distribution centers shall be Servicenter, as manufactured by General Electric, Mini-Power Center, as manufactured by Cutler Hammer, or Mini-Power Zone, as manufactured by Square D.
2. Integral transformer and distribution center shall have a main breaker, a transformer and a secondary panelboard with a main breaker.
3. Maximum temperature rise shall be 80 degrees C. Windings shall be copper.
4. Circuit breakers shall be bolt on type.
5. Enclosures shall be NEMA 12 for climate controlled electrical rooms and non-process areas, and NEMA 4X stainless steel for damp, wet, corrosive and process areas.

I. Noise Isolation Transformers

1. Transformers shall be dry type, two-winding with kVA and voltage ratings as shown on the Drawings.
2. Furnish a minimum of four full capacity taps; two 2-1/2 percent above and two 2-1/2 percent below rated primary voltage.
3. Furnish electrostatic shielding and "spike" suppression.

4. Maximum temperature rise shall be 80 degrees C. Windings shall be copper.
5. Transformers shall be furnished with hot dipped galvanized mounting hardware.
6. Transformers shall be General Electric Company's "Guard II"; Topaz "Ultra-Isolator" or equal.

J. Transient Voltage Surge Protection

1. Lightning and surge protection shall be as manufactured by Advanced Protection Technologies (APT), Surge Suppression Incorporated or equal. Models based on voltage and phase shall be:

APT Model	Surge Suppression Inc. Model	
TE/1HP	CILA1S1M	120/240 volt, single phase
TE/2HP	CILA3Y1M	120/208 volt, three phase
TE/3HP	CILA3D1M	120/240 volt, three phase
TE/4HP	CILA3Y2M	277/480 volt, three phase

2. Transient voltage surge suppression units shall be provided with optional dry6 contacts for remote monitoring

K. Wireway

1. NEMA 1 wireway shall be gasketed painted steel with stainless steel screw covers.
2. NEMA 4X wireway shall be 316 stainless steel with gasketed clamped covers.
3. NEMA 1 wireway shall be Square-Duct as manufactured by the Square D Co.; NEMA 4X shall be Bulletin F-22 as manufactured by the Hoffman Engineering Co. or equal.

L. Control Relays

1. Control relays shall be heavy duty machine tool type, with 10 Amp, 300 Volt convertible contacts. Number of contacts and coil voltage shall be as shown on the Drawings. General use relays shall be Square D Company, Class 8501 Type X, similar by; Cutler-Hammer, Allen-Bradley Company or General Electric Company. Latching relays shall be Square D Company, Class 8501 Type X, similar by; Cutler-Hammer, Allen-Bradley Company or General Electric Company.
2. Time delay relays shall be electronic, 600 Volt, 20 Amp contacts, with calibrated knob operated adjustment and numerical time dial. On delay and off delay types and timing ranges shall be as shown on the Drawings or as required for proper operation of the actual equipment furnished. Relays shall

be Agastat Model 7012 or 7022 or equal.

M. Polyethylene Warning Tape

1. Warning tape shall be red polyethylene film, 6-in minimum width.
2. Warning tape shall be W.H. Brady Co., Catalog No. 91296 or equal.

N. Terminal Blocks

1. Terminal blocks shall be 600 Volt, channel mounted, with tubular screw and pressure plate.
2. Terminal blocks shall be Bulletin 1492-CA1 as manufactured by the Allen-Bradley Co. or equal.

O. JIC Boxes for GF Receptacles

1. JIC boxes shall be 6-inches x 6-inches x 4-inches aluminum continuous hinge clamp cover boxes, Hoffman Catalog Number A-606 CHAL with Type L23 stainless steel fast operating JIC clamp, or equal.
2. Install 1-1/2-inch bushings in bottom of box for cord and plug to pass through.

P. Corrosion Inhibitors

1. All equipment enclosures, terminal boxes, etc, located in a NEMA 4X rated area (where shown on the Drawings) that contains electrical or electronic equipment or terminal strips shall be furnished with an internally mounted, chemically treated corrosion inhibitor pad.
2. The corrosion inhibitor pads shall be as manufactured by Hoffman Engineering Co.; 3M or equal.

Q. Equipment Mounting Stands

1. Equipment mounting stands shall be custom fabricated from 1/4-in 316 stainless steel plate and 3-in 316 stainless steel channel, unless otherwise shown on the Drawings.
2. All hardware shall be 316 stainless steel.

R. Terminal Cabinets:

1. Interiors shall be so designed that control relays and terminal blocks can be replaced or added without disturbing adjacent units. Each cabinet shall be furnished with a minimum of 50 spare terminals.

2. All interiors shall be completely factory assembled with control relays, terminal blocks, insulating barriers, etc. All 120 volt AC and DC terminal blocks shall be isolated from each other by insulating barriers or separate enclosures.
 3. All wiring within the cabinets shall be grouped together in harnesses and secured to the structure.
 4. All shielded cables shall terminate in separate cabinets. A third terminal shall be provided for each twisted shielded pair and the shield for each connected thereto, unless otherwise noted on manufacturer's shop drawings.
 5. Terminal blocks shall be tubular screw type with pressure plates and shall be rated 600 volts. Terminal blocks shall be Allen Bradley Catalog Number 1492-CA1 or equal.
 6. Boxes shall be made from 14 gauge galvanized steel and shall be of sufficient size to provide a minimum of 4 inches of wiring space on all sides and between adjacent terminal blocks. A minimum 2-inch spare shall be provided between control relays. A minimum of four mounting studs shall be provided on each cabinet. Cabinets shall be furnished without knockouts. Holes for raceways shall be drilled on the job.
 7. A single or double hinged door shall cover the front of each terminal cabinet. Doors shall have a neoprene gasket, vault type handle, three point catch and lock. Two keys shall be supplied for each lock. All locks shall be keyed alike. A terminal block schedule shall be provided with each terminal point numbered and identified (typewritten) as to function.
 8. All exterior and interior steel surfaces of the cabinets shall be properly cleaned and finished with ANSI 61 grey over a rust-inhibiting phosphatized coating conforming to ANSI A55.1. The finish paint shall be of a type to which field applied paint will adhere.
 9. Cabinets in wet, damp, corrosive and all outdoor locations shall be NEMA 4X316 stainless steel.
 10. Cabinets shall be Hoffman Engineering Company with latch kit hardware or be an equal product.
- S. Emergency Shower Alarm Horn and Light
1. Emergency shower alarm horn shall be vibrating type for 120 Volts, 60 Hz and shall be Federal Signal Corp.; Catalog No. 350+WB for surface mounting, Catalog No. 350+FG+FB for flush mounting, similar by Benjamin Co.; Edwards Co. or equal.

2. Emergency shower alarm light shall be a flashing strobe unit with red fresnel globe, for use on a 120 Volts, 60 Hz power supply, and shall be Benjamin Catalog No. KL-4011-120, similar by Federal Signal; Edwards Co. or equal.

T. Intrinsically Safe Relays

1. Intrinsically safe relays shall be solid state type with 5 Amp output contacts, suitable for use on a 120 Volt, 60 Hz power supply and shall be FM approved for pilot devices in Class I, Division 1, Group D hazardous atmospheres.
2. Intrinsically safe relays shall be Gems Solid State Safe-Pak as manufactured by Gems Sensors, Division of Transamerica Delaval, Inc. or equal.

U. Lighting Contactor

1. Lighting contactor shall be of the electrically operated, mechanically held type mounted in NEMA 1, enclosures (except where noted otherwise on the Drawings) with number of poles as noted on the Drawings. Operating coils shall be rated for 120 Volts unless otherwise indicated on the Drawings and shall be for momentary operation. Provide with "Hand Off-Auto" switch on cover where shown on the Drawings.
2. Contactors shall be rated for 20 Amps, 600 VAC and shall be Automatic Switch Co., Bulletin 917 RC, similar by Square D Co.; Cutler Hammer/Westinghouse or equal.

V. Beacon Alarm Light

1. Beacon alarm light for building exterior mounting shall be flush mounted, weatherproof construction and have a 750,000 candlepower xenon strobe tube and red polycarbonate lens. Beacon alarm light shall be Federal Signal, Model 371 DST.

W. Alarm Horn and Light

1. Alarm horn shall be vibrating type for 120 volts, 60 Hertz and shall be Federal Signal Corp. Cat. No. 350 + WB for surface mounting, Federal Signal Corp. Cat. No. 350+FG+FB for flush mounting, equal by Benjamin Co. or Edwards Co. or equal.
2. Alarm light shall be a NEMA 4X flashing strobe unit with red glass globe, for use on a 120 volts, 60 Hertz power supply, and shall be Federal Signal Co. Model 191X, or equal.

X. Photocells

1. The photocells shall be suitable for power duty with individual fixtures or for pilot duty with contactors as detailed on the Drawings. Enclosure shall be NEMA 3R or 4. Contacts shall be rated for 2,000 watts continuous at 120 Volts. The unit shall turn on at 1.5 footcandles and off at 5.5 footcandles.
2. Photocells shall be Tork, Model 2101 or equal.

Y. 24-Hour Programmable Timers

1. Unless otherwise specified, time switches shall be of the programmable type capable of being programmed at the intervals as noted on the Drawings over a 24-hour day. Program tabs shall be easily set by hand without tools to obtain or to change the desired programming schedule. The switching condition shall be maintained when adjacent tabs are set alike.
2. The unit shall be powered by a self-starting, enclosed, 120 Volt, synchronous motor capable of continuous accurate operation. A reserve power, precision wound spring and associated escapement device shall be integrally mounted to maintain time settings during power failures of up to 24 hours.
3. The switch mechanism shall be a self-contained unit rated at not less than 20 Amps, 120 Volts, single pole, double throw and shall be readily replaceable in the field.
4. An omitting device shall be furnished as an integral part of the time switching operation to be skipped for any preselected day or days of the week.
5. Unless otherwise specified, time switches shall be as manufactured by Intermatic; Tork; Paragon or equal.

Z. Power Monitors

1. Microprocessor based metering: At each circuit location shown on the Drawings, furnish a digital microprocessor based metering device capable of monitoring and displaying the functions listed below. The device shall provide the status input functions indicated and the capability to communicate data to a centralized monitoring system via a data highway network. The device shall be UL listed. The device shall be the "POWERLOGIC" as manufactured by the Square D Company or equal.
2. Metering Functions
 - a. The Digital AC Instrumentation Package shall be capable of measuring, calculating and directly displaying on the front panel display the following information:
 - 1) Volts on each phase plus average of all three phases
 - 2) Current on each phase plus average of all three phases
 - 3) Neutral or ground current

- 4) Frequency
 - 5) Power Factor
 - 6) KVA
 - 7) KVAR
 - 8) KW
 - 9) Total KWH as an accumulating total, providing bi-directional (import/export) indication
 - 10) Total KVARH as an accumulating total, providing bi-directional (import/export) indication
 - 11) Amps Demand.
3. Monitoring and Control Functions
- a. Provide eight self-powered digital status inputs to monitor the following points:
 - 1) Circuit breaker OPEN status
 - 2) Circuit breaker CLOSED status
 - 3) Circuit breaker TRIPPED status
 - 4) Circuit breaker OUT OF SERVICE (withdrawn) status.
 - b. Provide one auxiliary analog input rated 1.0 VAC/VDC nominal full scale input which can be used to measure an external variable such as transformer temperature, air temperature, or battery voltage.
 - c. Provide one auxiliary analog output (selectable 0-20ma or 4-20ma) proportional to any measure parameter.
 - d. Provide three Form C dry contact control relay outputs rated 277 VAC or 30 VDC at 10 Amp maximum load current, that can each function as:
 - 1) Setpoint relays that operate as a function of any measured parameter for demand, power factor, or load control. Seventeen programmable setpoints shall each have programmable operate and release limits and time delays on operate and release. Relays shall provide selectable pulse mode or tach mode operation.
 - 2) Remote control relays operated by commands via the communications port.
 - 3) Breaker trip relay (over/under volt, volt unbalance, phase reversal, current unbalance, over/under frequency).
 - 4) KWH or KVARH pulse output relay.
 - 5) Alarm relays.
4. Operational Features
- a. Provide the following operating features:
 - 1) True RMS measurements.
 - 2) Connect directly to PT's and CT's for systems over 600 volts.
 - 3) Provision for a fourth current input for measurement of ground or neutral current.
 - 4) 300 amp, one second surge protection on all four current inputs.
 - 5) 3-field, 20 character, high visibility 0.4-in character height vacuum-fluorescent display with a programmable time out feature.
 - b. Store in non-volatile memory the following:

- 1) A time-stamped alarm and event log of up to 50 events which records event date, time (to 1 second), event type and value for all over/ under limit conditions, all status input activity and all relay operations. Log shall be read via the communications port.
 - 2) A time-stamped minimum/ maximum log, which records the value of any parameter exceeding the previous highest or lowest value recorded. Log shall be read from the front panel display or via communication port.
 - 3) A time-stamped snapshot (historical) log, with a 100 snapshot capacity and user- definable snapshot interval from 1 second to 400 days which records snapshot values for Average Volts, Average Amps, KW, KVAR, KW Demand, Power Factor, Frequency, KWH, KWH Reverse, KVARH and Auxiliary Volts Input. Log shall be read via the communications port.
 - 4) All setup data.
5. The device shall be field programmable as follows:
- a. Volts scale, volts mode (wye, delta, single phase), amps scale, Vaux scale, baud rate and the relay operation shall be programmable from the front panel.
 - b. All parameters above, plus additional alarm/event parameters shall be programmable via the communications port using a portable terminal or a computer.
 - c. The programming shall be password protected.
6. Data Communications
- a. Provide a serial communication port which has:
 - 1) Switchable RS-232C and RS-485 capability.
 - 2) Addressable polling of multiple units.
 - 3) Packet transmission.
 - 4) Selectable transmission at 300 to 19,200 baud.
 - b. Provide all communication cables to interconnect monitors within the electrical equipment.

AA. Manual Transfer Switches

1. Furnish and install manual transfer having the ratings shown on the Contract Drawings
2. The transfer switch shall meet UL 1008, NFPA 70, and NFPA 110.
3. The overall short circuit withstand rating of the equipment and devices shall be 65,000 (minimum) Amperes R.M.S. symmetrical at 480 volts.
4. The transfer switch shall be 100% equipment rated for continuous duty.
5. The transfer switch shall be mechanically interlocked to prevent cross

connection of sources when operated.

6. Transfer switches shall be capable of being operated manually under full rated load conditions.
7. Each transfer switch shall be provided in a NEMA 1 enclosure except where located in process areas or outdoors, in which case they shall have a NEMA 4X stainless steel enclosure.
8. Main circuit breakers, enclosures, etc., shall be as manufactured by Cutler-Hammer, Square D or General Electric.

2.2 CONTROL SYSTEM

- A. The Manufacturer shall provide a complete and fully functional control system to manually or automatically operate the control system as specified herein and in other applicable sections of these specifications. All Manufacturers recommended safety devices shall be furnished to protect operators. All control devices, unless specified otherwise, shall be mounted in the Control Panel.
- B. Control Panel Construction
 1. The control panel shall consist of a main circuit breaker, a motor circuit protector (MCP) and magnetic starter for each motor, and a 120-volt control power transformer (fused on primary and secondary). All control components shall be mounted in one common enclosure. Control switches shall provide means to operate each motor manually or automatically.
 2. Unless specifically noted otherwise, the electrical control equipment shall be mounted within a NEMA 4X enclosure, constructed of not less than 14 gauge 316 stainless steel. Latches shall be quarter turn quick release type and all hardware shall be 316 stainless steel. Where NEMA 3R or 12 enclosures are specifically required, the door shall be provided with a pad-lockable vault type 3-point latch. The enclosure shall be equipped with a door and shall incorporate a removable back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. Door(s) shall be interlocked with main circuit breaker and provided with pad-locking provision.
 3. All motor branch circuit breakers, motor starters and control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.
 4. A thermal-magnetic air circuit breaker, Type FH as manufactured by the

Square D Company, or equal, shall be furnished for the main breaker. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering. Each circuit breaker shall be adequately sized to meet the equipment operating conditions. Motor Circuit Protectors (MCP) shall be molded case with adjustable magnetic trip only, "Mag-Gard" as manufactured by the Square D or equal.

5. An open frame, across-the-line, NEMA-rated magnetic motor/starter, Class 8536 as manufactured by the Square D Company, or equal, shall be furnished for each motor. All motor starters shall be provided with motor circuit protectors and equipped to provide under-voltage release and overload protection on all three phases. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position. Overloads shall be of the melting alloy or bi-metallic type, adjustable overloads are not acceptable, Class 10 quick trip overloads shall be provided for all submersible motors. Overload reset push-buttons shall be located on the exterior of the door. Normally open and normally closed auxiliary motor overload contacts wired to terminal blocks shall be provided for each motor starter within the control panel
6. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by Divisions 13, 16 and as shown on the drawings.
7. All operating control and instruments shall be securely mounted on the exterior door. All controls and instruments shall be clearly labeled to indicate function. All exterior mounted equipment shall be NEMA 4X.
8. Mode selector switches shall be Hand-Off-Auto type to permit override of automatic control and manual actuation of shutdown. Switches shall be NEMA 4X (800H) as manufactured by Allen-Bradley, or equal, providing three (3) switch positions, each of which shall be clearly labeled according to function.
9. Indicator lamps shall be LED (indoors) or Incandescent (outdoors) full voltage type and mounted in NEMA 4X (800H) modules, as manufactured by Allen-Bradley. Lamp modules shall be equipped to operate at 120 volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position. Indicators shall be provided for individual motor run and an indicator for each failure condition.
10. A six (6) digit, nonreset elapsed time meter shall be connected to each motor starter to indicate the total running time of each motor in "hours" and "tenth of hours". The elapsed time meters shall be Series T50 as manufactured by the ENM Company or equal.

11. A failure alarm with horn and beacon light shall be provided. Silence and reset pushbuttons shall also be furnished. A common failure reset pushbutton shall be provided to reset the alarm conditions (reset shall occur only if fault condition has been cleared). The alarm horn shall be weatherproof rated with gasket (Federal Signal Corporation, Cat. #350 or equal). The alarm beacon shall be NEMA 4X rated, red lense and solid state flasher (Ingam Products Inc. LRX-40).
12. The control panel shall operate on a power supply of 480 volts, 3-phase, 60 hertz unless otherwise noted.
13. The control diagrams and overload tables shall be laminated to the inside of the door except where door space is limited the laminated documents shall be in the print storage pocket.
14. Print storage pockets shall be provided on the inside of each panel. Pocket shall be of sufficient size as required to hold all prints necessary to service the equipment. A set of reduced drawings shall be provided for each panel, fixed to fit in the storage pocket.
15. A duplex GFCI utility receptacle (circuit breaker protected) providing 120 volts, 60 Hertz, single phase current shall be mounted on the side of the enclosure.
16. The control panel shall include an adjustable time delay relay to prevent any two motors from starting simultaneously. All timing relays shall be solid state, with pin (octal) and bases, relays shall be T-series as manufactured by Diversified Electronics Inc. or equal.
17. Alternators shall be provided to sequence motors, alternators shall be 008-120-13SP or 009-120-23AP as manufactured by Sta-con, or equal.
18. A phase monitor shall be provided for the control panel, monitors shall be model SUA- 440-ASA as manufactured by Diversified Electronics Inc., or equal.
19. All exterior mounted equipment shall be rated NEMA 4X. Hinged NEMA 4X 316 stainless steel viewing windows will be permitted where such equipment is not available with a NEMA 4X rating.
20. The control panel shall be provided with lightning and surge protection. Protection devices shall be mounted within the control panel enclosure. Lead lengths shall not be longer than 12 inches from the main circuit breaker. Protection shall be as manufactured by Advanced Protection Technologies (APT), Surge Suppression Incorporated, or equal for the power supply voltage:

APT Model	Surge Suppression Inc. Model	
TE/4XF	CKLA3Y2	480/277 VAC, 3-Phase
TE/3XF	CKLA3D1	120/240 VAC, 3-Phase
TE/2XF	CKLA3Y1	120/208 VAC, 3-Phase
TE/1XF	CKLA1S1	120/240 VAC, 1-Phase

21. All control panel wiring shall be numbered at both ends with type written heat shrinkable wire markers.
22. Wiring shall be stranded copper, minimum size #14 AWG (except for shielded instrumentation cable), with 600 volt, 90 degree C, flame retardant, TypeMTW thermoplastic insulation.
23. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc. Nameplates shall be permanently affixed using an epoxy process (inner door nameplates shall be fastened with stainless steel screws). Nameplates shall be laminated plastic, engraved white letters with a black background.
24. All control panels shall be provided with a master nameplate located on the exterior door.
25. Where applicable provide a nameplate which reads as follows "CAUTION - THIS PANEL CONTAINS A VOLTAGE FROM AN EXTERNAL SOURCE." Letters shall be black on a high visibility yellow background.
26. Corrosion Inhibitor Emitter: Inclusion of an industrial corrosion inhibitor emitter that shall protect internal components of control panel from corrosion for up to one year. One spare emitter shall be provided for each control panel.
27. All control relays shall be have 10 amp rated contacts (minimum), 11 pin with mounting base , 3PDT (minimum), with LED indicators to show relay status, relays shall be manufactured by Potter Brumfield or equal.
28. Terminal blocks shall be 600 volt heavy duty rated, tubular clamp type. Terminal strips shall be Allen Bradley catalog #1492-CA-1 or equal. Each terminal shall be individually labeled.
29. The completed control panel assembly shall be U.L. certified. The minimum overall short- circuit withstand rating of the control panel and devices shall be 65,000 amperes RMS symmetrical at 480 volts.
30. Intrinsically safe relays shall be solid state type with 5 amp output contacts, suitable for use on 120 volt, 60 hertz power supply and shall be Factory Mutual approved for devices in Class 1, Division 1 hazardous atmospheres. Intrinsically safe relays shall be Gems Solid State Safe-Pak as manufactured by Gems Sensors, Division of Transamerica Delaval, Inc. or equal.

31. All electronic control equipment (i.e. controllers, isolators, signal boosters, transmitters, PLC's, etc) shall be as specified in Division 13.
32. A copper ground bar with sufficient terminals for all field and panel ground connections shall be provided.
33. All signal wiring entering and exiting the control panel shall be provided with surge protection. Surge protection shall be as specified in Division 13.
34. An 8-inch (minimum) clear space within the enclosure shall be provided horizontally along the entire top and bottom of the control panel. A 4-inch (minimum) clear space within the enclosure shall be provided vertically along the entire sides of the control panel. No devices, terminals, etc. shall be installed within this space, the space shall be provided for field conduit and wiring access only.
35. All wiring within the control panel shall be color coded or coded using electrical tape in sizes where colored insulation is not available. The following coding shall be used. For different system voltages, the color coding shall be as required by the Engineer.

System Wire	Wire	Color
480Volts 3 Phase	Ground	Green
	Neutral	White
	Ph A	Brown
	Ph B	Orange
	Ph C	Yellow
Control (Individual Conductors)	Ac	Red
	dc	Blue
	Foreign	Yellow

36. See instrument drawings and specifications for remote control and monitoring interface requirements to the plant control system.

C. Spare Parts

1. The following number of spare parts shall be furnished for each control panel.
 - a. 1 Indicator light assembly
 - b. 2 control relays for each type furnished
 - c. 5 fuses for each type/size furnished

- d. 1 set thermal overloads for each size furnished
- e. 1 selector switch for each type furnished
- f. 1 starter coil for each size

furnished PART 3 EXECUTION

3.1 INSTALLATION

A. Mounting stands

- 1. Field mounted disconnects, pushbutton control stations, etc, shall be mounted on 316 stainless steel stands as specified herein or as shown on the Drawings. Where clearance requirements for stands may not be maintained, the Engineer may direct equipment to be wall-mounted adjacent to the motor or device, but in no case shall the distance from the motor or device to the control station exceed 3-ft.

END OF SECTION

SECTION 16370
VARIABLE FREQUENCY
DRIVES

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required to manufacture, assemble, shop- test, and install variable frequency drives as shown on the Drawings and as specified herein.
All variable frequency drives shall be coordinated with the equipment manufacturer as specified in Division 11.
- B. These specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment furnished. They are, however, intended to cover the furnishing, the shop testing, the delivery and complete installation and field testing, of all materials, equipment and appurtenances for the variable frequency drives herein specified.
- C. The Contractor shall furnish only one Manufacturer of variable frequency drives as specified herein.
- D. The work shall include the services of factory representatives of the variable frequency drive manufacturers to inspect the final installation, to perform field acceptance tests on the installed equipment and to instruct the regular operating personnel in the care, operation and maintenance of equipment.
- E. Concrete housekeeping pads are furnished in Division 3.

1.2 DESCRIPTION OF SYSTEMS

- A. The variable frequency drives specified hereinafter will become part of a complete system as specified in Division 11. The variable frequency drive manufacturer shall coordinate with the Manufacturer of the Division 11 equipment to ensure the compatibility of the equipment.
- B. The variable frequency drives will operate motors as specified in Division 11 and Division 16150. The drives furnished herein under shall be totally compatible with the Motors to be supplied.
- C. Additional controls shall be provided as required by Division 11 and 13 and as shown on the drawings.

1.3 QUALIFICATIONS

- A. Variable speed drives shall be of sufficient size for the duty to be performed and shall not exceed their full-rated capacity when the driven equipment is operating as specified.
- B. The Manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement. The equipment furnished shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.
- C. All equipment furnished under these Specifications shall be new and unused and shall be the standard cataloged product of a manufacturer having a successful record of manufacturing and servicing the equipment and systems specified herein for a minimum of five (5) years.
- D. The variable frequency drive manufacturer shall maintain, as part of a national network (United States), engineering service facilities within 250 miles of the project site to provide start-up service, emergency service, calls, repair work, service contracts, and maintenance and training of customer personnel. When requested by the Engineer, documentation shall be provided showing compliance, capabilities and references for this requirement.
- E. The Manufacturer of the assembly shall be the Manufacturer of the major components within the assembly.
- F. For the equipment specified herein, the Manufacturer shall be ISO 9000, 9001 or 9002 certified.
- G. Approved Manufacturers: Cutler-Hammer SVX9000, Square D Altivar 630, Danfoss VLT FC 202, Allen Bradley Powerflex 753 or approved equal.

1.4 SUBMITTALS

- A. Copies of all materials required to establish compliance with the specifications shall be submitted. Submittals shall include at least the following:
 - 1. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations. Details to also include front elevations with designation of devices and equipment on door(s) and internal to the enclosure. Internal layout of components including dimensions and space requirements. Standard preprinted sheets or drawings simply marked to indicate applicability to this contract will not be acceptable.
 - 2. Descriptive literature, bulletins and/or catalogs of the equipment.

3. Data on the characteristics and performance of the variable frequency drives. Data shall include certification that the variable frequency drives are warranted for use with the motors specified in Division 11 and Division 16150.
4. Complete drawings shall be furnished for approval before proceeding with manufacture and shall consist of job specific master wiring diagrams, elementary or control schematics including coordination with other electrical control devices operating in conjunction with the variable frequency drive, and suitable outline drawings with sufficient details for locating conduit stub-ups and field wiring. Due to the complexity of the system, it is imperative the above drawings be clear and carefully prepared to facilitate interconnections with other equipment. Standard preprinted sheets or drawings simply marked to indicate applicability to this contract will not be acceptable.
5. The total weight of the equipment including the weight of the single largest item.
6. A complete total bill of materials of all equipment.
7. A list of the Manufacturer's recommended spare parts with the Manufacturer's current price for each item.

1.5 OPERATING INSTRUCTIONS

- A. The operating and maintenance manuals shall be furnished in accordance with Section 01730. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.
- B. A factory personnel of the Manufacturer who has complete knowledge of proper operation and maintenance of the specified equipment shall provide all the instruction and training as specified herein. This shall be done in conjunction with and coordinated with the O&M instructions to be provided for the equipment, motors and control panels.
- C. The cost of training programs to be conducted with Owner's personnel shall be included in the Contract Price. The training and instruction, insofar as practicable, shall be directly related to the System being supplied. The Manufacturer shall include the travel and expenses for two Owner personnel attending factory training.
- D. The Manufacturer shall provide classroom training detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project as per Section 01730.

- E. The Manufacturer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to Owner.
- F. The training program shall represent a comprehensive program covering all aspects of the VFD and maintenance of the system.
- G. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.
- H. On-site Training: On-site (field) training shall be conducted at the Owner's site and shall provide detailed hands-on instruction to Owner's personnel covering: system debugging, program modification, trouble-shooting, maintenance procedures, calibration procedures, and system operation. The training shall run at times chosen by the Owner. The training shall be conducted over a period of one day.

1.6 TOOLS AND SPARE PARTS

- A. One (1) set of all special tools required for normal operation and maintenance shall be provided.
- B. The Manufacturer shall furnish a complete list of recommended spare parts necessary for the first five (5) years of operation.

1.7 PRODUCT HANDLING

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- B. All equipment and spare parts must be properly protected against any damage during a prolonged period at the site.
- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- D. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.8 WARRANTY

- A. All equipment supplied under this Section shall be warranted by the Contractor and the equipment manufacturers for a period of one (1) year from startup or 24 months from shipment, whichever occurs first in accordance with Section 01740.

- B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s) and the unit(s) restored to service at no additional cost to the Owner.
- C. The Manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.

PART 2 PRODUCTS

2.1 GENERAL

- A. The Contractor shall furnish and supervise installation of variable frequency drives as described in this specification and as detailed on the applicable Drawings.
- B. The Contractor shall be responsible for the erection, installation, and startup of the equipment covered by this specification.
- C. The variable frequency drive shall comply with the latest applicable standards of ANSI, NEMA, IEEE, and the National Electrical Code.
- D. Variable frequency drives shall operate as specified on existing or new standby generators or normal power sources.

2.2 CONSTRUCTION

- A. The variable frequency drives (VFD) shall be rated at 480 Vac input with features and options as specified.
- B. The variable frequency drives shall be rated for the HP, full load current and rpm of the motor. The variable frequency drives shall be designed to provide microprocessor-based continuous speed adjustment of three-phase motors. The variable frequency output voltage shall provide constant volts-per-Hertz excitation for the motor up to 60 Hertz. The variable frequency drives shall be optimized for an adjustable or selectable carrier frequency to reduce motor noise. The carrier frequency shall be field adjustable and adjusted by the Manufacturer's field engineer during start up.
- C. The variable frequency drives shall be of the Pulse Width Modulated (PWM) design converting the utility input voltage and frequency output via a two-step operation. Variable frequency drives utilizing a third power section are not acceptable. Adjustable Voltage and Current Source variable frequency drives are not acceptable. IGB transistors shall be used in the inverter section. GTOs and SCRs are not acceptable.
- D. The variable frequency drives shall be current regulated. Variable frequency drives

- permitting instantaneous overcurrent trips other than an output short circuit are not acceptable.
- E. The variable frequency drives shall have an efficiency that exceeds 97% at 100% speed and load. The efficiency shall exceed 90% at 50% speed and load. The variable frequency drives shall maintain the line side displacement power factor no less than .95 regardless of speed and load. Variable frequency drive efficiency shall be defined as drive output power at the motor output terminals divided by the input power at the line side of the main circuit breaker.
 - F. Standard operation conditions shall be:
 - 1. Incoming power: Three phase, 480V (+10% to -10%) and 60 hertz (+/- 2 hertz) power to a fixed potential DC bus level.
 - 2. Humidity: 0 to 95% (noncondensing)
 - 3. Altitude: 0 to 3,300 feet above sea level.
 - 4. Ambient temperature: 0 to 40 degrees C.
 - G. The variable frequency drives shall be able to start into a spinning motor. The variable frequency drives shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the variable frequency drives shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor in the preset method of starting.
 - H. Variable frequency drive enclosures shall be NEMA Type 1 free-standing floor-mounted (i.e., use of legs or extensions will not be acceptable), force ventilated (with replaceable air filters) construction requiring front access only. Variable frequency drives requiring rear access for any maintenance are not acceptable. The cooling air required to dissipate heat generated by the power electronics shall be isolated from all drive electronics. Variable frequency drives using liquid-cooled assemblies in conjunction with associated pumps, piping, and separate remote mounted exchangers are not acceptable. The inverters and converters shall have complete unobstructed front accessibility with easily removable assemblies. The complete enclosure shall maintain a constant height, width and depth. The height for all floor-mounted enclosures shall be 90" high. Models 25HP and smaller may be wall mounted. The enclosures shall include the integral isolation/phase shift transformer (as required).
 - I. All variable frequency drive programmable parameters shall be adjustable from a digital operator keypad located on the front door of the variable frequency drive. Parameters shall include:
 - 1. Programmable maximum and minimum frequency.

2. Programmable acceleration and deceleration times.
 3. Selectable carrier frequencies, V/Hz, and critical frequency avoidance lockout.
 4. Adjustable electronic overload and torque limits.
 5. Multiple attempt restart following utility outage or fault condition.
 6. Jog, thread, and preset speeds.
 7. Keypad lockout and factory default overrides.
 8. Adjustable slip compensation (+/- 5%).
- J. The variable frequency drives shall be additionally equipped with a digital operator station mounted on the enclosure front door. Control operator devices and indication lights shall include:
1. Local digital speed control.
 2. Hand-Off-Remote control selector switch.
 3. LED status lights for each HOR position.
 4. Momentary start/stop push buttons utilized with the HOR in "Hand".
 5. Local-Remote speed control selector switch.
 6. LED status lights for each Local-Remote position.
 7. LED status lights for run, fault, alarm, up-to-speed, power on, and drive ready status.
 8. Additional controls as required by Division 11 and 13 and as shown on the drawings. Pump Failure will require pump fail timer (as required). Provide for terminations of remote mounted operator control devices and field devices.
- K. The variable frequency drives shall have the following system interfaces:
1. Inputs:
 - a. Two (2) isolated process control speed reference interfaces to receive and isolate 0-10 Vdc or 4-20 mAdc signals.
 - b. Dedicated terminal blocks for interface with remote operator and field devices.
 - c. 120 Vac control to allow variable frequency drives to interface with remote contacts and with two or three-wire control.

- d. Additional inputs as required by Division 11 or 13 and as shown on the drawings.
2. Outputs:
 - a. Four (4) analog output signals 0-10 Vdc or 4-20 mAdc for external metering.
 - b. Run relay with an isolated set of form C contacts.
 - c. Dry contact output (N.O.) to indicate protective function trip.
 - d. Dry contact output (N.O.) to indicate common alarm.
 - e. Additional outputs as required by Division 11 or 13 and as shown on the drawings.
- L. Monitoring and Displays
1. The variable frequency drives shall have a 40-character vacuum fluorescent display indicating monitored functions as described in the following paragraph.
 2. The following parameters shall be monitored:
 - a. Input current. (3 phases)
 - b. Input voltage. (3 phases)
 - c. Output current. (3 phases)
 - d. Output voltage. (3 phases)
 - e. Output frequency.
 - f. Kilowatts.
 - g. Drive temperature.
 - h. Time.
 - i. Date.
 3. Motor rpm
 - a. Ten (10) most recent trips/faults.
- M. Protection Functions
1. The variable frequency drives shall have the following protective features (with indication for a. through i.):
 - a. Speed compensated electronic motor overload current.
 - b. Undervoltage.
 - c. Overfrequency.
 - d. Overtemperature.
 - e. Ground Fault.
 - f. DC bus protection.
 - g. Inrush current limit (adjustable 50 to 150%).
 - h. Input and output phase loss.
 - i. Emergency stop pushbutton (Red mushroom head and maintained).
 - j. The output side of the VFDs shall be equipped with a current limiting reactor to reduce the amount of fault current to the VFDs.
 - k. Phase insensitive to input power.
 - l. Surge protection from input AC line transients at line side of main circuit breaker.

- m. Electrical isolation between the power, control and logic circuits.
- n. Drive to be capable of withstanding output terminal line short or open circuits without component failure.

N. Additional Features shall be provided as follows:

1. The variable frequency drives shall be equipped with a flange mounted molded case input circuit breaker (65,000 AIC minimum). The breaker shall be interlocked with the enclosure doors to prevent access to the variable frequency drive unless the breaker is in the open position and to prevent moving the breaker to the ON position while the unit door is open. The circuit breaker shall have provisions for padlocking in the open position. Provide mechanical interlocks on doors of auxiliary sections of multi-bay or multi-cubical cabinets.
2. The variable frequency drives shall be variable torque design. Provide constant torque design as required by Division 11.
3. Variable frequency drives shall be capable of unidirectional operation.
4. Variable frequency drives shall have 115 Vac control power for operator devices.
5. Control relays shall be machine tool type, heavy duty type, industrial grade, 600 volt, 10 amp rating, Square D, Class 8501, Type X or equal.
6. All wiring shall be numbered at each end with permanent heat shrink markers. Wiring less than 6 inches may be numbered at only one end.
7. A copper ground bus.
8. Cooling fans shall be on when the variable frequency drive is operating and off when drive is off (fans shall run for a period of time after the variable frequency drive shuts down to dissipate heat and controlled by a thermal switch).
9. All bus and exposed copper shall be tin plated.
10. All floor mounted enclosures shall have complete 24" (minimum) clear space in bottom of the cubical for line, motor and field cable terminations. All wall mounted enclosures shall have complete 18" (minimum) clear space in bottom of the enclosure for line, motor and field cable terminations.
11. Barriers and warning signs on terminals that are energized with the power disconnect OFF.
12. A 2-inch by 5-inch, nominal, engraved three-layer laminated plastic master nameplates on each VFD fastened with stainless steel screws or rivets. Nameplates shall be black letters with white background core, 3/8-inch high lettering and shall indicate equipment designation as shown on the Drawings.

13. Provide legend plates or 1-inch by 3-inch engraved nameplates with 1/4-inch lettering for identification of pilot devices and meters.
14. Provide permanent warning signs as follows:
 - a. "DANGER - HIGH VOLTAGE - KEEP OUT" on all enclosure doors.
 - b. "WARNING - HAZARD OF ELECTRIC SHOCK - DISCONNECT POWER BEFORE OPENING OR WORKING ON THIS UNIT".

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation shall be in strict accordance with the Manufacturer's instructions and recommendations in the locations shown on the Drawings. Field wiring shall be in accordance with Manufacturer's recommendations. Anchor bolts shall be set in accordance with the Manufacturer's recommendations.

3.2 SHOP PAINTING

- A. Prior to shop painting, all surfaces shall be thoroughly cleaned, dry, and free from all mill/scale, rust, grease, dirt, and other foreign matter.
- B. Variable frequency drive enclosures shall be shop painted.

3.3 INSPECTION, TESTING AND STORAGE

- A. The Contractor shall notify the Engineer two weeks prior to all factory and field tests. The Engineer shall have the option to inspect all tests at the factory and in the field.
- B. The Manufacturer shall test the variable frequency drive with a motor load (full rated) prior to shipment for 4 hours. All printed circuit boards shall be tested at 50 degrees C for 40 hours. The variable frequency drive manufacturer shall provide the actual test data and certification that the tests have been completed prior to shipment to the Engineer for approval.
- C. Field Tests
 1. Field tests of the drive shall be made by the Manufacturer who will furnish all equipment and record all data. The Contractor shall be present during testing.
 2. Field tests are the basis of demonstrating equipment proficiency and correct operation.
 3. If the drive performance does not meet the Specifications, corrective measures shall be taken or the drive shall be removed and replaced with a drive which

satisfies the conditions specified. A seven (7) day 24 hour (actual operation) operating period as specified herein of the drive will be required before acceptance. The Contractor shall provide for seven (7) day 24 hour (minimum) on-site supervision of the field acceptance tests. If a drive fails to perform and must be replaced, the rejected drive shall not be removed until the replacement drive has been delivered to the site. If corrective measures are to be taken, such measures shall be done on-site at such times as convenient to the Owner. The Owner shall be allowed to use any drive supplied immediately following installation and testing whether or not the equipment meets the conditions specified.

4. Factory representatives of the Manufacturer who are competent and experienced and who have complete knowledge in the proper operation and maintenance of the equipment shall be provided to inspect and supervise the installation of the equipment and supervise the initial test run. The first visit will be for checking and inspecting the equipment during installation. The second visit will be to operate and supervise the initial field test. If problems are encountered in operation of the equipment additional service shall be provided at no additional cost to the Owner. These services are in addition to the services required for training.
5. Training will not be permitted until all equipment is fully operational. In the event that the equipment becomes inoperable under warranty provisions, additional training will be provided at no additional cost to the Owner.
6. All training shall be coordinated and conducted concurrently with training to be supplied by the equipment and motor manufacturers.
7. Functional Test: Prior to plant start-up, all equipment described herein shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance by means of a functional test. Submit test procedure for review and approval by the Engineer.
8. Vibration Test: Vibration analyses shall be performed on the equipment when operating the variable frequency drive through its entire speed range. Where loads and drives are separated by intermediate flexible shafting, vibration shall be measured both at the top motor bearing and at two points on the equipment bearing, 90 degrees apart.
9. Performance Testing: Demonstrate system performance by operating the system for a seven (7) day continuous period while varying the application load, as the input conditions allow, to verify system performance. Record all data necessary to document the successful performance of the system. Provide all instruments, equipment, and labor required to accomplish this test. If a unit fails the performance test, the supplier will be allowed to readjust and retest the system. If the unit fails the second test, the unit will be rejected and the Contractor shall furnish a unit that will perform as specified.

10. Check each alarm and detection device for proper operation.
11. The drive manufacturer shall provide all necessary personnel and equipment necessary to properly start-up and pass all tests at no additional cost to Owner.
12. A copy of all tests and checks performed in the field complete with meter readings and recordings, where applicable, shall be submitted to the Engineer.

D. General

1. All factory and field tests are typical for each variable frequency drive.
2. Electrical equipment shall at all times during manufacture, testing, delivery and construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors. Electrical equipment shall be stored in dry permanent shelters. Temporary connections shall be provided to operate space heaters and temporary lights required for heat shall be provided to control moisture. If any apparatus has been damaged prior to acceptance the Owner, such damage shall be repaired by the contractor at his own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer, at the cost and expense of the Contractor, or shall be replaced by the Contractor at his own expense.

END OF SECTION

SECTION 16470
PANELBOARDS

PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Furnish all labor, materials, equipment and incidentals required and install all panelboards as shown on the Drawings and as specified herein.
- B. All panelboard wiring shall include wiring numbers and terminal point numbers cross referenced to shop drawing and subsequent record drawing submittals.

1.2 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data, for the following as a minimum:
 - 1. Equipment outline drawings showing elevation and plan views, dimensions and weight. Indicate all options, special features, ratings and deviations from this section.
 - 2. Bus arrangement drawings.
 - 3. Product data sheets and catalog numbers for circuit breakers, etc. List all options, trip adjustments and accessories furnished specifically for this project.
 - 4. Instruction and renewal parts books.
 - 5. Test and inspection reports.
 - 6. Complete bill of materials list.
 - 7. The equipment drawings, summary tables, and bill of materials list shall be computer generated (i.e. no hand-drawn drawings, sketches, lists will be accepted).

1.3 REFERENCE STANDARDS

- A. Panelboards shall be in accordance with the Underwriter Laboratories (UL) "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code (NEC).

- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.4 MANUFACTURERS

- A. 120/240 Volt, single phase, 3 Wire and 120/208 Volt, 3 Phase, 4 Wire panelboards shall be Type Pow-R-Line by Cutler Hammer/Westinghouse; Type NQOD by Square D Co. or Spectra Series as manufactured by the General Electric Co.
- B. 277/480 Volt, 3 Phase, 4 Wire panelboards shall be; Type NEHB by Square D Co.; Type Pow- R-Line by Cutler Hammer or Type AE as manufactured by the General Electric Co.
- C. 480 Volt, 3 Phase, 3 Wire panelboards shall be; I-Line series by Square D Co.; Type Pow-R- Line by Cutler Hammer or Spectra Series as manufactured by the General Electric Co.
- D. NEMA 3R and 4X panelboards shall be as specified herein, provided in 316 stainless steel enclosures as manufactured by the Hoffman or equal and completely assembled by the panelboard manufacturer.
- E. Refer to additional requirements for manufacturers in Section 16000. Alternate suppliers must be submitted for approval to the Engineer in writing four weeks prior to the original bid date with supporting documentation to confirm all aspects of the specifications.

PART 2 PRODUCTS

2.1 GENERAL

- A. Rating
 - 1. Panelboard ratings shall be as shown on the Drawings. All panelboards shall be rated for the intended voltage.
 - 2. Circuit breaker panelboards shall be fully rated for the specified circuit breaker fault current interrupting capacity. Series connected short circuit ratings will not be acceptable.

2.2 MATERIALS (NEMA 1)

- A. Interiors
 - 1. All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the

anti-turn solderless type and all shall be suitable for copper wire of the sizes indicated.

2. Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling or tapping.
3. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.
4. A nameplate shall be provided listing Manufacturer's name, panel type and rating.

B. Buses

1. Bus bars for the mains shall be of tin plated copper. Full size tin plated copper neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction. Cross connectors shall be tin plated copper. Each panel shall be provided with a ground bus bar, with removable link/jumper between neutral and ground bus. The ground bus shall be sized to the maximum number of circuit breakers that can be installed in the panelboard.
2. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
3. Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.
4. Tin plated copper equipment ground bars shall be furnished.

C. Boxes

1. Recessed or flush mounted boxes shall be made from galvanized code gauge steel having multiple knockouts, unless otherwise noted. Boxes shall be of sufficient size to provide a minimum gutter space of 4-in on all sides.
2. Surface mounted boxes and trims shall have an internal and external finish as specified in Paragraph 2.04D4 below.
3. At least four studs for mounting the panelboard interior shall be furnished.

4. All conduit entrances shall be field punched.

D. Trim

1. Hinged doors covering all circuit breaker handles shall be included in all panel trims.
2. Doors shall have semi flush type cylinder lock and catch, except that doors over 48-in in height shall have a vault handle and 3-point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Furnish two keys for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door. All trims shall be door-in-door type construction.
3. The trims shall be fabricated from code gauge sheet steel.
4. All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with ANSI Z55.1, No. 49 or 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.
5. Trims for flush panels shall overlap the box by at least 3/4-in all around. Surface mounted panel trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.

2.3 MATERIALS (NEMA 3R AND 4X)

A. Interiors and Buses

1. Interiors and buses shall be as hereinbefore specified for NEMA 1 construction.

B. Boxes and Covers

1. Boxes, covers and hardware shall be made from 316 stainless steel with natural finish.
2. Boxes and covers shall have continuous welded seams and shall be hinged (piano type) together and gasketed.
3. Conduit openings shall be tapped.

2.4 CIRCUIT BREAKERS

- A. Panelboards shall be equipped with circuit breakers with frame size and trip settings as shown on the Drawings.
- B. Circuit breakers shall be molded case, bolt-in type.

- C. Each circuit breaker used in 120/208 Volt panelboards shall have an interrupting capacity of not less than 22,000 Amps, RMS symmetrical.
- D. Each circuit breaker used in 480 Volt panelboards shall have an interrupting capacity of not less than 65,000 Amps, RMS symmetrical.
- E. GFCI (ground fault circuit interrupter) shall be provided for circuits as required and where indicated the Drawings. GFCI units shall be 1 Pole, 120 Volt, molded case, bolt-on breakers, incorporating a solid state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be UL listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time) and an interrupting capacity of 22,000 Amps, RMS.
- F. Circuit breakers shall be manufactured by the panelboard manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Mount boxes for surface mounted panelboards so there is at least XX-in air space between the box and the wall.
- B. Connect panelboard branch circuit loads so that the load is distributed as equally as possible between the phase busses. Record normal base load phase voltages and currents for each phase and the total neutral current and submit to the Engineer for review.
- C. Install markers on the front cover of all panelboards which identify the voltage rating. Markers shall be made of self-sticking B-500 vinyl cloth printed with black characters on an Alert Orange background, 2-1/4-in high by 9-in wide, Style A as manufactured by W.H. Brady Co. or equal.
- D. Install a 1-in by 3-in nominal laminated plastic nameplate with 1/2-in white letters on a black background on each panelboard. Nameplate lettering shall be as shown on the Drawings. Nameplates shall be stainless steel screw mounted.
- E. Unless otherwise noted on the Drawings, top of cabinets shall be mounted 6 feet-0-inch above the floor, properly aligned and adequately supported independently of the connecting raceways.
- F. All wiring in panelboards shall be neatly formed, grouped, and identified to provide a neat and orderly appearance. A typewritten directory card identifying all circuits shall be placed in the card holder inside the front cover.
- G. All panelboards shall be protected from physical damage, water damage, moisture, corrosion, dirt and dust during construction. Any panelboard judged to be

unacceptable by the Engineer shall be replaced by the Contractor at no additional cost to the Owner.

- H. Standard factory testing shall be performed for the equipment furnished under this section and these tests shall be in accordance with the latest version of NEMA and UL standards. Certified copies of these tests shall be provided to the Engineer upon request.
- I. Field testing and commissioning shall be done in accordance with the latest revision of the "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" published by the International Electrical Testing Association (NETA Standard ATS-2013) unless otherwise modified by this Section.

3.2 CLEANING

- A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner or clean lint-free rags. Do not use compressed air.

END OF SECTION

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SECTION 16480
480 VOLT MOTOR CONTROL CENTERS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish install and test the motor control centers as shown on the Drawings and as specified herein.
- B. Motor control centers shall be sized to include all equipment, spares and spaces shown on the Drawings.

1.2 RELATED WORK

- A. Concrete for equipment pad is included in Division 3.

1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data, for the following as a minimum:
 - 1. Equipment outline drawings showing elevation and plan views, dimensions, weight, shipping splits and metering layouts. Indicate all options, special features, ratings and deviations from this Section.
 - 2. Conduit entrance drawings.
 - 3. Bus arrangement drawings.
 - 4. Unit summary tables showing detailed equipment description and nameplate data for each compartment.
 - 5. Product data sheets and catalog numbers for overcurrent protective devices, motor starters, control relays, control stations, meters, pilot lights, etc. List all options, trip adjustments and accessories furnished specifically for this project.
 - 6. Provide control systems engineering to produce custom unit elementary and compartment wiring diagrams for metering, relay, power and control circuits in accordance with the NEMA wiring class specified. Elementary drawings shall show interwiring and interlocking between units and to remotely mounted devices. Show all field devices, switches, lights, wire, terminal numbers, etc. and indicate special identifications for electrical devices per the Drawings.
 - 7. Instruction and renewal parts books.

8. Itemized list of spare parts furnished specifically for this project, including quantities, description and part numbers.
9. Test and inspection reports.
10. Complete bill of materials list.
11. The equipment drawings, summary tables, elementary drawings/ diagrams, spare parts list and bill of materials list shall be computer generated (i.e. no hand-drawn drawings, sketches, lists will be accepted).

1.4 REFERENCE STANDARDS

- A. Motor control centers shall be designed, built and tested in accordance with the latest editions and revisions of NEMA Standard ICS-2 and Underwriters Laboratories (UL) Standard No. UL- 845. Equipment shall conform to ANSI C19.3 test standards and the requirements of the National Electrical Code (NEC).

1.5 QUALITY ASSURANCE

- A. The motor control centers shall be the product of a manufacturer who shall also be the manufacturer of all the circuit breakers, fused switches and motor starters included in the motor control center and who has produced the same type of equipment for a period of at least 15 consecutive years.
- B. Motor control centers shall be designed, assembled and tested by the manufacturer of the motor control equipment included in the control center assembly.
- C. All units and sections shall be UL labeled. Motor control centers containing service entrance equipment shall be UL labeled "Suitable For Use As Service Equipment."

1.6 OPERATING AND MAINTENANCE MANUALS

- A. Operating and maintenance manuals shall be furnished in accordance with Division 01 and Section 16000.
- B. The manuals shall be bound and shall also include:
 1. A list of "as left" settings for all motor circuit protectors and circuit breakers.
 2. A table listing cubicle number, load description, installed overload heater size and motor horsepower, Amps, service factor and starting code letter.

1.7 MANUFACTURERS

- A. The general arrangement of the motor control centers is shown on the Drawings. Motor control centers shall be one of the following products:
 - 1. Eaton / Cutler Hammer Freedom 2100 Series
 - 2. Schneider Electric / Square D Model 6 Series
 - 3. Allen Bradley Centerline 2100 Series

PART 2 PRODUCTS

2.1 RATING

- A. Service: 480 Volt, 3 Phase, 3 Wire, 60 Hz.
- B. The overall short circuit withstand and interrupt rating of the equipment and devices shall be not less than 65,000 Amps, RMS symmetrical at 480 Volts unless otherwise shown on the Drawings. Main and feeder circuit protective devices shall be fully rated for the specified short circuit duty. Systems employing series connected ratings for main and feeder devices shall not be used. Motor starter units shall be tested and UL labeled for the specified short circuit duty in combination with the motor branch circuit protective device.
- C. The continuous current rating of the main horizontal bus shall be as shown on the Drawings. Vertical busses shall be sized for the structure load and shall have a minimum rating of 300 Amps. Bus bracing shall equal or exceed the specified equipment short circuit rating.
- D. Motor control centers, including devices, shall be designed for continuous operation at rated current in a 40 degree C ambient temperature.

2.2 CONSTRUCTION

- A. Enclosure
 - 1. Enclosure type shall be NEMA Type 1 gasketed unless otherwise noted on the drawings.
- B. Structure
 - 1. Motor control centers shall consist of a series of metal enclosed, free-standing, dead front vertical sections bolted together to form double wall construction between sections. Individual vertical sections shall be nominally 90-in high, 20-in wide and 20-in deep unless otherwise shown on the Drawings. Bottom channel sills shall be mounted front and rear of the vertical sections extending the full width of each shipping split. Top of each section shall have removable plates with lifting angle. Make provisions for field installation of additional sections to each end and provide full depth cover plates (rodent barriers) at each end of the motor control center channel sills.

2. Provide continuous top and bottom horizontal wireways extending the full width of the line-up, isolated from the horizontal bus. Provide a 4-in wide, full height, vertical wireway in each section, equipped with a hinged door and cable supports. Vertical wireway shall be isolated from the bus and device compartments. Wireways openings shall have rolled edges or protective grommets.
3. Provide individual, flange formed, pan type door with concealed hinges and quarter turn latches for each device compartment and future space. Doors shall be removable. Door removal shall not be required to withdraw starter units or feeder tap devices.
4. Motor control centers shall be designed for against-the-wall or back-to-back mounting. All wiring, bus joints and other mechanical parts requiring tightening or other maintenance shall be accessible from the front or top.

C. Unit Compartments

1. Provide individual compartments for each removable combination starter and feeder tap device unit. Each vertical section shall accommodate a maximum of six compartments. Steel barriers shall isolate the top, bottom and sides of each compartment from adjacent units and wireways. Removable units shall connect to the vertical bus in each section with tin plated, self-aligning, pressure type copper plug connectors. Size 5 and larger starter units may be wired directly to the bus. Removable units shall be aligned in the structure on guide rails or shelves and secured with a cam latch mechanism or racking screw.
2. Provide individual, isolated compartments for all fixed mounted devices including circuit breakers, cable lugs, metering, relaying and control devices. Main and bus tie circuit breakers shall be wired directly to the main horizontal bus. All bus connections shall be fully rated.
3. Provide the following features:
 - a. Provision to padlock removable units in a partially withdrawn TEST position, with the bus stabs disengaged.
 - b. Provision to padlock unit disconnect handles in the OFF position with up to three padlocks.
 - c. Mechanical interlock with bypass to prevent opening unit door with disconnect in the ON position, or moving disconnect to the ON position while the unit door is open.
 - d. Mechanical split-type terminal blocks for disconnecting external control wiring.
 - e. Auxiliary contact on unit disconnect to isolate control power when fed from an external source.
 - f. Disconnect operating handles and control devices mounted on the removable units.

- g. All compartments shall have laminated wiring diagrams fastened to the inside of each compartment door. Compartments containing motor starters shall have laminated wiring diagrams and heater tables fastened to the inside of the compartment door. Compartments containing panelboards shall have circuit directories consisting of two ply laminated plastic, with black face and white core fastened to the inside of the compartment door.

D. Bus Systems

1. Main horizontal bus: Tin plated copper, bolted joints, accessible from the front of the structure, fully rated throughout the lineup.
2. Vertical section bus: Tin plated copper, full height, totally insulated and isolated by glass polyester barriers with shutters to cover stab openings when units are withdrawn. Provide fishtape barriers to isolate bottom wireways from lower ends of vertical bus.
3. Vertical buses used for a tie circuit breaker or tie feeder lugs shall be rated for a continuous capacity equivalent to the main horizontal bus rating.
4. Horizontal ground bus: Provide a 1/4-inch by 2-inch (minimum) tin plated copper uninsulated ground bus in each section equipped with lugs for termination of feeder and branch circuit ground conductors. Connect to ground bus in adjacent sections with splice plates.

E. Wiring

1. Wiring: Stranded copper, minimum size No. 14 AWG, with 600 Volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation, NEMA Class II-S, Type B. Line side power wiring shall be sized for the full rating or frame size of the connected device.
2. Identification: All wiring shall be numbered with type written heat shrinkable type wire markers at each termination point, color coding per NEMA Standards and the NEC. Foreign voltage control wiring shall be yellow.

F. Signage

1. Each motor control center shall be furnished with a sign marked "DANGER - 480 VOLTS - KEEP OUT". Letters shall not be less than 1-in high, 1/4-in stroke. Signs shall be laminated plastic, engraved white letters with a red background.
2. Compartments with voltages from sources outside of the compartment shall have a sign mounted inside the compartment door marked "CAUTION - THIS

UNIT CONTAINS A VOLTAGE FROM AN EXTERNAL SOURCE". Letters shall be black on a high visibility yellow background.

3. Provide a 2-in by 6-in nominal engraved master nameplate, of two ply laminated plastic, black face, 1/4-in high by 1/8-in stroke white letters, screw fastened to the top wireway of each lineup with stainless steel screws. Include MCC designation and service ratings.
4. Provide 1-in by 3-in nominal engraved unit nameplates of two ply laminated plastic, black face, 3/8-in high by 1/16-in stroke white letters, screw fastened to each door with stainless steel screws. Equipment names shall be as shown on the drawings.

2.3 COMPONENTS

A. General

1. The Drawings indicate the approximate horsepower and intended control scheme of the motor driven equipment. Provide the NEMA size starter, circuit breaker trip ratings, control power transformers and thermal overload heater element ratings matched to the motors and control equipment actually supplied, in compliance with the NEC and the manufacturer's heater selection tables. All variations necessary to accommodate the motors and controls as actually furnished shall be made without extra cost to the Owner.

B. Circuit Breakers

1. Power circuit breakers (400 Amps and larger): 100 percent equipment rated, 600 Volt, molded case circuit breakers with integral fully adjustable solid state trip device. Trip device shall be temperature insensitive and have the following characteristics and functions:
 - a. Independently adjustable long time pick-up and delay.
 - b. Independently adjustable short time pick-up and delay with i 2 t in and out switch.
 - c. Adjustable instantaneous.
 - d. Independently adjustable ground fault pick-up and delay.
 - e. Trip mode targets for over load, short circuit and ground fault.
 - f. Long time pick-up light.
2. Circuit breakers (Less than 400 Amps): Thermal-magnetic trip type, 600 Volt, 2 or 3 Pole as required, labeled in accordance with UL 489. Provide integral current limiting fuses as required to meet the specified equipment short circuit rating. Provide independently adjustable magnetic trips on 225A frame breakers and larger.

C. Combination Starter Units

1. Combination starters shall include a motor circuit protector (MCP) in series with a motor controller and an overload protective device. The MCP shall have an adjustable magnetic trip range up to 1000 percent of rated continuous current and a trip test feature. MCP's shall be labeled in accordance with UL489.
2. Motor starters: 3 Pole, 600 Volt, electrically operated, of the types shown on the Drawings. Provide NEMA sizes as required for the horsepower shown on the Drawings. Minimum size shall be NEMA Size 1. Fractional size starters are not acceptable. IEC rated starters shall not be acceptable. Starters shall have 120 Volt encapsulated operating coils; individual control power transformers with primary and secondary fuses and silver cadmium oxide renewable line contacts.
3. Multi-speed and reversing starters shall include two motor rated contactors mechanically and electrically interlocked so that only one device may be energized at any time.
4. Reduced voltage starters: Auto-transformer type with closed circuit transition. Auto- transformers shall be dry type with 50, 65 and 80 percent voltage taps and over- temperature protection. Timing relays shall be pneumatic, adjustable. Relay settings shall be approximately 75 percent of relay range.
5. Reduced voltage starters: Solid state, six SCR, full wave type with adjustable current limit and voltage ramp to control starting torque, automatic load sensing circuit to minimize energy consumption, line and load side surge protection and noise suppression and controlled deceleration adjustment to reduce the effects of surges caused by centrifugal pump loads. Provide heat sinks and ventilation to remove heat from the structure. Each starter shall include a motor horsepower rated isolation contactor to positively disconnect the line voltage when the SCR control is off.
6. Variable Speed Drives: Where shown on drawings, furnish VFD's mounted within the MCC. The VFD's shall be of the manufacturer specified in Section 16370, Paragraph 1.3,G.
7. Contactors: Electrically held, 120 VAC coil operator, suitable for tungsten, ballast, or resistive non-motor loads, with over current protection, control transformer and contact ratings and poles as shown on the Drawings.
8. Motor overload protection: Standard, 3 Pole, thermal bi-metallic or melting alloy type, with push-to-test feature. Electronic or adjustable overload relays will not be acceptable. Overload relays for submersible pump motors shall be ambient compensated, quick trip, Class 10. Overload relays shall be manually reset from outside the enclosure by means of an insulated pushbutton. Provide auxiliary alarm contacts where shown on the Drawings.
9. Auxiliary contacts: Form C, NEMA A600 rating, as required by the control schemes on the Drawings. Provide 1-normally open and 1-normally closed

spare contacts on each starter. Additional auxiliary contacts shall be furnished as shown on the Drawings or as required by the control schematic and this Section.

10. Control power transformers: Two winding type, 120 VAC secondary, fused in accordance with the NEC. Provide extra capacity as required or where shown on the Drawings.

D. Relays and Timers

1. Control relays and timers: Heavy duty machine tool type, with 10 Amps, 600 Volt convertible contacts, General Electric Co., CR120 Series; Cutler Hammer, Type M-600; Square D, Type X or equal. Provide pneumatic timing or latching attachments as required by the control schemes shown on the Drawings.
2. Panel mounted timers: Provide as noted on the drawings, flush mounted, plug-in type, Eagle Signal, Bulletin 125 Cycle-Flex or equal, with ranges as shown on the Drawings.

E. Protective Relays

1. 3 Phase voltage relays: Solid state, Westinghouse Type SVM3 or equal, with the following features:
 - a. Undervoltage protection, 10 to 20 percent, adjustable.
 - b. Phase Unbalance, 5 to 10 percent, adjustable.
 - c. Phase loss/reversal protection.
 - d. Restart timer, 0 to 5 minutes, adjustable.
 - e. LED trip indicators.
 - f. Automatic or manual reset.
 - g. Isolated NO and NC output contacts for alarm and trip.
2. Single phase current sensing relays: Solid state, Allen Bradley Bulletin 809S or equal, with the following features:
 - a. Independently adjustable trip setting and differential.
 - b. Adjustable trip time delay.
 - c. Restart timer.
3. LED trip indicator.
 - a. Automatic reset.
 - b. Isolated NEMA B600 output contact
 - c. 5 Amp window type current transformer for input.

F. Pilot Devices

1. Control operators: Heavy duty, full size, oiltight, with NEMA A600 contact rating. Types and quantities as shown on the Drawings.
2. Indicator lights: Full size, oiltight, low voltage, LED type, with push-to-test

feature. Colors and quantities as shown on the Drawings.

G. Miscellaneous Units

1. Bus connected surge protection: 600 Volt, 3 Phase lighting protection shall be Advanced Protection Technologies, TE/4HP Series, Surge Suppression Inc. CILA3Y2M, or equal.
2. Power factor correction capacitors: Installed by the motor control center manufacturer and furnished by the motor manufacturer.
3. General purpose transformers: Open, dry-type, with primary and secondary overcurrent protection in accordance with the NEC, size and voltage ratings as shown on the Drawings. Refer to Section 16191 for additional requirements.
4. Lighting and Distribution Panelboards: Factory wired to transformer, bolt-on branch circuit breakers, size and voltage rating as shown on the Drawings. Refer to Section 16470 for additional requirements.

2.4 SURFACE PREPARATION AND SHOP COATINGS

- A. All non-current carrying metal parts of the control center assembly shall be cleaned of all weld spatter and other foreign material and given a heat cured, phosphatized chemical pre-treatment to inhibit rust.
- B. Unpainted non-current carrying parts shall receive a protective zinc plating to prevent corrosion.
- C. Indoor equipment shall be finish painted with one coat of manufacturers standard electrocoated, heat cured enamel. Color shall be ANSI-49 or 61 light grey.

2.5 SHOP TESTING

- A. Perform Manufacturers standard production testing and inspection in accordance with NEMA and ANSI standards. If requested by the Engineer, the manufacturer shall submit certified copies of the test results and reports.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Motor control center floor sills shall be bolted directly to the finished floor or equipment pad. Structure shall be leveled and plumb. Anchor bolts shall be 1/2-inch (minimum). Provide hardware and shims for installation.
- B. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are

not stressed.

- C. In general, all conduit entering or leaving a motor control center shall be stubbed up into the bottom horizontal wireway directly below the vertical section in which the conductors are to be terminated, or shall enter the motor control center from the top. Conduits shall not enter the motor control center from the side unless approved in writing by the Engineer.
- D. Housekeeping pads shall be included for the motor control centers as detailed on the Drawings with the exception of motor control centers which are to be installed adjacent to an existing unit. Housekeeping pads for these (if used) should match the existing installation.
- E. Where motor control centers are to be installed on existing floor slabs, concrete anchor bolts sized and installed per the requirements of this Section shall be used.
- F. Install the equipment in accordance with the manufacturer's instructions.
- G. Remove temporary lifting angles, lugs and shipping braces. Touch-up damaged paint finishes.
- H. Make wiring interconnections between shipping splits.
- I. Install bus splice plates and torque connections.
- J. No operator devices shall be located over 6 ft. 6 in. above the operating floor. Circuit breaker operating handles located more than 6 ft. 6 in. above the operating floor shall have operating arm extensions.

3.2 FIELD TESTING

- A. Make the following minimum tests and checks before the manufacturer's representative is called in for testing and adjustment.
 - 1. Megger incoming line terminals and buses, phase-to-phase and phase-to-ground after disconnecting devices sensitive to megger voltage.
 - 2. Remove current transformer shunts after completing secondary circuit. Check polarity and continuity of metering and relaying circuits.
 - 3. Check mechanical interlocks for proper operation.
 - 4. Test ground connections for continuity and resistance.
 - 5. Adjust unit compartment doors.

6. Check control circuit interlocking and continuity with starters in the TEST position. Provide external source of control power for this test.
 7. Adjust motor circuit protectors and voltage trip devices to their correct settings.
 8. Install overload heaters for actual motor nameplate currents.
- B. In the event of an equipment fault, notify the Engineer immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor, Engineer, Owner and the equipment manufacturers' factory service technician. Repair or replace the equipment as directed by the Engineer prior to placing the equipment back into service.

3.3 ADJUSTMENT

- A. The motor control center manufacturer shall provide the services of a factory trained service technician for start-up and training of the Owner's personnel. The first trip shall be coordinated with the equipment start-up. The second trip shall include any necessary follow-up or punch list work and shall also include instructions to the Owner or to his/her designated personnel. The manufacturer's service technician shall demonstrate and test all operational features of the installed equipment to the satisfaction of the Owner. Submit a certified copy of the field inspection to the Engineer. No equipment shall be energized without the written approval of the Engineer.
- B. The motor control center manufacturer's factory service technician shall make the following inspection, tests and adjustments:
1. Calibrate and test main and feeder circuit breaker trip devices and protective relays per the approved Coordination Study specified in Section 16000.
 2. Inspect the installation for compliance with the manufacturers recommended installation practices and report all deviations to the Engineer.

3.4 CLEANING

- A. Remove all rubbish and debris from inside and around the control center. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

END OF SECTION

SECTION 16502
LIGHTNING PROTECTIVE SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. This section includes the work required to furnish and install a complete lightning protection system (LPS) for the Arbennie Pritchett WRF.
- B. The lightning protection system shall be furnished to provide protection to the Owner's personnel, buildings, and equipment from lightning strikes.
- C. The lightning protection system shall be Master U.L. certified.

1.2 WORK INCLUDED

- A. The Contractor shall provide all components, system installation services, and all specified ancillary services in connection with the LPS.
- B. The system shall include all materials, labor, tools, fees, charges, and documentation required to furnish, install, test, and place in operation a complete and operable LPS.
- C. The system shall include all air terminals, wire, ground rods, bonding plates, accessories, and other components required for the completion of a functional and unobstructive LPS for proposed buildings, structures and equipment at this projectsite.
- D. Roof mounted equipment includes air handling units, exhaust fan housings, vents, etc., and shall be protected with Class II aluminum components.
- E. The scope of the work to be performed includes all existing and proposed buildings, structures and equipment at this project site, including the following:
 - 1. Proposed Electrical Building No. 3
 - 2. Proposed Oxidation Ditch No. 3
 - 3. Proposed Clarifier No. 3
 - 4. Proposed RAS Pump Station No. 2
 - 5. Proposed Generator

- F. It is the intent of the specifications to construct a complete LPS installation for the entire site. Items of equipment or materials which may reasonably be assumed as necessary to accomplish this end shall be supplied whether or not they are specifically stated herein.
- G. It is the intention of the specifications to call for finished work, tested, and ready for operation. All materials, equipment, and apparatus shall be new and first class quality.
- H. Any apparatus, appliance, material, or work mentioned in the specifications or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation, shall be provided without additional expense to the Owner.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The LPS shall be installed in accordance with the following code requirements:
 - 1. National Fire Protection Association (NFPA) Code NFPA 780 (latest edition).
 - 2. Underwriter's Laboratories Standards for Safety UL 96 "Lightning Protection Components".
 - 3. Underwriter's Laboratories Standards for Safety UL 96A "Instrumentation Requirements for Lightning Protection Systems".

1.4 GENERAL INFORMATION AND DESCRIPTION

- A. Where manufacturers are named for a particular item of equipment, it is intended as a guide to acceptable quality and performance and does not exempt such equipment from the requirements of these Specifications.
- B. In order to centralize responsibility, it is required that all the LPS components shall be furnished and installed by the Contractor who shall assume complete responsibility for installation of the LPS.
- C. The Contractor shall retain total responsibility for the proper detailed design, fabrication, inspection, test, delivery, assembly, installation, activation, checkout, adjustment and operation of the entire LPS.
- D. The Contractor shall be responsible for the delivery of all detailed drawings, manuals, and other documentation required for the complete coordination and installation of the LPS.
- E. The Owner shall have the right of access to the Contractor's facility and the facilities

of its equipment suppliers to inspect materials and parts; witness inspections, tests and work in progress; and examine applicable design documents, records and certifications during any stage of design, fabrication and tests.

- F. If any departures from the contract documents are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted as soon as practicable to the Engineer for approval. No such departures shall be made without the prior written approval of the Engineer.

1.5 LIGHTNING PROTECTION CONTRACTORS

- A. Acceptable lightning protection contractors shall meet the following qualifications:
 - 1. Ten years or more in the lightning protection contracting business.
 - 2. Reference ten or more LPS projects completed in the last five years.
 - 3. Reference five or more major LPS projects completed in Florida.
 - 4. Contractors must be UL Master Labor Approved.

1.6 INTERPRETATION OF SPECIFICATIONS

- A. Any questions or disagreements arising as to the intent of the specification or the kind and quality of work required thereby shall be decided by the Engineer, whose interpretations thereof shall be final, conclusive, and binding on all parties.
- B. In case of disagreement within the specification, the better quality, greater quantity, or more costly work shall be included in the contract price and the matters referred to the Engineer's attention for decision.

1.7 SITE VISIT

- A. The Contractor shall visit the site to examine the location of the proposed work and to determine the existing conditions that may affect the work.

1.8 SUBMITTALS

- A. Submittal data for the LPS shall include the following:
 - 1. Plan view of sites showing buildings and structures, locations of air terminals, and associated zone of protection for each air terminal. Show all equipment on roofs which require protection.
 - 2. Schematic diagram of LPS showing air terminals, conductors, and other connectors or fittings required for the complete system. Provide details showing all bonding requirements to structural steel, water piping, etc.

3. Locations of connection points of the LPS to facility grounding system.
4. Contractor shall provide five (5) complete sets of shop drawings for review, showing locations of air terminals, conductors, installation procedures and details, and detailed data sheets on all components, accessories, and miscellaneous equipment to be used in this installation.

1.9 SHOP DRAWINGS

- A. Submit to the Engineer for approval shop drawings of all equipment, catalog cuts, and plans, plus any additional copies required for installation of the work, and further obtain written approval for same from the Engineer before installing any of these items.
- B. Shop drawings shall also consist of manufacturer's product data, catalog cuts, including descriptive literature showing dimensions, code requirements, etc., as indicated in the specifications.

1.10 RECORD DRAWINGS

- A. During construction maintain an accurate record of all work installed.
- B. Make a complete record of all changes and revisions made to the original design in a neat and accurate manner.
- C. When all revisions showing the work as finally installed are made, the corrected prints shall be submitted to the Engineer. Submit three (3) sets of record drawing prints and one (1) mylar set.

1.11 ORGANIZATION OF WORK

- A. The work shall be executed in the best and most thorough manner and to the satisfaction of the Engineer, who shall have the authority to reject any work and materials which, in the Engineer's judgement, are not in full accordance therewith.
- B. Where the work is to be installed in close proximity to existing work or where there is evidence that the work is to interfere with existing conditions, work out space conditions to make a satisfactory adjustment.
- C. If the installation is made before coordination with existing conditions, all necessary changes in the work to correct the condition shall be made without extra charge to the Owner.
- D. All work shall be subject to inspection by the Engineer and the facility personnel during the course of construction.

1.12 PROTECTION OF WORK AND PROPERTY

- A. Maintain and protect all equipment and materials from loss or damage of all causes until final acceptance by the Owner.
- B. Assume responsibility for the protection of any finished work from damage or defacement by the operations and remedy any such injury or damage.

1.13 STANDARD

- A. All equipment used in this installation shall be factory inspected, approved, and properly labeled in accordance with UL requirements.
- B. All equipment shall be new, the product of a single manufacturer as outlined above, and of a design and construction to suit the application where it is used in accordance with accepted industry standard UL requirements.

1.14 REFERENCED DOCUMENTS

- A. Underwriters Laboratories, Inc.
- B. National Fire Protection Association.

1.15 DOCUMENTATION

- A. All documentation shall be delivered to the Owner prior to final acceptance of the work in accordance with the Contract Documents.
- B. If any documentation or other technical information submitted is considered proprietary, such information shall be so designated. Such documentation or information will be used only for the construction, operation, or maintenance of the LPS and, to the extent permitted by law, will not be published or otherwise disclosed.
- C. A complete set of detailed diagrams defining the LPS shall be prepared and delivered. All diagrams shall be 11" x 17" and shall be original mylars or transparent reproducible prints.
- D. All diagrams shall have been corrected so as to describe final "as-built" hardware configurations and to reflect the system configuration and control methodology adopted to achieve final system acceptance.
- E. The diagram submittal shall be made before final acceptance of the work. Copies of diagrams shall be furnished in accordance with the General Conditions.
- F. The Contractor shall deliver the installation manual containing illustrations, detailed drawings, wiring diagrams, instructions necessary for installing and

maintaining the equipment.

- G. All information shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

1.16 GUARANTEE

- A. The Contractor shall furnish, install, maintain, and guarantee the LPS as specified in the General Conditions.
- B. The Contractor guarantees by its acceptance of the Contract that all work installed will be free from any and all defects, and that if during a period of one year from the date of completion and acceptance of the work, any such defects in workmanship, material, or performance appear, it shall immediately replace, repair, or otherwise correct the defect or deficiency without cost to the Owner within reasonable time.
- C. Replace or repair to the satisfaction of the Owner any damage done to the building or its contents in consequence of work performed in fulfilling guarantee.
- D. In the event of default on this guarantee by the Contractor, the Owner may have such work done as required and charge the cost to the Contractor.
- E. The date of acceptance shall be the date of final payment by the Owner or notice of acceptance by the Owner, whichever is later.

1.17 QUALITY ASSURANCE

- A. It is the intent of these Specifications to secure high quality in all materials, equipment, and workmanship in order to facilitate operations and maintenance of the LPS.
- B. All equipment and materials shall be new and the products of reputable recognized suppliers having adequate experience in manufacturing the materials and equipment.
- C. For uniformity, only one manufacturer will be accepted for each type of product.
- D. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and during continuous or intermittent operation.
- E. All equipment shall be adequately stayed, braced, anchored, and installed in a neat and workmanlike manner. Appearance, safety, and utility shall be given consideration in the design of the details.

- F. All components and devices installed shall be of standard items of industrial grade, unless otherwise noted, which shall be of sturdy and durable construction suitable for long, trouble- free service.
- G. All work shall be installed in accordance with the UL 96A Code, state, local, and other applicable codes.
- H. All components used in the LPS shall conform to the requirements and specifications of UL Standards for Safety UL 96, Lightning Protection Components, and shall have affixed thereon the appropriate UL Listing labels.
- I. The installation methods and techniques used in the LPS shall conform, to the maximum extent possible, to the requirements and specifications of UL Standards for Safety UL 96A, Installation Requirements for Lightning Protection Systems.
- J. The Contractor shall be responsible for accompanying the Owner or its representative on a walk-through of each structure as the installation is completed, and on a walk-through of the entire facility upon completion of the project.
- K. Complete shop drawings showing the type, size, and locations of all equipment, grounds, and cable routings, etc., shall be submitted to the Engineer for approval prior to starting work.
- L. Samples and pertinent catalog data shall be submitted to the Engineer for approval upon request. Any deviations shown must comply with UL requirements.
- M. All materials and components shall be listed and/or certified to indicate that they have been manufactured for use in Class II building lightning protection systems under provisions of UL 96.
- N. All installation shall be performed to meet UL Master Label standards.
- O. To the extent that the structure to be protected is eligible under the standards of UL 96A, a UL Master Label shall be provided for the installation upon completion of the work.
- P. If the structure is not eligible under the standards of UL 96A, a Letter of Findings shall be provided for the installation upon completion of the work.

PART 2 PRODUCTS

2.1 GENERAL

- A. The equipment shall be provided by the Contractor to provide a facility LPS

based on the requirements contained herein.

2.2 CERTIFICATION

- A. The complete system shall meet or exceed NFPA-780, and UL Standard Nos. 96 and 96A.

2.3 CONDUCTORS

- A. Cable shall be copper and shall meet all the requirements of NFPA No. 780 and UL Standard Nos. 96 and 96A. Aluminum conductors will be allowed where required to avoid corrosion due to galvanic action between dissimilar metals.

- B. Copper Conductors:

- 1. Shall consist of UL listed 32 strands of 17 gauge copper wire weighing 215 pounds per 1,000 feet and installed in accordance with the UL Code.
- 2. A perimeter cable shall be installed around the entire main roof, and all penthouses and cooling towers.
- 3. All center roof air terminals shall be interconnected with conductors to the outside perimeter cable.
- 4. Conductors on the flat roof areas may be run exposed.
- 5. Ground connections shall be made around the perimeter of each roof and to the main down conductor.

- C. Aluminum Conductors:

- 1. Shall consist of Listed 37 strands of 13 guage aluminum wire weighing 200 poundsper 1,000 feet for roof conductor, and 28 strands of 14 gauge copper wire weighing 375 pounds per 1,000 feet for downlead conductor.
- 2. A perimeter cable shall be installed around the entire main roof, and all penthouses and cooling towers. Each perimeter cable shall be connected to at least two down leads, providing a two-way path to ground.
- 3. All center roof air terminals shall be interconnected with conductors to the outside perimeter cable.
- 4. Conductors on the flat roof areas may be run exposed.
- 5. Ground connections shall be made around the perimeter of each roof and to the main down conductor.

2.4 CONCEALED CONDUCTORS

- A. All concealed conductors shall be installed in Schedule 80 PVC conduit.

2.5 FASTENERS

- A. Conductor fasteners shall be an approved type of non-corrosive metal, have ample strength to support conductors, and be spaced not to exceed 3'-0" centers.
- B. Masonry type cable fasteners spaced every 3'-0" on masonry.
- C. Adhesive type cable fasteners spaced every 3'-0" on flat roofs.

2.6 ROOF PENETRATIONS

- A. Wherever the conduit penetrates the roof, copper pitch pans shall be furnished by the lightning protection contractor.

2.7 DOWN CONDUCTORS

- A. Buildings that are of reinforced concrete or wall bearing structures, the concealed down conductors shall be installed in Schedule 80 PVC conduit.
- B. Each perimeter roof cable shall be connected to at least two downleads.
- C. The average distance between down leads shall not exceed 100 feet from upper roof to lower roof, or from roof to ground terminals.
- D. Irregularly shaped structures may require extra down conductors to provide a two way path to ground from each air terminal.

2.8 CABLE CONNECTORS

- A. All cable connectors shall be cast bronze with screw-pressure type stainless steel bolts and nuts.

2.9 INTERCONNECTION OF METALS

- A. All metal bodies within six feet (6') of the conductor shall be bonded to the system with approved fittings and conductor.
- B. Connections between dissimilar metals shall be made with approved bimetallic connections.
- C. Bonding of all metallic objects and systems at roof levels and elsewhere on the structure shall be complete.

- D. Primary bonds for metal bodies of conductance shall be bonded with appropriate fittings and full-size conductor; and shall consist of, but not limited to the following: Roof exhaust fans, HVAC units with related piping ductwork, exhaust vents and any other roof piping systems, handrails, roof ladders, etc.

2.10 GROUNDING

- A. In addition to the requirements specified in UL Standard Nos. 96 and 96A, the LPS shall be in accordance with the following requirements:
 - 1. Wherever practicable, connections to ground electrodes should be made at a point not less than one foot (1') below grade and at not less than two feet (2') away from structure foundations.
 - 2. Interconnection to the ground electrodes shall be made utilizing main size conductors.

2.11 GROUNDING CLAMPS

- A. Clamps used to connect down conductors to driven ground rods shall make contact with the rod for a continuous length of 1-1/2". This connection shall be measured parallel to the axis of the ground rod.
- B. Clamps shall be secured with a minimum of two bolts. Crimp type fittings are not acceptable.

2.12 AIR TERMINAL

- A. Air terminals shall be 5/8-in x 18-in minimum solid copper and shall extend at least 18-in above the object to be protected. Air terminal bases shall be cast bronze with stainless steel bolt pressure cable connectors. The air terminals should be spaced as not to exceed 20 feet apart around the outside perimeter of the roof or the ridge and not over 50 square feet apart through the center of flat roof areas. The air terminals in the center roof area shall be 5/8-in x 18-in solid copper with proper bracing. All air terminals shall not exceed 18-in unless approved by the Engineer.
- B. Aluminum air terminals will be allowed where required to avoid corrosion due to galvanic action between dissimilar metals. Aluminum air terminals shall be solid and have the same dimensions as copper air terminals.

2.13 MATERIALS

- A. The supplier must include all items necessary for a complete LPS installation.
- B. If material of equipment is installed before it is approved, and in the opinion of the Engineer the material or equipment does not meet the intent of the specifications, the removal and replacement shall be made at no extra cost to the Owner.

- C. All equipment and materials required for installation under these specifications shall be new and without blemish or defect.
- D. All LPS equipment shall bear labels attesting to UL approval.
- E. Where it is proposed to use an item or equipment other than that specified and it requires any redesign, all such redesign, and all new drawings and detailing required therefore shall, with the approval of the Engineer, be prepared at no additional cost to the Owner. Such review costs shall be borne by the Contractor.
- F. Where such approved deviation requires a different quantity and arrangement of material and equipment from that specified, with the approval of the Engineer furnish and install any such material and equipment required by the system, at no additional cost to the Owner.
- G. All equipment of one type shall be the product of the same manufacturer.
- H. Note that the approval of shop drawings, or other information submitted in accordance with the requirements heretofore specified, does not assure that the Engineer attests to the dimensional accuracy or dimensional suitability of the material or equipment involved or the performance thereof.
- I. All products employed shall meet the standards of UL 96, Lightning Protection Components.
- J. The products employed shall be produced by manufacturers who have obtained on those products UL listings appropriate to the class of device employed.
- K. Each component shall have affixed thereon a UL Listing mark or label appropriate to the class of service in which it is employed.
- L. Components shall be constructed of material as specified by UL 96 and UL 96A for a system employing copper components, unless otherwise necessary to prevent metals from coming into contact, in which case aluminum components will be acceptable.

2.14 STANDARD LIGHTNING PROTECTION COMPONENTS

- A. Lightning protection components for installation to the above specifications shall be manufactured and supplied by one, or a combination, of the following companies, or approved equal:
 - 1. Thompson Lightning Protection, Inc.
 - 2. Robins Lightning, Inc.

3. Or equal.

PART 3 EXECUTION

3.1 GENERAL

- A. The Contractor shall design and install the LPS.
- B. Installation shall be performed by a certified installer and shall be inspected by a UL Master Label certified inspector.
- C. When the installation has been completed and inspected, the Contractor shall submit the inspection report to the Engineer for review.
- D. Fasten air terminals with approved brackets and cable connectors. Locate terminals as indicated on the approved design shop drawings specified herein for protection of buildings or equipment.
- E. Conductor cable shall have a minimum bending angle of 90 degrees for one conductor bend.
- F. Maintain a horizontal or downward course for conductors free from dips or pockets. If dips or pockets cannot be avoided, provide an additional down conductor or connection from the low point to the nearest roof or down conductor.
- G. Coordinate the location of roof-mounted equipment which require grounding on structural and mechanical drawings.
- H. Provide conductor fasteners 3 feet on centers on vertical conductors and 4 feet on centers on horizontal conductors. Provide fasteners and accessories of same material as conductors.
- I. Set fasteners in masonry to withstand a minimum pull of 100 pounds. Fit fasteners tightly to prevent entrance of moisture or dirt.
- J. When conductors or air terminals pass through roofing, provide proper flashing to conform with roofing requirements.
- K. Use exothermic process welds for buried and non-accessible connections.

3.2 INSTALLATION

- A. Components shall be installed in accordance with the requirements of UL 96A.
- B. Installation shall be accomplished by an experienced installer who has been approved by the Engineer and certified by UL as a Master Label installer.

- C. All equipment shall be installed by skilled workmanship and in the most inconspicuous manner.
- D. Dissimilar metals shall not be allowed to contact. Aluminum fittings shall be mounted on aluminum where necessary and bonded to the main system using bi-metal connectors. Lead coating shall not be acceptable as a bi-metal transition.

3.3 COORDINATION

- A. The installer shall coordinate the lightning protection work to insure a correct, neat, and unobtrusive installation.
- B. Any electrical service and metallic water service piping to the structure shall be electrically bonded to the LPS.
- C. The Contractor shall coordinate its work in such a manner as to not interfere with the normal operation of the buildings.

3.4 COMPLETION

- A. The installer shall secure and deliver the UL Master Letter or Letter of Findings to the Owner upon completion of the installations.
- B. The Contractor shall also submit copies of as-built shop drawings.

3.5 SLEEVES, PIPE AND CONDUIT

- A. All cable and conduits passing through masonry walls or dry wall partitions shall be with appropriate pitch pockets and/or through-wall connectors approved for such application.

3.6 MANUFACTURER'S IDENTIFICATION

- A. Manufacturer's name plate, name or trademark shall be permanently affixed to all equipment and material furnished under this specification.

3.7 RUBBISH REMOVAL

- A. See to it that the project is at all times maintained free of all rubbish, waste material, packaging materials, etc., accumulating as a result of the work.
- B. Assume responsibility for the clean-up of packaging removed from materials and equipment.
- C. Note that final acceptance of the work is contingent upon the project being free of all excess and waste materials resulting from the work.

3.8 EXCAVATION AND BACKFILL

- A. Excavate and backfill as required.
- B. Finish grade and restore to original condition.

3.9 SHUTDOWNS

- A. When installation of a new system requires the temporary shutdown of an existing operating system, the connection of the new system shall be performed at such time as designated by the Owner so as to minimize interference with the operating system.
- B. Work shall be arranged for continuous performance, including overtime, at no extra cost to the Owner, if required, to assure that existing operating services will be shut down during the time actually required to make necessary connections.

3.10 SCAFFOLDING, RIGGING AND HOISTING

- A. Provide all scaffolding, rigging, hoisting and services necessary or erection and delivery into the premises of all equipment and materials furnished under this Section of the Specifications, and remove same from the premises when no longer required.
- B. In the event that supplementary bracing of the basic building structure is required to assure rigging procedures and a secure route for the equipment being handled. Assume full responsibility for such supplementary bracing.

3.11 TESTS

- A. All cables and equipment shall be tested to insure continuity to ground.
- B. Furnish all labor, materials, instruments and power required for testing.
- C. Tests shall be performed in the presence and to the satisfaction of a representative of the Engineer.
- D. The completed LPS shall be fully tested in the presence of the Engineer to demonstrate continuity of all conductors. A written test report shall be submitted.
- E. The ground grid resistance shall be measured and a written statement submitted to the Engineer. Grid resistance shall be 3 ohms or less.
- F. Defective work shall be promptly repaired or replaced, and the tests shall be repeated until the particular system and component parts thereof receive the

approval of the Engineer.

END OF SECTION

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SECTION 16600
UNDERGROUND SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish and install a complete underground system of raceways, manholes and handholes as shown on the Drawings and as specified herein. This work includes all underground raceways which are direct buried or concrete encased.

1.2 RELATED WORK

- A. All concrete and reinforcing steel shall be as specified in Division 3, but the responsibility of furnishing and installing the material shall be that of this Section.
- B. All trenching, excavation and backfilling, including gravel and sand bedding and surface restoration shall be as specified in Division 2, but the responsibility of furnishing and installing the material shall be that of this Section.
- C. Conduit, fittings, installation, etc. shall be as specified in Section 16110.
- D. Ground rods and other grounding materials and methods shall be as specified in Section 16660.
- E. Precast electrical concrete manholes and handholes shall be furnished under Division 16.

1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data, for the following:
 - 1. Manholes and handholes
 - 2. Plastic duct spacers
 - 3. Manhole and handhole frames and

covers PART 2 PRODUCTS

2.1 MATERIALS

- A. Cable racks, supports, pulling-in irons, manhole steps and hardware shall

be hot dipped galvanized steel as manufactured by Line Materials Co. or equal.

- B. Precast concrete manholes and handholes shall be heavy duty type, designed for a Class H20 wheel load. Precast manholes and handholes shall be as manufactured by Brooks Products Co.
- C. Manhole frames and covers shall be cast iron heavy duty type for class H-20 wheel loading, and shall be as manufactured by Neenah, or equal. Manhole covers shall be marked "ELECTRIC".
- D. Handhole covers and frames shall be hot dipped galvanized and designed for a Class H-20 wheel load. Handhole covers and hatches shall have 316 stainless steel security bolts. Handhole covers shall be marked "ELECTRIC".
- E. Bell ends and plastic duct spacers shall be as manufactured by Carlon or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install raceways to drain away from buildings. Raceways between manholes or handholes shall drain toward the manholes or handholes. Raceway slopes shall not be less than 3-in per 100-ft.
- B. Reinforce raceway banks as shown on the Drawings.
- C. Lay raceway lines in trenches on a clean backfill bedding not less than 6 inches thick and well graded and compacted.
- D. Make raceway entrances to buildings and vaults with hot dipped rigid galvanized steel conduit not less than 10-ft long. Conduits which are not concrete encased for runs below floor slabs in slab-on-grade construction shall be hot dipped rigid galvanized steel conduit. Conduits which are concrete encased for runs below floor slabs in slab-on-grade construction shall be encased under the slab to their respective equipment.
- E. Raceway terminations at manholes shall be with end bells for PVC conduit and insulated throat grounding bushings with lay-in type lugs for metal conduit.
- F. For bends in 2 inch and larger raceways, long radius elbows, sweeps and offsets shall be used.
- G. All 2 inch and larger raceways shall have a mandrel drawn through followed by a swab to clean out any obstructions which may cause cable abrasions. The mandrel shall be 12 inches in length and the diameter 2 inch less than the inside diameter of the raceway. All 3/4 inch and smaller raceways shall be swabbed clean before

- installing cables.
- H. Plug spare raceways and seal them watertight at all buildings and structures.
 - I. Raceways in use shall be sealed watertight at all buildings and structures.
 - J. Install pulling-in irons opposite all raceway entrances to manholes.
 - K. Cables shall be trained in manholes and supported on racks and hooks at intervals not greater than 3 feet-0 inches and supports shall be installed on each side of all splices. Furnish inserts on all manhole walls for mounting future racks as well as racks required for present installation. Branch circuit conductors shall not be run in manholes.
 - L. All joints shall be made so as to prevent the passage of concrete inside the conduit to form obstructions or cause cable abrasions.
 - M. Manhole covers in streets shall finish flush with finished paving and in other areas shall finish 3 inches above crown of adjacent roadway. Floor elevations of manholes shall be so set that the center line of the lowest conduit entering will be not less than 1-foot above the floor and center line of the highest conduit entering will be not less than 1 foot below the roof slab.
 - N. Concrete monuments shall be provided at each stubbed conduit location. Monuments shall be as shown on the Drawings and shall be installed in the same manner outlined for manhole covers.
 - O. A #6 bare copper wire (stranded) shall be installed in each 4-inch PVC conduit containing control cable unless otherwise noted.
 - P. A 3/4-inch by 10-foot copperclad ground rod shall be driven in the bottom of each manhole. All bond wires, galvanized conduits and metal cable racks shall be bonded to the ground rod.
 - Q. Polyethylene warning tape shall be provided for all underground raceways, duct banks etc. Tape shall be placed along the raceways entire length and shall be installed 18" above the raceways on compacted backfill material.
 - R. Spare and empty conduits shall have a pull wire (3/16 inch polypropylene) installed.
 - S. As-built drawings shall be furnished showing each conduit terminations, elevations, locations, manholes, handholes, etc.

END OF SECTION

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SECTION 16660
GROUNDING SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code (NEC), as shown on the Drawings and as specified herein.
- B. All raceways, conduits and ducts shall contain equipment grounding conductors sized in accordance with the NEC. Minimum sizes shall be No. 12 AWG.

1.2 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data, for the following:
 - 1. Manufacturer's name and catalog data for ground rods, materials and exothermic welding methods and materials.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Conduit shall be as specified under Section 16110.
- B. Wire shall be as specified under Section 16120.
- C. Ground rods shall be 3/4-in diameter by 10-ft copper clad steel and constructed in accordance with UL 467. The minimum copper thickness shall be 0.25 mm. Ground rods shall be Copperweld or equal.
- D. Grounding conduit hubs shall be malleable iron type, manufactured by Thomas & Betts Co.; Catalog No. 3940 (3/4-in conduit size), similar to Burndy; O.Z./Gedney Co. or equal, and of the correct size for the conduit.
- E. Waterpipe ground clamps shall be cast bronze saddle type, manufactured by Thomas & Betts Co. Cat. No. 2 (1/2-in, 3/4-in, or 1-in size), similar by Burndy; O.Z./Gedney Co. or equal, and of the correct size for the pipe.
- F. Buried grounding connections shall be by Cadweld process, or equal exothermic welding system.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The service entrance equipment ground bus shall be grounded to a 3/4-inch cold water pipe and to the ground as indicated on the Drawings. Run grounding electrode conductors in Schedule 80 PVC conduits and seal conduits watertight. Do not allow water pipe connections to be painted. If the connections are painted, disassemble them and re-make them with new fittings.
- B. Install equipment grounding conductors with all feeders and branch circuits.
- C. Bond all steel building columns in new structures together with ground wire in rigid conduit and connect to the distribution equipment ground bus, as shown on the Drawings.
- D. Ground wire connections to structural steel columns shall be made by exothermic welding.
- E. Metal conduits stubbed into a motor control center shall be terminated with insulated grounding bushings and connect to the motor control center ground bus. Bond boxes mounted below motor control centers to the motor control center ground bus. Size the grounding wire in accordance with NEC Table 250.122, except that a minimum No. 12 AWG shall be used.
- F. Ground bus in all motor control centers and unit substations shall be connected to the service entrance equipment ground bus with a No. 1/0 conductor or as noted on the Drawings.
- G. Ground transformer neutrals to the nearest available grounding electrode with a minimum conductor sized in accordance with NEC Article 250 or as shown on the drawings.
- H. Drive grounding electrodes (where rock is encountered, grounding plates may be used in lieu of grounding rods) and install ground grids as shown on the Drawings.
- I. All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and all other equipment and materials required by the NEC to be grounded, shall be grounded and bonded in accordance with the NEC.
- J. Seal exposed connections between different metals with No-Oxide Paint Grade A or equal.
- K. Lay all underground grounding conductors slack and, where exposed to

mechanical injury, protect by pipes or other substantial guards. If guards are iron pipe, or other magnetic material, electrically connect conductors to both ends of the guard. Make connections as specified herein.

- L. Care shall be taken to ensure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.
- M. All grounding type receptacles shall be grounded to the outlet boxes with a No. 12 THW green conductor connected to the ground terminal of the receptacle and fastened to the outlet box by means of a grounding screw.

3.2 INSPECTION AND TESTING

- A. Inspect the grounding and bonding system conductors and connections for tightness and proper installation.
- B. Use Biddle Direct Reading Earth Resistance Tester or equivalent test instrument to measure resistance to ground of the system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method. Notify the Engineer in writing at least two weeks prior to scheduling any testing. Provide certified calibration sheets including dates for all equipment to be used for testing with notice of scheduled testing. Calibration sheets shall also indicate that the units have been calibrated within six months of the testing date.
- C. All test equipment shall be provided under this Section and approved by the Engineer.
- D. Resistance to ground testing shall be performed during dry season. Submit test results in the form of a graph showing the number of points measured (12 minimum) and the numerical resistance to ground.
- E. Testing shall be performed before energizing the distribution system.
- F. A separate test shall be conducted for each building or system.
- G. Dry season resistance of the system at each testing location shall not exceed three ohms. If such resistance cannot be obtained with the system, provide additional grounding, as directed by the Engineer, at no additional cost to the Owner.

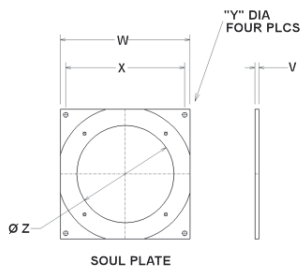
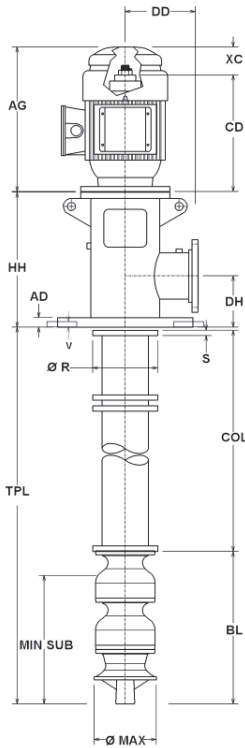
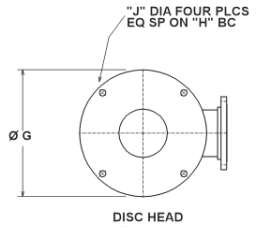
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EXHIBIT A

VERTICAL TURBINE PUMPS (OWNER PURCHASED)

OUTLINE DRAWING

Quote ID: 3302-181113-009:0:1 QTY: 1
VIT-FFFM 20RCLC, 2 Stages
MORROW WATER TECHNOLOGIES
BIRMINGHAM



DIMENSIONS

G [Mounting Flange Dia]	38.75 in
J [Mounting Flange Hole Dia]	1.38 in
K [Mounting Hole Places]	12
H [Mounting Flange Bolt Circle]	36.00 in
BD Head [Discharge Head Base Dia]	20.00 in
HH [Head Height]	49.50 in
AD [Mounting Flange Thickness]	1.75 in
DD [Disch Flange Stickout]	22.00 in
DH [Disch Flange Height]	14.00 in
S [Hanger Flange Stickdown Length]	1.38 in
R [Hanger Flange OD]	18.50 in
Column Length (COL)	130.24 in
COL [Column Diameter]	14.00 in
TPL [Total Pump Length]	185.00 in
MIN SUB [Minimum Submergence]	42.01 in
MAX [Max Assembly OD]	21.10 in
BL [Bowl Assembly Length]	64.64 in
V [Sub Base Thickness]	1.25 in
W [Sub Base Overall Size]	38.75 in
X [Center Line of Holes]	36.00 in
Y [Mounting Holes Base Plate Dia]	1.25 in
Z [Base Plate Opening or Can ID]	30.00 in

PUMP DATA

Column Diameter	14" [356mm]
Lineshaft Diameter	1 11/16 in [42.9 mm]
Specified Flow	2800.00 USgpm
Specified TDH	126.00 ft
Pumping Level	11.00 ft
Motor Manufacturer	
Driver Type	Vertical Hollow Shaft Motor
Selected Motor Power	
Phase / Frequency	
Voltage	

WEIGHTS

Total Bowl Weight	1220 lbs
Unit Bowl Weight	720 lbs / 500 lbs
Total Column Weight	792 lbs
Unit Column Weight	72 lbs
Head Weight	**Refer to Factory**
Motor Weight	**Refer to Factory**
Total Weight	**Refer to Factory**
Total Rotating Weight	334 lbs

NOTES

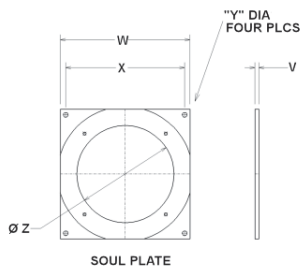
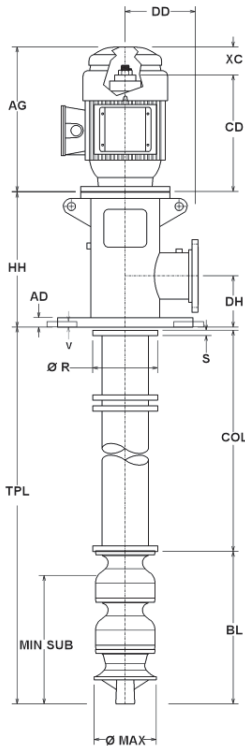
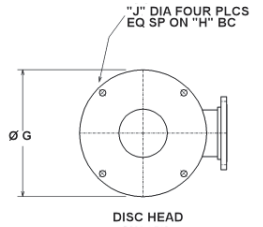
1	Total Pump Length ± 1.0 inch.
2	Tolerance on all dimensions is .12 or ± .12 inch per 5 ft, whichever is greater.
3	All dimensions shown are in inches unless otherwise specified.
4	Drawing not to scale.
5	½" NPT – Gauge Conn (plugged)
6	Driver may be rotated at 90° intervals about vertical centerline for details refer to driver dimension drawing.
7	Refer to product IOM for impeller setting requirements.
8	This assembly has been designed so that its natural frequency responses avoid the specific operating speeds by an adequate safety margin. The design has assumed the foundation to be rigid.

DO NOT USE FOR CONSTRUCTION UNLESS CERTIFIED

Certified By	
Project	Okaloosa Arbennie Pritchett WRF Expansion
Tag	
PO Number	
Serial Number	

OUTLINE DRAWING

Quote ID: 3302-181113-009:0:2 QTY: 1
VIT-FFFM 14RHMC, 3 Stages
MORROW WATER TECHNOLOGIES
BIRMINGHAM



DIMENSIONS

G [Mounting Flange Dia]	25.00 in
J [Mounting Flange Hole Dia]	1.25 in
K [Mounting Hole Places]	12
H [Mounting Flange Bolt Circle]	22.75 in
BD Head [Discharge Head Base Dia]	20.00 in
HH [Head Height]	44.00 in
AD [Mounting Flange Thickness]	1.75 in
DD [Disch Flange Stickout]	17.50 in
DH [Disch Flange Height]	12.00 in
S [Hanger Flange Stickdown Length]	1.13 in
R [Hanger Flange OD]	14.60 in
Column Length (COL)	131.86 in
COL [Column Diameter]	10.00 in
TPL [Total Pump Length]	187.38 in
MIN SUB [Minimum Submergence]	37.03 in
MAX [Max Assembly OD]	14.00 in
BL [Bowl Assembly Length]	69.02 in
V [Sub Base Thickness]	1.00 in
W [Sub Base Overall Size]	25.00 in
X [Center Line of Holes]	22.00 in
Y [Mounting Holes Base Plate Dia]	1.00 in
Z [Base Plate Opening or Can ID]	19.00 in

PUMP DATA

Column Diameter	8" [203mm]
Lineshaft Diameter	1 3/16 in [30.2 mm]
Specified Flow	1400.00 USgpm
Specified TDH	75.00 ft
Pumping Level	11.00 ft
Motor Manufacturer	
Driver Type	Vertical Hollow Shaft Motor
Selected Motor Power	
Phase / Frequency	
Voltage	

WEIGHTS

Total Bowl Weight	883 lbs
Unit Bowl Weight	493 lbs / 195 lbs
Total Column Weight	396 lbs
Unit Column Weight	36 lbs
Head Weight	**Refer to Factory**
Total Weight	**Refer to Factory**
Total Rotating Weight	196 lbs

NOTES

1	Total Pump Length ± 1.0 inch.
2	Tolerance on all dimensions is .12 or ± .12 inch per 5 ft, whichever is greater.
3	All dimensions shown are in inches unless otherwise specified.
4	Drawing not to scale.
5	½" NPT – Gauge Conn (plugged)
6	Driver may be rotated at 90° intervals about vertical centerline for details refer to driver dimension drawing.
7	Refer to product IOM for impeller setting requirements.
8	This assembly has been designed so that its natural frequency responses avoid the specific operating speeds by an adequate safety margin. The design has assumed the foundation to be rigid.

DO NOT USE FOR CONSTRUCTION UNLESS CERTIFIED

Certified By	
Project	Okaloosa Arbennie Pritchett WRF Expansion
Tag	
PO Number	
Serial Number	

EXHIBIT B

Okaloosa County Water and Sewer
Department

**Arbennie Pritchett Water Reclamation Facility
Okaloosa County, Florida**


June 8, 2007

Subsurface Soil Exploration Report

Okaloosa County Water and Sewer Department

**Arbennie Pritchett Water Reclamation Facility
Okaloosa County, Florida**

June 2007


Thomas Nichols, P.E. *11 June 07*
Senior Geotechnical Engineer
Fla. Reg. No. 38764

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Section 1

Introduction

1.1 Project Description and Location

Camp, Dresser, and McKee, (CDM), has been retained by Okaloosa County Water and Sewer Department to provide professional engineering and technical services associated with the proposed structures at existing Arbennie Pritchett Water Reclamation Facility in Okaloosa County, Florida. The purpose of this preliminary geotechnical report is to present data collected during the field and laboratory investigation and provide geotechnical engineering recommendations for design and construction of the proposed structures.

The project location is shown on **Figure 1-1**.

1.2 Scope

The scope of work for the geotechnical investigation consists of the following:

1. Review available geotechnical information provided by the County and from the preliminary subsurface exploration program conducted in March 2007 using Piezocone soundings;
2. Within the footprint of the proposed structures, conduct 6 Standard Penetration Test (SPT) soil borings to depths of 25 to 70 feet below land surface to collect lithologic samples and investigate the subsurface conditions;
3. Perform 8 hand auger borings up to 7 feet deep to check for unsuitable near surface soils in the parking/drive areas;
4. At 3 locations along the center line of the storm water pond area conduct SPT soil borings to depths of 20 to 25 feet below land surface and conduct Double Ring Infiltrometer (DRI) tests to fulfill permit requirements for the stormwater retention pond and estimate the unsaturated hydraulic conductivity of the soil in the proposed pond area;
5. Provide wet season ground water estimation based upon the data collected and available soil survey data; and
6. Make analyses related to the geotechnical engineering aspects of foundation design and construction and prepare this geotechnical report that includes the following items as applicable to the project and site:
 - A. SPT and hand auger boring logs indicating soil conditions encountered.
 - B. Provide Piezocone sounding profiles from the preliminary subsurface exploration program.

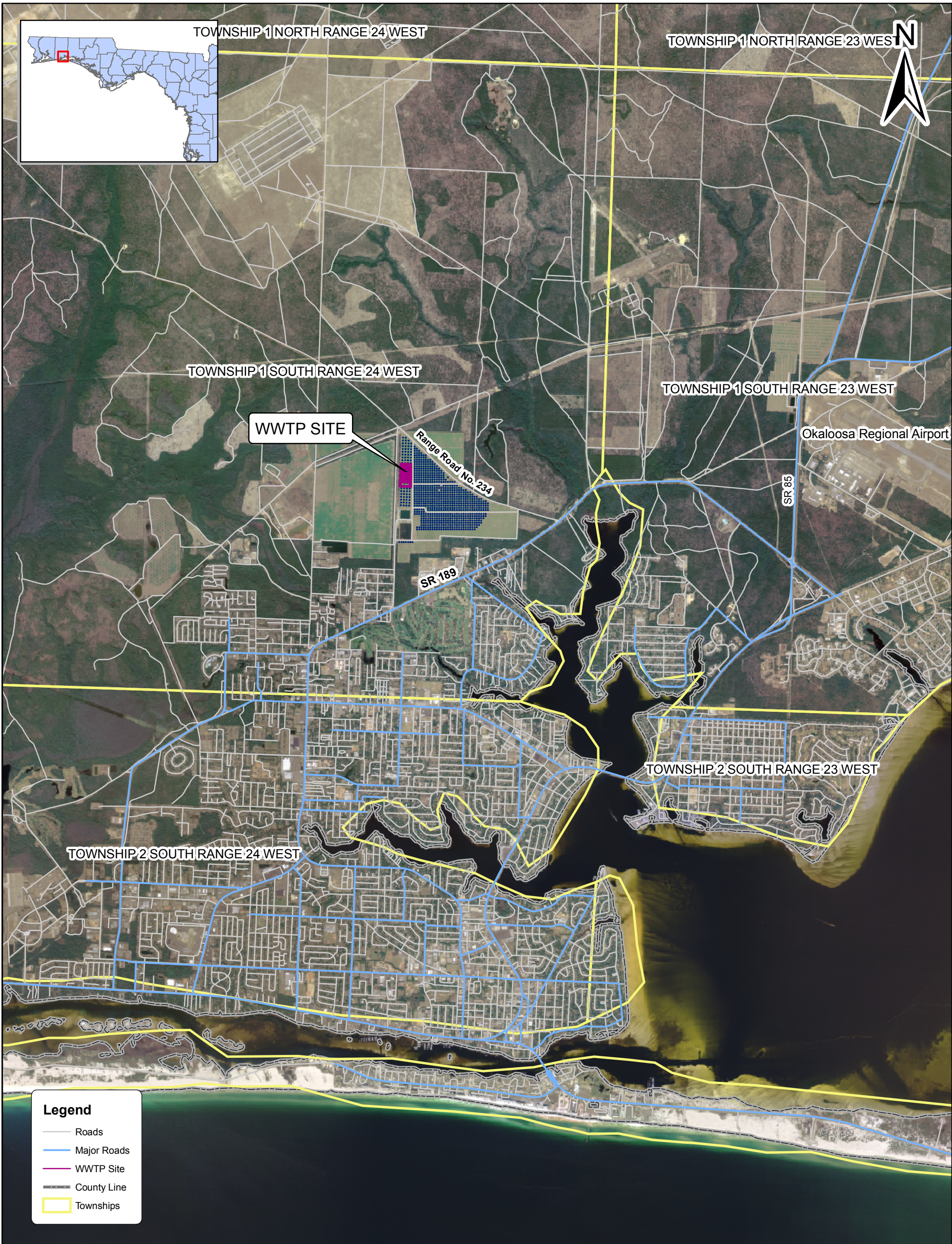


Figure 1-1
General Location for
Arbennie Pritchett
Water Reclamation Facility
Okaloosa, FL



- C. Location plan of the subsurface explorations using the available base plan.
- D. Recommended foundation type with foundation design criteria including allowable soil bearing pressure, foundation embedment depth, lateral earth pressures, and other information required for final design and preparation of contract drawings and specifications.
- E. Recommended treatment of ground floor slab, whether slab-on-grade or structural slab.
- F. Total and differential settlement estimates for structural elements at design loading.
- G. Reuse of on-site materials as fill or backfill and other special construction considerations related to soils and foundation construction.
- H. Trenching, bedding, and backfill recommendations for the pipelines.
- I. Comments on aspects of construction related to soils and foundations including excavation and filling, protection of adjacent structures and utilities, excavation support, dewatering, and special requirements for protecting strength of undisturbed soils at foundation elevation.

1.3 Elevation Datum

Elevations noted herein are based upon National Geodetic Vertical Datum (NGVD) of 1929.

1.4 Report Limitations

These recommendations have been prepared for design of the proposed improvements at Arbennie Pritchett Water Reclamation Facility in Okaloosa County, Florida as understood at this time and described in this report. This report has been prepared in accordance with generally accepted engineering practices. No other warranty, express or implied, is made. In the event that changes in the design or location of the structures occur, the conclusions and recommendations contained herein should not be considered valid unless verified in writing by CDM.

Section 2

Site and Subsurface Conditions

2.1 Site History

The proposed Arbennie Pritchett Water Reclamation Facility (WRF) is located to the north of Fort Walton Beach, in southern Okaloosa County, Florida. The site is east of Roberts Road and south of Range Road No 234 in Township 1 South Range 24 West.

The Okaloosa County Water and Sewer Department has used the Garnier Sprayfield site since 1971 for disposal of wastewater from its Ocean City Plant. The proposed WRF would occupy the central western portion of the 621-acre spray-irrigation field along Roberts Road.

2.2 Existing Site Conditions

2.2.1 Site Geology & Hydrogeology

The proposed WRF site is underlain by the following geologic and hydrogeologic units.

- Pliocene-Recent Sand Unit and Citronelle – **Sand and Gravel Aquifer**: this is a unfossiliferous, unconsolidated body of quartz sand with discontinuous layer of gravel and clay. The thickness of this unit beneath the project site is approximately 100 to 110 feet.
- Intracoastal Formation-Alum Bluff Group – Undifferentiated – **Intermediate System Confining Unit**: This is poorly consolidated sandy, clayey microfossiliferous limestone.
- Bruce Creek Limestone and Tampa and Chickaswhay Limestones – Undifferentiated – **Upper Floridan Aquifer**: This unit is white to yellow gray, granular, slightly sandy, fossiliferous limestone, tan sucrosic dolomite to cream, buff fossiliferous limestone.
- Bucatunna Clay Member of Byrum Formation – **Bucatanna Clay**: this unit is brown to dusky yellow brown sparsely fossiliferous clay.
- Ocala Group Limestone – **Lower Floridan Aquifer**: this unit is white to light gray, chalky, fossiliferous to tan sucrosic dolomite.
- Lisbon and Tallahatta Formation – **Sub-Floridan System**: this unit is cream, sand, pyretic, glauconitic limestone and light gray clay and sand.

The subsurface explorations beneath the proposed WRF were consistent with regional literature and previous explorations from the *Ground Water Modeling Report for Okaloosa County Garnier RIB Wastewater Disposal Site, Fort Walton Beach, FL* (Brown Consulting Group, Inc., 2005). The Sand & Gravel Aquifer that lies beneath the

proposed site was generally described as a white to tan unconsolidated unit of clean quartz sand with little to no clay. The grain size was moderately to well sorted fine/medium to coarse.

The aforementioned groundwater modeling report included monitoring wells located near the proposed WRF. The data from the nearest wells (FW BSF-20, FW BSF-21, and OK G-7) were used to help develop a historical groundwater level baseline for the proposed site and are included in **Appendix A**.

The Sand & Gravel Aquifer is unconfined at the site and is recharged by the sprayfield and by rainfall. The aquifer discharges to local water bodies. Groundwater level readings were taken during this phase of exploration and they ranged from EL 48.6 feet to EL 50.4 feet (NGVD 1929), with an average groundwater elevation across the proposed site of about EL 49.3 feet (**Table 2-1**). Historical groundwater level readings shown in Appendix A were higher and ranged from about +65 to + 50 feet.

Table 2-1
Summary of Water Level Readings
at Arbennie Pritchett Water Reclamation Facility

Location	GWL (ft - below land surface)	Ground Surface EL. ⁽¹⁾	GWL EL. ⁽¹⁾	Date
SPT-1	23.3	71.9	48.6	4/26/2007
SPT-4	23.7	72.4	48.7	4/26/2007
SPT-8	21.9	70.9	49.0	4/26/2007
CPT-1	23.0	72.6	49.6	3/8/2007
CPT-2	21.5	71.9	50.4	3/8/2007
CPT-3	23.0	72.6	49.6	3/8/2007
CPT-4	21.5	71.3	49.8	3/8/2007
CPT-5	22.5	72.1	49.6	3/8/2007
CPT-6	23.0	71.7	48.7	3/8/2007
CPT-7	23.0	71.8	48.8	3/8/2007
CPT-8	22.8	72.2	49.4	3/8/2007

Notes:

1. Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.

2.2.2 Site Topography, Features and Boundaries

The project site is located directly north of the existing water reclamation facility and at the west edge of the Garnier Sprayfield. The existing FWB Sprayfield is located to the west of the proposed facility.

The general site topography is gently sloping with a slight rise in grade from south to north varying from about EL. 67 to EL. 74 (NGVD 1929). There are no existing structures at the site. However, the site is covered with sprinkler heads and associated buried pipelines. The site is bounded by Roberts Road to the west, a service road to the east, and existing lagoons to the south.

2.3 Proposed Construction

The proposed structures at Arbennie Pritchett Water Reclamation Facility are summarized in **Table 2-2**, shown on **Figure 2-1**, and include the following:

- Aeration Basin(s),
- Anoxic Basin(s),
- Clarifier(s),
- Dewatering Centrifuge Structure,
- Concentric Digester,
- UV System/Effluent Pump Station,
- Headworks,
- Septage Receiving Station,
- Lift Station,
- Administration Building,
- Maintenance Building
- Electric Building
- RAS/WAS Pump Station, and
- Digester Sludge Pumps

2.4 Subsurface Exploration Program

The recent subsurface exploration program consisted of Standard Penetration Test (SPT) soil borings, Cone Penetration Test (CPT) soundings, Double Ring Infiltrometer (DRI) tests, and hand auger borings. Exploration locations are shown on **Figure 2-2**.

All of the CPT soundings were performed by Insitu Group of Orlando, Florida on March 8, 2007. SPT soil borings, DRI tests, and hand augers were performed by Williams Earth Sciences, Inc. of Panama City, Florida between April 23 and April 26, 2007.

2.4.1 CPT Soundings

A total of eight (8) Cone Penetration Test (CPT) soundings were conducted in March 2007 at the proposed structure locations. The depths of the CPT soundings ranged

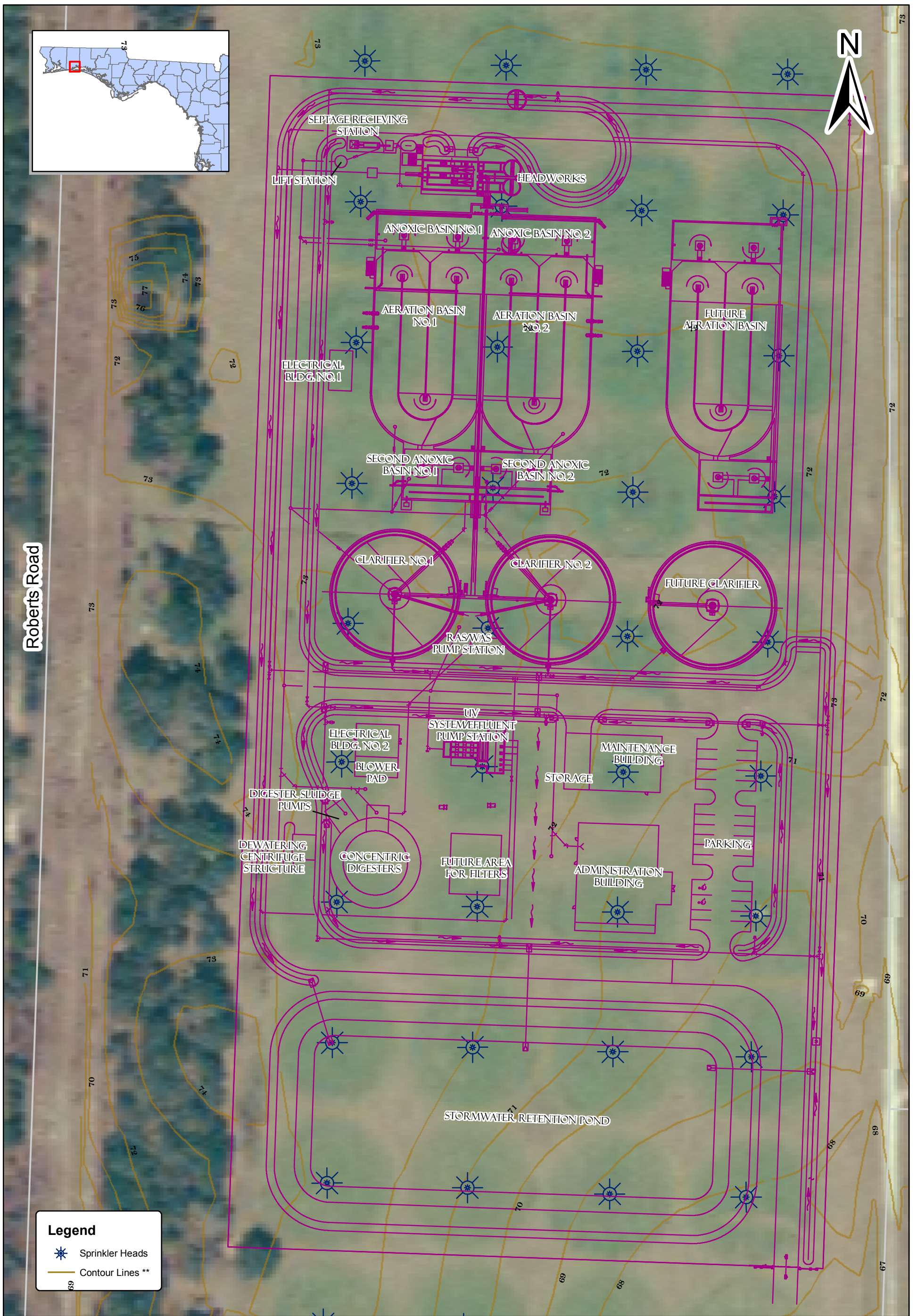
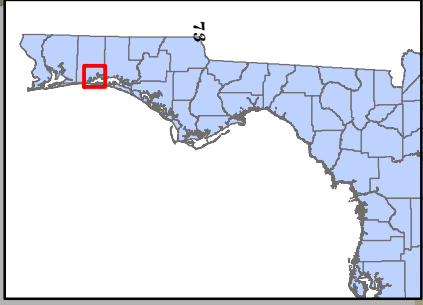
**Table 2-2
Proposed Structures at Arbennie Pritchett Water Reclamation Facility
Okaloosa County, Florida**

No.		Structure Name	Approximate Dimensions (feet)	Maximum Water Height (feet)	Depth of Embedment (feet below land surface)	Structure Type	Designed Foundation Loads
1		Storm Water Retention Pond	150 x 400	N/A	N/A	Unlined Retention Pond with Berm. Partially embedded below land surface	N/A
2	Tank Structures Mat Foundation	Aeration Basin(s) - Two	190 x 110	22	3 to 4	Cast in Place Concrete or CROM Tank	Uniform Contact Stress: 1.8 ksf Wall Loads: 4 kips/ft
3		Anoxic Basin(s) - Two	110 x 40	22	3 to 4	Cast in Place Concrete or CROM Tank	
4		Second Anoxic Basin - Two	75 x 45	22	3 to 4	Cast in Place Concrete or CROM Tank	
5	Tank Structure - Flexible Membrane Slab	Concentric Digesters	100-foot Diameter	22	3 to 4	CROM Tank or Similar	Uniform Contact Stress: 1.3 ksf Wall Loads: 3 kips/ft
6		Clarifier(s) - Two	130-foot Diameter	16	1.5	CROM Tank or Similar	
7	Spread Footing Structure	Dewatering Centrifuge Structure	20 x 25	N/A	2	Elevated Steel Structure	Column Loads: 30 to 50 kips Wall Loads: 1 to 2 kips/ft
8	Mat Foundation	UV System/Effluent Pump Station	35 x 55	10	Structure 5 feet above grade 8 to 10 feet below grade	Cast in Place Concrete	Uniform Contact Stress: ≤ 2 ksf
9		Headworks	25 feet high 40 x 100	6	2	Elevated with Cast in Place Concrete	
10		Septage Receiving Station	15 x 45	6	6	Slab with Equipment on Top	
11		Lift Station	12-foot Diameter	10	12	Cast in Place Concrete	
12	Slab on Grade with Thickened Edge Footing	Administration Building	110 x 95	N/A	1 to 1.5	Concrete Block, Single Story	Uniform Contact Stress: ≤ 1 ksf Wall Loads: 1 to 2 kips/ft
13		Maintenance Building & Storage	95 x 55	N/A	1 to 1.5	Concrete Block, Single Story	
14		Electrical Building No. 1	40 x 20	N/A	1 to 1.5	Concrete Block, Single Story	
		Electrical Building No. 2 with Blower Pad	54 x 40	N/A	1 to 1.5	Concrete Block, Single Story	
16		RAS/WAS Pump Station	45 x 25	N/A	1 to 1.5	Open Equipment Slab	
17	Digester Sludge Pumps	25 x 30	N/A	1 to 1.5	Open Equipment Slab		
18		Roadway and Parking	N/A	N/A	N/A	Asphaltic Concrete Pavement	N/A

Legend:

N/A = Not Applicable

ksf = Kips per Square Foot



Roberts Road

Legend

- Sprinkler Heads
- Contour Lines **

CDM
 Datum: NAD_1983_HARN
 Coordinate System: StatePlane_Florida_North
 FIPS_0903_Feet
 ** Elevations are assumed to be based on
 NGVD_1929 Vertical Datum. Contour lines
 were taken from previous data supplied by Client.

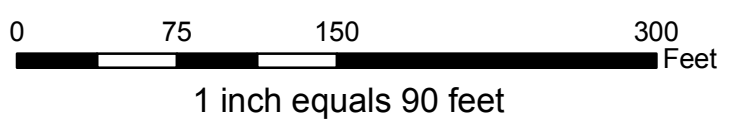
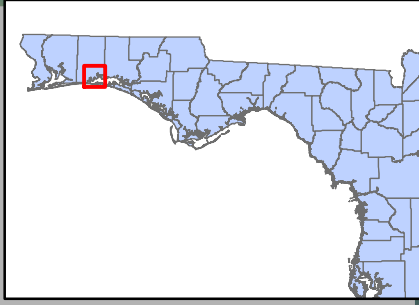


Figure 2-1
Arbennie Pritchett
Water Reclamation Facility
Okaloosa, FL



Roberts Road

Existing Sewage Lagoon

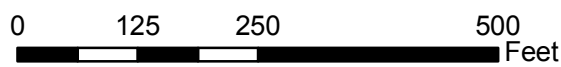
- Legend**
- Standard Penetration Test Boring
 - Piezocone Sounding
 - Double Ring Infiltrometer Test
 - Hand Auger Boring
 - Sprinkler Heads
 - Contour Lines **

Type of Test	Northing (approximate)	Easting (approximate)	Depth below land surface
SPT-1	545219	1299488	40'
SPT-2	545049	1299510	70'
SPT-3	544838	1299459	70'
SPT-4	544647	1299510	30'
SPT-5	544648	1299675	25'
SPT-6	544570	1299435	70'
SPT-7	544285	1299360	20'
SPT-8	544274	1299548	25'
SPT-9	544274	1299728	20'
HA-1	545254	1299620	7'
HA-2	545050	1299326	7'
HA-3	544795	1299385	7'
HA-4	544551	1299331	7'
HA-5	544433	1299556	7'
HA-6	544700	1299829	7'
HA-7	544431	1299820	7'
HA-8	544148	1299813	7'
CPT-1	544787	1299397	41'*
CPT-2	544791	1299536	52'*
CPT-3	544520	1299384	56'*
CPT-4	544514	1299618	44'*
CPT-5	544931	1299506	50'*
CPT-6	544837	1299621	50'*
CPT-7	545105	1299590	31'*
CPT-8	545171	1299411	48'*
DRI-1	544280	1299360	12"
DRI-2	544279	1299548	12"
DRI-3	544269	1299728	12" 6"x

* Terminated due to refusal to further penetration from very dense (or cemented) layer.



Datum: NAD_1983_HARN
 Coordinate System: StatePlane_Florida_North
 FIPS_0903_Feet
 ** Elevations are assumed to be based on
 NGVD_1929 Vertical Datum. Contour lines
 were taken from previous data supplied by Client.



1 inch equals 200 feet

Figure 2-2
Subsurface Exploration
Location Plan
Okaloosa, FL

from 31 to 57 feet below land surface where they were terminated due to refusal to further penetration through very dense material.

The piezocone is an *in-situ* deep-testing device that uses electrical transducers to obtain a nearly continuous depth profile of point resistance and sleeve friction on a cylindrical section immediately above the tip. These data are then used to evaluate *in-situ* soil properties such as shear strength, relative density, friction angle, elastic modulus, undrained shear strength, and hydraulic conductivity with respect to depth. The piezocone soundings were performed in general accordance with ASTM D-5778 using a cone penetrometer with a data acquisition system. Readings of tip resistance, sleeve friction, and pore pressure were taken every 0.07 feet (5 cm). The tip resistance was measured as the force over the projected area of the cone tip. The measured tip resistance is corrected for porewater pressure. The sleeve friction is used to differentiate between soil types and can be expressed by the friction ratio (sleeve friction divided by corrected tip pressure). The piezocone sounding logs are included in **Appendix B**.

2.4.2 SPT Soil Borings

A total of nine (9) SPT soil borings were drilled at the proposed structure locations and storm water pond area to investigate subsurface conditions and to collect soil samples. The exploration locations were as follows:

- Six (6) SPT soil borings at the proposed structure locations to depths of 25 to 70 feet below land surface, and
- Three (3) SPT soil borings at the storm water pond area to depths of 20 to 25 feet below land surface.

The test borings were drilled using a CME 75 truck-mounted drill rig. Borings were advanced with mud rotary to the bottom of the holes. Split-spoon sampling was conducted continuously for the first ten feet below grade and at 5-foot-intervals thereafter. Split-spoon sampling was performed in accordance with ASTM D1586 (2-inch-diameter sampler driven 24 inches for the top 10 feet and 18 inches for the remaining samples by blows from a 140-pound hammer falling freely for a 30-inch drop). The number of blows required to drive the sampler each 6-inch increment was recorded and the Standard Penetration Resistance (N-value) was determined as the sum of the blows over the 2nd and 3rd 6-inch increments. All SPT soil borings were backfilled with bentonite chips to the ground surface upon completion.

A CDM geotechnical engineer observed the test borings in the field and visually classified the soil samples in accordance with the Unified Soil Classification System (USCS - ASTM D2488). Representative soil samples were taken from each split-spoon sample and stored in jars for later review and laboratory testing.

The SPT soil boring and hand auger logs, prepared by CDM, are included in **Appendix C**.

2.4.3 Hand Auger Borings

A total of eight (8) hand auger borings were advanced to 7 feet below land surface within the proposed parking/ drive areas to check for unsuitable near surface soils and to collect soil samples.

The hand augers were drilled using a 3-inch-diameter bucket auger. All hand augers were backfilled with soil cuttings to the ground surface upon completion.

A CDM geotechnical engineer observed the hand augers in the field and visually classified the soil samples in accordance with the Unified Soil Classification System (USCS - ASTM D2488). Representative soil samples were taken at every 2-foot interval stored in jars for later review.

2.4.4 DRI Tests

A total of three (3) Double Ring Infiltrometer (DRI) tests were conducted at the proposed storm water pond area. The DRI locations were placed within 5 feet of the corresponding SPT boring.

The DRI tests were conducted in general accordance with ASTM D3385-03 “Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer” and consisted of placing a 1-foot-diameter steel cylinder inside a 2-foot-diameter steel cylinder. Existing grass and soil were stripped up to 12 inches below land surface and the inner and the outer cylinders were driven 4 and 6 inches below land surface, respectively. The rings were then filled with water to maintain a constant liquid level within the rings of 6 inches above the new ground surface. The volume of water added to the inner and annular space was recorded for each 5 minute interval until the termination of the test.

The information recorded during the tests provided by Williams Earth Sciences, Inc. is included in **Appendix D**. A summary of DRI test results converted to units of feet per day is shown in **Table 2-3**.

Table 2-3
Summary of Double Ring Infiltrometer Test Results
at Arbennie Pritchett Water Reclamation Facility

Test No.	Hydraulic Conductivity			
	Inner Ring*		Outer Ring	
	feet/day	cm/sec	feet/day	cm/sec
1	53.9	1.90E-02	95.9	3.39E-02
2	60.0	2.12E-02	95.9	3.39E-02
3	89.9	3.17E-02	58.0	2.05E-02

Note:

* Inner Ring to be used for infiltration rate

2.5 Laboratory Testing

Geotechnical laboratory testing was conducted on selected split-spoon (disturbed) samples collected in the test borings as follows:

- Three (3) grain size analyses were performed in accordance with ASTM D422;
- Eight (8) percent passing No. 200 sieve tests were performed in accordance with ASTM D1140; and
- One (1) FDOT corrosion series test.

A summary of the laboratory test results is presented in **Table 2-4**.

Results of the geotechnical laboratory tests, provided by Williams Earth Sciences, Inc., are included in Appendix C.

2.6 Subsurface Conditions

Subsurface soil conditions described in this section are based upon the SPT borings, hand auger borings, and laboratory testing conducted as part of this investigation. In general, the subsurface conditions within the subject consist of TOPSOIL underlain by SAND and SAND with fines.

Subsurface conditions in these explorations consisted of the following, in order of their occurrence below land surface:

- Organic TOPSOIL was encountered within the top 0.3 feet and consists of sand with roots;
- Very loose to medium dense fine SAND was encountered below the topsoil and ranged in thickness between 21 and 22 feet;
- Medium dense fine SAND with fines was encountered below the previous layer and ranged in thickness between 6 and 20 feet. This layer appears to be discontinuous; and
- Medium dense to very dense fine SAND was encountered below the previous layer and extended to the limits of the explorations.

A summary of subsurface conditions encountered in the borings is presented in **Table 2-5**.

2.7 Groundwater Conditions

Groundwater levels were measured at three SPT soil boring locations (SPT-1, SPT-4, and SPT-8) by installing temporary piezometers at those locations. Readings in these three temporary piezometers were taken approximately 24 hours after completion of the drilling. Approximate groundwater elevations at the other SPT boring locations were estimated based on averaging readings taken at SPT-1, SPT-4, and SPT-8.

**Table 2-4
Summary of Laboratory Test Results
at Arbennie Pritchett Water Reclamation Facility
Okaloosa County, Florida**

Test Boring	Sample No.	Sample Depth Interval (ft-bls)	Grain Size Analysis ⁽¹⁾			Moisture Content (%) ⁽²⁾	USCS Classification ⁽³⁾
			Gravel (%)	Sand (%)	Fines (%)		
SPT-2	S-2	2.0 to 4.0	---	---	5.0	5.1	SP
	S-4	6.0 to 8.0	---	---	2.0	3.8	SP
	S-6	13.5 to 15.0	---	---	4.0	14.0	SP
	S-8	23.5 to 25.0	---	---	12.0	19.5	SP-SC
	S-10	33.5 to 35.0	---	---	2.0	19.9	SP
	S-12	43.5 to 45.0	---	---	2.0	18.2	SP
	S-14	53.5 to 55.0	---	---	3.0	16.7	SP
SPT-8	S-2	2.0 to 4.0	0.0	96.0	4.0	3.6	SP
	S-4	6.0 to 8.0	0.0	98.0	2.0	2.9	SP
	S-6	13.5 to 15.0	0.0	99.0	1.0	12.5	SP

Sample ID #	Sample Location	Sample Type	Sample Depth (ft)			pH	Chlorides ppm	Sulphate ppm	Resistivity (ohm-cm)	FDOT Classification	
				to						Concrete	Steel
1	Building Area	Fine Sand	2.0	to	4.0	7.1	60	6	10,000	S	S

Notes:

- 1 Grain Size Analysis tests were conducted in accordance with ASTM D422.
- 2 Moisture contents were conducted in accordance with ASTM D2216.
- 3 Unified Soil Classifications System (USCS) were performed in accordance with ASTM D2487.

Unified Soil Classification System:

- SP Poorly Graded Sand
- SP-SC Poorly Graded Sand with Clay

FDOT Classification:

- S Slightly Aggressive

Client: Okaloosa County Water and Sewer Department
 Project: Arbennie Pritchett Water Reclamation Facility
 Project No: 5000-58811

Prepared By: ISA
 Date: 5/9/2007
 Checked By:
 Date:

Table 2-5
Summary of Subsurface Conditions
at Arbennie Pritchett Water Reclamation Facility

Boring No.	Approximate Ground Surface Elevation (ft) ⁽¹⁾	Total Drilling Depth (ft)	Approximate Strata Thickness (ft)				Approximate Depth to Groundwater (ft)	Approximate Groundwater Elevation (ft) ⁽¹⁾
			Topsoil	Layer 1: SP	Layer 2: SP-SC	Layer 3: SP		
SPT-1	71.9	40	≤0.3	21.3	5.0	13.5	23.3	48.6
SPT-2	72.1	70	≤0.3	21.3	5.0	43.5	23.3	48.8 ⁽²⁾
SPT-3	71.9	70	≤0.3	69.8	-	-	23.1	48.8 ⁽²⁾
SPT-4	72.4	30	≤0.3	21.3	2.4	6.1	23.7	48.7
SPT-5	71.5	25	≤0.3	21.3	3.5	-	22.7	48.8 ⁽²⁾
SPT-6	72.4	70	≤0.3	69.8	-	-	23.6	48.8 ⁽²⁾
SPT-7	72.8	20	≤0.3	19.8	-	-	24.0	48.8 ⁽²⁾
SPT-8	70.9	25	≤0.3	21.3	3.5	-	21.9	49.0
SPT-9	68.9	20	≤0.3	19.8	-	-	20.1	48.8 ⁽²⁾

Notes:

- 1- Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
- 2- Approximate groundwater elevations are estimated based on averaging readings taken at SPT-1, SPT-4, and SPT-8, where temporary piezometers were installed. Readings in these three temporary piezometers were taken approximately 24 hours after stabilization.
- 3- Shaded cells represent the end of exploration.

Groundwater levels measured in the temporary piezometers and piezocone soundings are presented in Table 2-1.

Historical graphs of water level readings are presented by Brown Consulting Group, Inc. in their groundwater modeling report dated October 2005, and excerpts from this report are included in Appendix A. Information from the soil survey of Okaloosa County indicates the wet season water table at the site can rise to within 5 to 6.5 feet from the land surface. The historical water level information between 1994 and 2005 shown in Appendix A indicates a wet season water table at about elevation EL +65.

2.8 Expected Variations in Subsurface Conditions

Interpretation of general soil conditions presented herein is based on soil and groundwater conditions observed at the test boring locations. However, subsurface conditions may vary between exploration locations. If conditions are found to be different from assumed, recommendations contained in this report should be reevaluated by CDM and confirmed in writing.

Water levels measured in the explorations should not be considered to represent stabilized groundwater levels. In addition, groundwater levels are expected to fluctuate with season, temperature, climate, construction in the area, and other factors. Actual conditions during construction may be different from those observed at the time of the explorations.

Section 3

Engineering Evaluation and Geotechnical Design Recommendations

3.1 General

This section describes our geotechnical engineering evaluation and design recommendations for the proposed structures at the existing Arbennie Pritchett Water Reclamation Facility in Okaloosa County, Florida. In general, geotechnical engineering evaluations and recommendations have been based on published correlations with soil properties and the minimum requirements of the Florida Building Code (2004). In addition, recommended design criteria are based on performance tolerances, such as allowable settlement, as understood to relate to similar structures.

3.2 Foundation Design Recommendations

3.2.1 General

Conventional shallow foundation systems bearing upon suitable foundation materials may be utilized for all proposed structures at the site. Suitable foundation materials consist of medium dense *in-situ* soils and compacted structural fill materials. Very loose *in-situ* soils are not considered suitable foundation materials and shall be removed and recompacted (or compacted in-place) prior to placement of foundations.

3.2.2 Foundation Type and Depth

The foundations systems for the proposed structures are summarized in Table 2-1. In general, the structures can be grouped by type, as described in the following paragraphs. **Table 3-1** provides a summary of the allowable soil bearing pressures and estimates of settlement for the proposed structures. The structural engineer should review this information together with information on Table 2-2 to confirm that final design structure dimensions and loads have not significantly changed.

If conditions significantly change from the assumptions shown in Table 2-2, then the allowable soil bearing pressures and estimates of settlement need to re-evaluated.

3.2.2.1 Tank Structures - Cast-in-Place Structure with Mat Foundation

The tank structures with mat foundation at the site consist of Aeration Basins and Anoxic Basins. The proposed foundations for these tank structures are 40 to 110 feet wide and 75 to 190 feet long bearing at depths of 3 to 4 feet below land surface. Due to the size and depth of the proposed tank foundations, bearing capacity is not anticipated to be a controlling design factor. Instead, the design contact stress was used to estimate settlements, as listed in Table 3-1. CDM understands that tanks with flexible membrane slabs such as the CROM tank are being considered for use. Thickened edge of footings should be designed for an allowable contact pressure of 2,000 psf.

Table 3-1
Summary of Settlement Calculations
Proposed Structures at Arbenie Pritchett Water Reclamation Facility
Okaloosa County, Florida

<i>Foundation Type</i>	<i>Structure Name</i>	<i>Approximate Dimension (feet)</i>	<i>Total Estimated Settlement (inches)</i>	<i>Estimated Differential Settlement (inches)</i>
Tank Structures - Mat Foundation or Flexible Membrane Slab	Aeration Basin(s) - Two	190 x 110	2 or less	1 1/4 (between edge and center of tank)
	Anoxic Basin(s) - Two	110 x 40		
	Second Anoxic Basin - Two	75 x 45		
CROM Tank Structure - Flexible Membrane Slab	Concentric Digester	100-foot Diameter	2 or less	1 1/4 (between edge and center of tank)
	Clarifier(s) - Two	130-foot Diameter		
Spread Footing Structure	Dewatering Centrifuge Structure	20 x 25	1 or less	3/4 (between adjacent footings)
Mat Foundation	UV System/Effluent Pump Station	35 x 55	1 or less	3/4 (tilt across narrowest dimension of slab)
	Headworks	25 feet high 100 x 4		
	Septage Receiving Station	15 x 45		
	Lift Station	12-foot Diameter		
Slab on Grade with Thickened Edge Footing	Administration Building	110 x 95	1 or less	3/4 (between adjacent footings)
	Maintenance Building & Storage	95 x 55		
	Electrical Building Two with Blower Pad	54 x 40		
	Electrical Building One	40 x 20		
	RAS/WAS Pump Station	45 x 25		
	Digester Sludge Pumps	25 x 30		

3.2.2.2 Tank Structure – Prestressed Tank with Flexible Membrane Slab

The tank structures with flexible membrane slab at the site consist of two clarifiers and the concentric digester. The proposed foundation for these tank structures is 130 feet in diameter bearing at a depth of 1.5 feet below land surface. Due to the size and depth of the proposed tank foundations, bearing capacity is not anticipated to be a controlling design factor. Instead, the design contact stress was used to estimate settlements, as listed in Table 3-1. Thickened edge of footings should be designed for an allowable contact pressure of 2,000 psf.

3.2.2.3 Spread Footings

The dewatering centrifuge structure will have spread footing foundation. All spread footings should have a minimum width of 3 feet and bear at least 3 feet below grade. The spread footings should be designed for an allowable contact pressure of 2,000 psf with an associated settlement of less than one inch and no more than 0.75 inches of differential settlement between adjacent columns. To be able to satisfy the recommended soil bearing pressure, 3 feet of soil below the footing plus a margin of 3 feet should be compacted. Structural fill should be placed in such a manner that it extends at least 2 feet beyond the outer edge of the foundation, then outward and downward at a slope of 1 horizontal to 1 vertical for a depth of at least 3 feet.

3.2.2.4 Mat Foundations

The foundation system for the UV system/Effluent pump station, Headworks, Septage receiving station, and Lift station will consist of mat foundations with varying dimensions bearing at depths of 2 to 12 feet below land surface. Due to the size and depth of the proposed mat foundations, bearing capacity is not anticipated to be a controlling design factor. Instead, the design contact stress was used to estimate settlements, as listed in Table 3-1.

A coefficient of subgrade reaction of 100 tons per cubic foot (tcf) may be used for slab design.

3.2.2.5 Slab on Grade with Thickened Edge Footings

The foundation systems for the administration building, maintenance building, electrical building, RAS/WAS pump station, and digester sludge pumps will consist of slabs on grade with thickened edge footings bearing between 1 to 1.5 feet below land surface. The thickened edge footings should be at least 3 feet wide and may be designed for an allowable bearing capacity of 2,000 psf with an associated settlement of less than 1 inch. To be able to satisfy the recommended soil bearing pressure, 3 feet of soil below the footing plus a margin of 3 feet should be compacted. Structural fill should be placed in such a manner that it extends at least 2 feet beyond the outer edge of the foundation, then outward and downward at a slope of 1 horizontal to 1 vertical for a depth of at least 3 feet.

3.2.3 Design Groundwater Level

Based on the historical groundwater level data shown in Appendix D, the design groundwater level for the proposed structures should be assumed to be at EL. 65 feet NGVD.

3.2.4 Lateral Loads on Below-Grade Foundation Walls

Below-grade walls that are backfilled on one side and restrained against rotation at the top, should be designed for lateral pressures from soil and groundwater based on an equivalent fluid unit weight of 60 pounds per cubic foot (pcf) above the design groundwater level and 90 pcf below the design groundwater level.

A lateral pressure equal to 0.5 times surface surcharge should be applied over the full height of all walls. Earthquake-induced pressures in accordance with the Florida Building Code should be included in the design of all walls.

3.2.5 Resistance to Unbalanced Lateral Loads

Unbalanced lateral loads should be designed to resist friction on the bottom of the foundations and slab. For purposes of design, a coefficient of friction of 0.4 should be used. It is expected that the available friction will be sufficient to resist all unbalanced lateral loads. However, should lateral loads exceed the friction available, the surplus loads may be resisted by passive pressures on foundations. A passive pressure resistance of up to a maximum equivalent fluid pressure of 150 pcf may be assumed provided the foundations are backfilled with compacted structural fill to a density of at least 95 percent of the maximum dry density as determined by laboratory test ASTM D1557. Frictional resistance should be assumed to be mobilized first and to its full capacity before any passive pressure is developed. Passive pressure resistance should be based on the assumption that the top foot of soil has been eroded.

3.3 Site Preparation and Compaction Recommendations

3.3.1 General

The existing site is well vegetated with thick grass cover with numerous existing water pipes to support the spray field. About 3-inches or less of organic topsoil is present at existing grade. Prior to commencing construction, the site should be stripped of organic topsoil to be stockpiled for re-use, if required. In addition, all organics, muck, roots, tree stumps, and other unsuitable materials within 5 feet of the footprint of any structure or pavement should be stripped/grubbed and disposed of site.

3.3.2 Special Site Preparation Procedures

The existing overburden soils encountered in the test borings are not suitable for support of the proposed foundations without improvement by compaction. To meet recommended soil bearing pressures and estimated settlements, 3 feet of soil underneath all footings, slabs, mats, and tank foundations plus a margin of 3 feet

should be either compacted by conventional heavy vibratory rollers to 95 percent of maximum dry density as determined by modified Proctor test (ASTM D1557) or removed and replaced with fill. The *in-situ* poorly graded sands are suitable for re-use as structural fill.

Density tests should be conducted to verify that proper compaction has been achieved beneath each structure.

3.3.3 Proposed Roads or Pavements

Subgrade soils for the proposed roads and pavements should be compacted to at least 95 percent of maximum dry density as determined by ASTM D1557 for a depth of 12 inches. Where subgrade soils are unsuitable or where fill is placed to build-up to subgrade levels, backfill shall consist of select common fill within 2 feet of roadway subgrade and shall be placed and compacted in 12-inch (maximum) lifts to 98 percent of maximum dry density as determined by ASTM D1557.

3.3.4 Proposed Water Main and Yard Piping

3.3.4.1 Pipe Subgrade and Bedding

The existing overburden soils encountered in the test borings are suitable for support of the proposed pipelines. Any loose or soft soils that may be present at the subgrade level are not considered suitable for pipeline support and should be removed and replaced with select common fill.

The pipe should be placed on a bedding of at least 12 inches of sand compacted to 90 percent of maximum dry density as determined by ASTM D1557 or use No. 57 stone. The stone should be placed directly over a prepared subgrade consisting of the undisturbed, naturally deposited inorganic soils or compacted structural fill. The pipe should be backfilled to the springline using No. 57 stone or sand compacted as above.

At locations where the stone is placed below the groundwater level over soils consisting of fine sand, silt or clay, a filter fabric should be placed between the natural subgrade and the stone to prevent the migration of fines from the subgrade into the stone.

3.3.4.2 Trench Backfill

Material placed against the pipeline and to at least 12 inches over the pipe should consist of select common fill that contains stones no larger than 2 inches. The remainder of the trench may be backfilled using common fill or the trench excavate, provided the excavate is substantially free of organic material, loam, wood, trash, stone blocks, broken concrete, masonry rubble, bituminous concrete, other deleterious or objectionable material, contain stones no larger than 6 inches, and can be readily placed and compacted.

In paved areas, it is recommended that the entire trench backfill contain stones no larger than 2 inches and be placed and compacted to at least 95 percent of the maximum dry density as determined by laboratory test ASTM D1557.

3.3.5 Proposed Stormwater Retention Pond

The proposed pond will be unlined and percolation into the subgrade soils should be determined by the results of the Double Ring Infiltrometer test results and seasonal high water table, as discussed in Section 2. The pond will be partially below grade with minimum containment berms and will be constructed by excavating through overburden soils. It is recommended that the internal and external slopes of the pond be three horizontal to one vertical (3H:1V) or shallower for stability and resistance to erosion due to pond level fluctuation.

As discussed previously in Section 2.7, the wet season water table at the site is estimated to be at EL +65.

Section 4

Construction Considerations

4.1 General

The purpose of this section is to discuss issues related to geotechnical aspects of construction as required for development of the project specifications. Included are anticipated methods of construction and identification of potential construction related problems. The project geotechnical engineer should prepare and/or review technical specifications and contract documents related to earthwork, dewatering, excavation support, and foundations. The word Contractor in the following sections refers to CDM Constructors, Inc. (CCI) or their subcontractor.

4.2 Excavation and Excavation Support

Excavation work must be done in accordance with the applicable federal and state laws and regulations, including OSHA. The appropriate Contractor shall develop an excavation plan, including temporary excavation support systems (if necessary) designed by a Professional Engineer registered in the State of Florida.

It is anticipated that all the excavations in the sandy overburden soils can be accomplished using conventional earth moving equipment. Due to the nature of the site, it is anticipated that many excavations could be accomplished by open-cut with stable side slopes by constructing deeper structures and then backfilling to construct the more shallow structures. Where open-cut is not feasible, use of temporary excavation support systems will limit the amount of soil removed as well as protect newly completed adjacent structures. The type of excavation method selected by the Contractor will depend upon subsurface stratum, groundwater conditions, adjacent structures/pipelines, surcharge loading, construction sequence, etc. The selected excavation methods should also be compatible with the CCI's selected dewatering method.

4.3 Dewatering

The appropriate subcontractor will be responsible for designing and implementing a dewatering system that maintains a dry, undisturbed subgrade. Dewatering systems are not anticipated to be required for the proposed excavations unless the groundwater level rises significantly above its current level. Historic groundwater levels from nearby monitoring wells are shown in Appendix A. Based on a wet season water table at EL 65, dewatering would likely be required for excavations deeper than about 3 to 5 feet.

To avoid disturbance to the subgrade, the groundwater elevation should be maintained at a minimum of 3 feet below the subgrade level during the entire period of excavation and fill placement. Dewatering may consist of sumps, wells, or wellpoints capable of lowering the groundwater 3 feet below the lowest level of the excavation.

The Contractor shall take care to avoid disturbance of the exposed subgrade soils by scheduling excavations to limit the duration of open cuts, sloping the bottoms of the excavations to facilitate drainage, and providing berms to limit runoff into the excavations. In addition, excavated material to be reused as backfill should be stockpiled in such a manner that promotes runoff and limits saturation of the materials.

4.4 Backfill Materials and Construction Requirements

4.4.1 Structural Fill

Material used as structural fill should consist of a mineral soil free of organic material, loam, debris, frozen soil or other deleterious material which may be compressible or which cannot be properly compacted. Material used as structural fill should conform to the following gradation requirements:

U.S. Standard Sieve Size	Percent Passing by Weight
3 inches	100
No. 4	20-100
No. 40	5-100
No. 200	0-12

Structural fill should have a maximum liquid limit of 40 percent, a maximum plasticity index of 10 percent, and a maximum dry density as determined by ASTM D1557 of at least 100 pcf.

Structural fill should be placed in layers no thicker than 12 inches, as placed, and compacted with suitable compaction equipment to at least 95 percent of maximum dry density as determined by ASTM D1557. Lift thickness should be reduced to 4 to 6 inches in confined areas accessible only to hand-guided compaction equipment.

Based on the strata encountered in the recent test borings drilled at the site, it is likely that some of the material excavated for foundation construction, not including topsoil, can be reused as structural fill.

4.4.2 Common Fill

Common fill used as fill below roadways and landscaped areas should consist of granular soil free of organic material, topsoil, debris, or other deleterious material that cannot be properly compacted. It should contain stones no larger than 6 inches and have no more than 20 percent of material passing the No. 200 sieve. It should be placed in layers not to exceed 12 inches and compacted with suitable vibratory compaction equipment to at least 95 percent of maximum dry density beneath roadways and at least 90 percent of maximum dry density in all other areas. Maximum dry density shall be as determined by ASTM D1557. Lift thickness should

be reduced to 6 inches in confined areas accessible only to hand-guided compaction equipment.

Select common fill should meet the requirements listed above, but should contain stones no larger than 2 inches.

Based on the strata encountered in the recent test borings drilled at the site, it is likely that most of the material excavated for foundation construction, not including topsoil, can be reused as common fill.

4.4.3 Screened Gravel and Crushed Stone

Screened gravel and crushed stone used for pipe bedding should be washed, hard, durable, with rounded or subangular particles of proper size and gradation, and should be free from sand, loam, clay, excess fines, and other deleterious materials. The material should conform to FDOT standard No. 57 for coarse aggregate.

4.5 Protection of Subgrades

Care should be taken to avoid excess traffic on the excavated subgrade prior to placement of the structural fill or concrete foundations. Subgrades should be proof rolled with at least five passes with a vibratory compactor prior to placement of structural fill or concrete foundations. Subgrades should be excavated within the final 6 inches using a smooth-edge bucket or hand excavation. Any unstable or unsuitable material present at the subgrade level should be removed and replaced with compacted structural fill.

Poorly graded sand subgrades can dry out and become friable and disturbed even to foot traffic. To help the subgrade remain stable, the following options may be used:

- 1) A binder material consisting of shellrock or limerock mixed with the top 6 inches of poorly graded sand to help to stabilize exposed surfaces such as excavation bottoms prior to pouring concrete;
- 2) Keep the surface moist by spraying with water to help prevent the subgrades from drying out; or
- 3) Use of a thin concrete mud mat.

A geotechnical engineer from CDM should be present during foundation excavation to confirm that subgrade conditions are consistent with those evaluated during design and are suitable for the proposed construction.

4.6 Construction Monitoring

A representative of CDM's geotechnical group or CCI should be present during construction to confirm that the appropriate subcontractor complies with the intent of

these recommendations. Specifically, the field representative would undertake the following responsibilities:

- Confirm removal of unsuitable materials and excavation/recompaction of loose subgrade soils;
- Confirm that appropriate dewatering methods are employed;
- Confirm that the subgrade conditions encountered are suitable for support of the proposed structures and pipelines; and
- Observe, test, and document placement and compaction of backfill material where appropriate.

In addition, the field representative should be present to identify and provide a response should conditions encountered differ from those assumed during preparation of this report.

Appendix C

SPT and Hand Auger Boring Logs



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-1

Client: Okaloosa County
Project Location: Okaloosa, FL

Project Name: Arbennie Pritchett Water Reclamation Facility
Project Number: 5000-58811

Drilling Contractor: Williams Earth Sciences
Drilling Method/Rig: Mud Rotary/CME 75
Drillers: Dave McMiller
Drilling Date: Start: 4-25-07 **End:** 4-25-07
Borehole Coordinates:
N 545,218.70 E 1,299,487.90

Surface Elevation (ft-NAVD 1988): 71.9* see notes below
Total Depth (ft.): 40
Depth to Groundwater Level (ft. BLS): 23.3** see notes below
Abandonment Method: Backfilled with Bentonite chips
Field Screening Instrument:
Logged By: I.S. Akbas

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			0		1			Grass Cover				
SS	S-1	24/24		3	1		SP	Organic TOPSOIL Poorly Graded SAND, fine, very loose, moist, brown.				
SS	S-2	24/19		1	1							
					1							
SS	S-3	24/19		2	1			Grades to light brown.				
			5		1							
					2							
SS	S-4	24/20		4	2			Grades to very loose to loose, very light brown.				
					2							
					3							
SS	S-5	24/20		6	3		Grades to loose.					
					3							
			10		2							
SS	S-6	18/14		18	5		Grades to medium dense, wet, brown and grayish brown.					
					7							
			15		11							
SS	S-7	18/14		16	5							
					7							
					9							

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer weight = 140 lb, Hammer drop height = 30 in., Spoon Size = 2 in. OD and 24 in. length.
* Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
** Groundwater reading was taken in temporary piezometer approximately 24 hours after stabilization.

Reviewed by: T.W. Nichols

Date: 5-9-07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-1

Client: Okaloosa County

Project Name: Arbennie Pritchett Water Reclamation Facility

Project Location: Okaloosa, FL

Project Number: 5000-58811

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			20				SP					
SS	S-8	18/15		7	4 4 3		SP-SC	Poorly Graded SAND with Clay, fine, wet, loose, brownish gray and light brown.				
			25									
SS	S-9	18/13		24	9 11 13		SP	Poorly Graded SAND, fine to medium, medium dense, wet, light gray.				
			30									
SS	S-10	18/12		16	6 7 9							
			35									
SS	S-11	18/5		13	6 6 7							
			40					Boring terminated at 40 feet below land surface.				
			45									
			50									
			55									

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-2

Client: Okaloosa County
Project Location: Okaloosa, FL

Project Name: Arbennie Pritchett Water Reclamation Facility
Project Number: 5000-58811

Drilling Contractor: Williams Earth Sciences
Drilling Method/Rig: Mud Rotary/CME 75
Drillers: Dave McMiller
Drilling Date: Start: 4-24-07 **End:** 4-24-07
Borehole Coordinates:
N 545,049.10 E 1,299,509.60

Surface Elevation (ft-NAVD 1988): 72.1* see notes below
Total Depth (ft.): 70
Depth to Groundwater Level (ft. BLS): 23.3** see notes below
Abandonment Method: Backfilled with Bentonite chips
Field Screening Instrument:
Logged By: I.S. Akbas

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			0		1			Grass Cover				
SS	S-1	24/24		3	1 1 2 2		SP	Organic TOPSOIL Poorly Graded SAND , fine, very loose, dry to moist, brown.				
SS	S-2	24/21		2	1 1 1			Grades to moist.	5.1		5	
SS	S-3	24/24	5	4	2 2 4			Grades to very loose to loose, light grayish brown.				
SS	S-4	24/19		2	1 1 2			Grades to very loose, very light brown.	3.8		2	
SS	S-5	24/20		5	2 2 3 3			Grades to loose.				
			10									
SS	S-6	18/15		9	3 3 6		Grades to wet, light brown to brown.	14.0		4		
			15									
SS	S-7	18/12		14	4 6 8		Grades to medium dense.					

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer weight = 140 lb, Hammer drop height = 30 in., Spoon Size = 2 in. OD and 24 in. length.

** Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
** Approximate groundwater elevation was estimated based on averaging readings taken at SPT-1, SPT-4, and SPT-8, where temporary piezometers were installed.

Reviewed by: T.W. Nichols

Date: 5-9-07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-2

Client: Okaloosa County

Project Name: Arbennie Pritchett Water Reclamation Facility

Project Location: Okaloosa, FL

Project Number: 5000-58811

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			20				SP					
SS	S-8	18/18		1	3 1 WOH		SP-SC	Poorly Graded SAND with Clay , fine, very loose, wet, brownish gray.	19.5		12	
			25				SP					
SS	S-9	18/13		20	6 10 10		SP	Poorly Graded SAND , fine to medium, medium dense, wet, light gray.				
			30									
SS	S-10	18/12		14	5 6 8			Grades to fine, light gray to light brown.	19.9		2	
			35									
SS	S-11	18/13		20	5 9 11			Grades to fine to medium.				
			40									
SS	S-12	18/13		23	9 10 13				18.2		2	
			45									
SS	S-13	18/17		>50	15 28 37			Grades to fine to medium, very dense, light brown.				
			50									
SS	S-14	18/18		43	14 18 25			Grades to dense.	16.7		3	
			55									
SS	S-15	18/18		>50	25 33 44			Grades to very dense.				



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-2

Client: Okaloosa County

Project Name: Arbennie Pritchett Water Reclamation Facility

Project Location: Okaloosa, FL

Project Number: 5000-58811

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			60				SP	Grades to light brown to brown.	18.5		2	
SS	S-16	12/12		>50	37 50/6"							
			65									
SS	S-17	12/12		>50	33 50/6"							
			70					Boring terminated at 70 feet below land surface.				
			75									
			80									
			85									
			90									
			95									

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-3

Client: Okaloosa County
Project Location: Okaloosa, FL

Project Name: Arbennie Pritchett Water Reclamation Facility
Project Number: 5000-58811

Drilling Contractor: Williams Earth Sciences
Drilling Method/Rig: Mud Rotary/CME 75
Drillers: Dave McMiller
Drilling Date: Start: 4-24-07 **End:** 4-24-07
Borehole Coordinates:
N 544,838.30 E 1,299,459.40

Surface Elevation (ft-NAVD 1988): 71.9* see notes below
Total Depth (ft.): 70
Depth to Groundwater Level (ft. BLS): 23.1** see notes below
Abandonment Method: Backfilled with Bentonite chips
Field Screening Instrument:
Logged By: I.S. Akbas

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			0		1		SP	Grass Cover				
SS	S-1	24/20		3	1			Organic TOPSOIL				
					2			Poorly Graded SAND, fine, very loose, dry, brown.				
SS	S-2	24/18		3	3				Grades to moist, orangish brown to brown.			
					2			Grades to very loose to loose.				
SS	S-3	24/18	5	4	2							
					2			Grades to loose, very light orangish brown.				
SS	S-4	24/17		5	3							
					2	Grades to fine to medium, very light brown.						
SS	S-5	24/17		6	3							
			10		3			Grades to fine, wet, brown.				
SS	S-6	18/14		8	3							
					5							
			15					Grades to fine to medium, medium dense, brown and orangish brown.				
SS	S-7	18/14		23	7							
					11							
					12							

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer weight = 140 lb, Hammer drop height = 30 in., Spoon Size = 2 in. OD and 24 in. length.

** Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
** Approximate groundwater elevation was estimated based on averaging readings taken at SPT-1, SPT-4, and SPT-8, where temporary piezometers were installed.

Reviewed by: T.W. Nichols

Date: 5-9-07

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-3

Client: Okaloosa County

Project Name: Arbennie Pritchett Water Reclamation Facility

Project Location: Okaloosa, FL

Project Number: 5000-58811

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index	
			20				SP						
SS	S-8	18/14		6	5 4 2								Grades to fine, loose, grayish brown.
			25										
SS	S-9	18/12		14	5 7 7								Grades to fine to medium, medium dense, light brown.
			30										
SS	S-10	18/12		11	4 5 6								Grades to fine, light gray to gray.
			35										
SS	S-11	18/12		11	5 5 6								
			40										
SS	S-12	18/16		12	5 6 6								
			45										
SS	S-13	18/14		32	12 13 19								Grades to dense, light gray.
			50										
SS	S-14	18/17		>50	19 26 32								Grades to fine to medium, very dense.
			55										
SS	S-15	18/18		>50	15 19 41	Grades to light brown to brown.							



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Raleigh, NC 27612

SPT BORING LOG

SPT-3

Client: Okaloosa County

Project Name: Arbennie Pritchett Water Reclamation Facility

Project Location: Okaloosa, FL

Project Number: 5000-58811

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index		
			60				SP	Grades to medium, light gray to light brown.						
SS	S-16	11/11		>50	41 50/5"									
			65											
SS	S-17	11/11		>50	40 50/5"					Grades to fine to medium, light brown.				
			70					Boring terminated at 70 feet below land surface.						
			75											
			80											
			85											
			90											
			95											

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-4

Client: Okaloosa County
Project Location: Okaloosa, FL

Project Name: Arbennie Pritchett Water Reclamation Facility
Project Number: 5000-58811

Drilling Contractor: Williams Earth Sciences
Drilling Method/Rig: Mud Rotary/CME 75
Drillers: Dave McMiller
Drilling Date: Start: 4-25-07 **End:** 4-25-07
Borehole Coordinates:
N 544,647.50 E 1,299,510.00

Surface Elevation (ft-NAVD 1988): 72.4* see notes below
Total Depth (ft.): 30
Depth to Groundwater Level (ft. BLS): 26.6**see notes below
Abandonment Method: Backfilled with Bentonite chips
Field Screening Instrument:
Logged By: I.S. Akbas

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			0		1			Grass Cover				
SS	S-1	24/22		1	1		SP	Organic TOPSOIL. Poorly Graded SAND , fine, very loose, dry to moist, brown.				
SS	S-2	24/17		2	1		Grades to moist, light brown to brown.					
SS	S-3	24/20	5	3	1		Grades to light brown.					
SS	S-4	24/24		4	2		Grades to very loose to loose.					
SS	S-5	24/20		3	2		Grades to very loose, light gray to light brown.					
			10		1							
SS	S-6	18/13		18	8		Grades to medium dense, wet, light brown to brown.					
			15		10							
SS	S-7	18/14		17	5	Grades to fine to medium, light brown.						
					7							
					10							

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer weight = 140 lb, Hammer drop height = 30 in., Spoon Size = 2 in. OD and 24 in. length.
* Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
** Groundwater reading was taken in temporary piezometer approximately 24 hours after stabilization.

Reviewed by: T.W. Nichols

Date: 5-9-07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-4

Client: Okaloosa County

Project Name: Arbennie Pritchett Water Reclamation Facility

Project Location: Okaloosa, FL

Project Number: 5000-58811

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			20				SP	<p>Poorly Graded SAND with Clay, fine, medium dense, wet, dark brown.</p> <p>Poorly Graded SAND, fine to medium, medium dense, wet, light brown.</p>				
SS	S-8	18/13		11	5 5 6		SP-SC					
			25									
SS	S-9	18/6		22	4 9 13		SP	Grades to light gray to gray.				
			30					<p>Boring terminated at 30 feet below land surface.</p>				
			35									
			40									
			45									
			50									
			55									

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-5

Client: Okaloosa County
Project Location: Okaloosa, FL

Project Name: Arbennie Pritchett Water Reclamation Facility
Project Number: 5000-58811

Drilling Contractor: Williams Earth Sciences
Drilling Method/Rig: Mud Rotary/CME 75
Drillers: Dave McMiller
Drilling Date: Start: 4-25-07 **End:** 4-25-07
Borehole Coordinates:
N 544,647.70 E 1,299,675.10

Surface Elevation (ft-NAVD 1988):71.5* see notes below
Total Depth (ft.): 25
Depth to Groundwater Level (ft. BLS):22.7** see notes below
Abandonment Method: Backfilled with Bentonite chips
Field Screening Instrument:
Logged By: I.S. Akbas

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/Plastic Index
			0		1			Grass Cover				
SS	S-1	24/21		1	1		SP	Organic TOPSOIL Poorly Graded SAND, fine, very loose, moist, brown.				
SS	S-2	24/16		2	1							
SS	S-3	24/21	5	2	1			Grades to light brown.				
SS	S-4	24/20		3	1			Grades to very light brown.				
SS	S-5	24/22		5	2			Grades to loose.				
			10		3							
SS	S-6	18/13		20	4			Grades to fine to medium, medium dense, wet, grayish brown and brown.				
			15		8							
SS	S-7	18/14		20	9		Grades to grayish brown.					
					11							

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer weight = 140 lb, Hammer drop height = 30 in., Spoon Size = 2 in. OD and 24 in. length.

* * Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
** Approximate groundwater elevation was estimated based on averaging readings taken at SPT-1, SPT-4, and SPT-8, where temporary piezometers were installed.

Reviewed by: T.W. Nichols

Date: 5-9-07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-5

Client: Okaloosa County

Project Name: Arbennie Pritchett Water Reclamation Facility

Project Location: Okaloosa, FL

Project Number: 5000-58811

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			20				SP					
							SP-SC					
SS	S-8	18/13		5	1 2 3			Poorly Graded SAND with Clay , fine, loose, wet, grayish brown.				
			25					Boring terminated at 25 feet below land surface.				
			30									
			35									
			40									
			45									
			50									
			55									

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07



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SPT BORING LOG

SPT-6

Client: Okaloosa County
Project Location: Okaloosa, FL

Project Name: Arbennie Pritchett Water Reclamation Facility
Project Number: 5000-58811

Drilling Contractor: Williams Earth Sciences
Drilling Method/Rig: Mud Rotary/CME 75
Drillers: Dave McMiller
Drilling Date: Start: 4-25-07 **End:** 4-25-07
Borehole Coordinates:
N 544,569.80 E 1,299,435.30

Surface Elevation (ft-NAVD 1988): 72.4* see notes below
Total Depth (ft.): 70
Depth to Groundwater Level (ft. BLS): 23.8** see notes below
Abandonment Method: Backfilled with Bentonite chips
Field Screening Instrument:
Logged By: I.S. Akbas

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			0		1			Grass Cover				
SS	S-1	24/24		4	2		SP	Organic TOPSOIL				
					1			Poorly Graded SAND , fine, very loose to loose, dry to moist, brown.				
SS	S-2	24/16		3	1			Grades to very loose, moist.				
					2							
SS	S-3	24/20	5	3	1			Grades to brown to light brown.				
					2							
SS	S-4	24/18		5	2			Grades to grayish brown.				
					3							
SS	S-5	24/24		5	3							
			10		3							
					3							
SS	S-6	18/13		10	7			Grades to loose to medium dense, wet, brown to dark brown.				
			15									
					5							
SS	S-7	18/10		20	9		Grades to medium dense.					
					11							

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer weight = 140 lb, Hammer drop height = 30 in., Spoon Size = 2 in. OD and 24 in. length.

* * Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
** Approximate groundwater elevation was estimated based on averaging readings taken at SPT-1, SPT-4, and SPT-8, where temporary piezometers were installed.

Reviewed by: T.W. Nichols

Date: 5-9-07

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-6

Client: Okaloosa County

Project Name: Arbennie Pritchett Water Reclamation Facility

Project Location: Okaloosa, FL

Project Number: 5000-58811

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index				
			20				SP	Grades to fine to medium, dense, dark brown.								
SS	S-8	18/11		34	9 12 22											
			25								Grades to medium dense, light gray.					
SS	S-9	18/11		18	5 8 10											
			30													
SS	S-10	18/11		12	4 5 7											
			35													
SS	S-11	18/11		24	5 11 13											
			40													
SS	S-12	18/14		14	6 7 7											
			45													
SS	S-13	18/16		32	12 16 16							Grades to dense.				
			50													
SS	S-14	18/15		>50	18 33 43							Grades to very dense.				
			55													
SS	S-15	17/17		>50	19 43 50/5"											



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-6

Client: Okaloosa County

Project Name: Arbennie Pritchett Water Reclamation Facility

Project Location: Okaloosa, FL

Project Number: 5000-58811

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index		
			60				SP	Grades to medium.						
SS	S-16	10/10		>50	48 50/4"									
			65											
SS	S-17	10/10		>50	42 50/4"									
			70					Boring terminated at 70 feet below land surface.						
			75											
			80											
			85											
			90											
			95											

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-7

Client: Okaloosa County
Project Location: Okaloosa, FL

Project Name: Arbennie Pritchett Water Reclamation Facility
Project Number: 5000-58811

Drilling Contractor: Williams Earth Sciences
Drilling Method/Rig: Mud Rotary/CME 75
Drillers: Dave McMiller
Drilling Date: Start: 4-25-07 **End:** 4-25-07
Borehole Coordinates:
N 544,285.10 E 1,299,360.40

Surface Elevation (ft-NAVD 1988): 72.8* see notes below
Total Depth (ft.): 20
Depth to Groundwater Level (ft. BLS): 23.9** see notes below
Abandonment Method: Backfilled with Bentonite chips
Field Screening Instrument:
Logged By: I.S. Akbas

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			0		1	SP		Grass Cover				
SS	S-1	24/20		2	1			Organic TOPSOIL				
					1			Poorly Graded SAND, fine, very loose, dry to moist, brown.				
					1			Grades to moist.				
SS	S-2	24/17		1	1							
					1			Grades to light brown to brown.				
SS	S-3	24/16	5	2	1							
					2			Grades to very loose to loose, very light brown.				
SS	S-4	24/19		4	2							
					3			Grades to loose.				
SS	S-5	24/19		6	3							
			10		3							
					4							
SS	S-6	18/13		25	6				Grades to fine to medium, medium dense, wet, grayish brown and brown.			
			15		11							
					14							
SS	S-7	18/13		22	8							
					10							
					12							

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
 HSA - Hollow Stem Auger
 SSA - Solid Stem Auger
 HA - Hand Auger
 AR - Air Rotary
 DTR - Dual Tube Rotary
 FR - Foam Rotary
 MR - Mud Rotary
 RC - Reverse Circulation
 CT - Cable Tool
 JET - Jetting
 D - Driving
 DTC - Drill Through Casing

SAMPLING TYPES:
 AS - Auger/Grab Sample
 CS - California Sampler
 BX - 1.5" Rock Core
 NX - 2.1" Rock Core
 GP - Geoprobe
 HP - Hydro Punch
 SS - Split Spoon
 ST - Shelby Tube
 WS - Wash Sample
OTHER:
 AGS - Above Ground Surface

REMARKS

Hammer weight = 140 lb, Hammer drop height = 30 in., Spoon Size = 2 in. OD and 24 in. length.

 ** Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
 ** Approximate groundwater elevation was estimated based on averaging readings taken at SPT-1, SPT-4, and SPT-8, where temporary piezometers were installed.

Reviewed by: T.W. Nichols

Date: 5-9-07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-7

Client: Okaloosa County

Project Name: Arbennie Pritchett Water Reclamation Facility

Project Location: Okaloosa, FL

Project Number: 5000-58811

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			20					Boring terminated at 20 feet below land surface.				
			25									
			30									
			35									
			40									
			45									
			50									
			55									

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-8

Client: Okaloosa County
Project Location: Okaloosa, FL

Project Name: Arbennie Pritchett Water Reclamation Facility
Project Number: 5000-58811

Drilling Contractor: Williams Earth Sciences
Drilling Method/Rig: Mud Rotary/CME 75
Drillers: Dave McMiller
Drilling Date: Start: 4-25-07 **End:** 4-25-07
Borehole Coordinates:
N 544,273.90 E 1,299,548.00

Surface Elevation (ft-NAVD 1988): 70.9* see notes below
Total Depth (ft.): 25
Depth to Groundwater Level (ft. BLS): 21.9** see notes below
Abandonment Method: Backfilled with Bentonite chips
Field Screening Instrument:
Logged By: I.S. Akbas

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			0		1			Grass Cover				
SS	S-1	24/22		3	2		SP	Organic TOPSOIL Poorly Graded SAND, fine, very loose, dry to moist, brown.				
SS	S-2	24/19		2	1			Grades to moist.	3.6	0/96	4	
					1			Grades to light brown.				
SS	S-3	24/19	5	3	2							
					3							
SS	S-4	24/20		4	2			Grades to very loose to loose, very light brown.	2.9	0/98	2	
					2							
SS	S-5	24/21		6	3			Grades to loose, very light brown to very light gray.				
					3							
			10		4							
SS	S-6	18/12		14	3			Grades to fine to medium, medium dense, wet, light brown and brown.	12.5	0/99	1	
					6							
			15		8							
SS	S-7	18/13		25	8							
					11							
					14							

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer weight = 140 lb, Hammer drop height = 30 in., Spoon Size = 2 in. OD and 24 in. length.

* Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
** Groundwater reading was taken in temporary piezometer approximately 24 hours after stabilization.

Reviewed by: T.W. Nichols

Date: 5-9-07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-8

Client: Okaloosa County

Project Name: Arbennie Pritchett Water Reclamation Facility

Project Location: Okaloosa, FL

Project Number: 5000-58811

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			20				SP					
							SP-SC					
SS	S-8	18/14		5	2 2 3			Poorly Graded SAND with Clay , fine, loose, wet, grayish brown.				
			25					Boring terminated at 25 feet below land surface.				
			30									
			35									
			40									
			45									
			50									
			55									

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-9

Client: Okaloosa County
Project Location: Okaloosa, FL

Project Name: Arbennie Pritchett Water Reclamation Facility
Project Number: 5000-58811

Drilling Contractor: Williams Earth Sciences
Drilling Method/Rig: Mud Rotary/CME 75
Drillers: Dave McMiller
Drilling Date: Start: 4-25-07 **End:** 4-25-07
Borehole Coordinates:
N 544,273.70 E 1,299,728.20

Surface Elevation (ft-NAVD 1988):68.9* see notes below
Total Depth (ft.): 20
Depth to Groundwater Level (ft. BLS):20.1** see notes below
Abandonment Method: Backfilled with Bentonite chips
Field Screening Instrument:
Logged By: I.S. Akbas

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			0	2	1		SP	Grass Cover Organic TOPSOIL Poorly Graded SAND , fine, very loose, dry to moist, brown. Grades to moist.				
SS	S-1	24/21		1	1							
SS	S-2	24/15		1	1							
SS	S-3	24/17	5	2	1							
SS	S-4	24/20		3	2							
SS	S-5	24/21		6	3							
			10		4							
SS	S-6	18/13		12	5			Grades to fine to medium, medium dense, wet, grayish brown and brown.				
			15		7							
SS	S-7	18/13		12	4			Grades to light gray to light brown.				
					6							
					6							

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer weight = 140 lb, Hammer drop height = 30 in., Spoon Size = 2 in. OD and 24 in. length.

* * Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
** Approximate groundwater elevation was estimated based on averaging readings taken at SPT-1, SPT-4, and SPT-8, where temporary piezometers were installed.

Reviewed by: T.W. Nichols

Date: 5-9-07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

SPT BORING LOG

SPT-9

Client: Okaloosa County

Project Name: Arbennie Pritchett Water Reclamation Facility

Project Location: Okaloosa, FL

Project Number: 5000-58811

Sample Type	Sample Number	Sample Recovery (Inches)	Elev. Depth (ft.)	In Situ Test (N value)	Blows per 6-in	Graphic Log	Stratum Designation	Material Description	Moisture content (%)	%gravel/%sand	%Fines	Liquid Limit/ Plastic Index
			20					Boring terminated at 20 feet below land surface.				
			25									
			30									
			35									
			40									
			45									
			50									
			55									

BOREHOLE 1 5000-58811-OKALOOSA.GPJ CDM_CORP.GDT 5/9/07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

HAND AUGER LOG

HA-1

Client: Okaloosa County **Project Name:** Arbennie Pritchett Water Reclamation Facility
Project Location: Okaloosa, FL **Project Number:** 5000-58811

Drilling Contractor: Williams Earth Sciences **Surface Elevation (ft-NAVD 1988):** 71.7* see notes below
Drilling Method/Rig: Hand Auger/2-inch diameter bucket Auger **Total Depth (ft.):** 7
Drillers: Pookie **Depth to Groundwater Level (ft. BLS):**** see notes below
Drilling Date: Start: 4-23-07 **End:** 4-23-07 **Abandonment Method:** Backfill with drill cuttings
Borehole Coordinates: **Field Screening Instrument:**
N 545,254.10 E 1,299,619.90 **Logged By:** I.S. Akbas

Sample No. (See Remarks)	Layer Thickness (inches)	Elev. Depth (ft.)	Excavation Effort	Graphic Log	ASTM Group Symbol	Material Description	Moisture content (%)	% fines	%gravel/sand	% Organic
						Grass Cover				
S-1	24	0			SP	Organic <u>TOPSOIL</u> . Poorly Graded SAND, fine, dry, light brown to brown.				
S-2	24					Grades to moist, brown.				
S-3	24	5								
S-4	12					Grades to light orangish brown.				
		10				Auger boring terminated approximately at 7 feet below land surface.				

TEST PIT 2 W/ LAB 5000-58811-OKALOOSA.GPJ_CDM_CORP.GDT 5/9/07

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

* Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
** Groundwater was not encountered within the depth drilled.

Reviewed by: T.W. Nichols

Date: 5-9-07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

HAND AUGER LOG

HA-2

Client: Okaloosa County **Project Name:** Arbennie Pritchett Water Reclamation Facility
Project Location: Okaloosa, FL **Project Number:** 5000-58811

Drilling Contractor: Williams Earth Sciences **Surface Elevation (ft-NAVD 1988):** 72.6* see notes below
Drilling Method/Rig: Hand Auger/2-inch diameter bucket Auger **Total Depth (ft.):** 7
Drillers: Pookie **Depth to Groundwater Level (ft. BLS):**** see notes below
Drilling Date: Start: 4-23-07 **End:** 4-23-07 **Abandonment Method:** Backfill with drill cuttings
Borehole Coordinates: **Field Screening Instrument:**
N 545,049.90 E 1,299,326.00 **Logged By:** I.S. Akbas

Sample No. (See Remarks)	Layer Thickness (inches)	Elev. Depth (ft.)	Excavation Effort	Graphic Log	ASTM Group Symbol	Material Description	Moisture content (%)	% fines	% gravel/sand	% Organic
						Grass Cover				
S-1	24	0			SP	Organic <u>TOPSOIL</u> . Poorly Graded SAND, fine, dry, brownish gray.				
S-2	24					Grades to moist, brown.				
S-3	24	5				Grades to light orangish brown.				
S-4	12									
		10				Auger boring terminated approximately at 7 feet below land surface.				

TEST PIT 2 W/ LAB 5000-58811-OKALOOSA.GPJ_CDM_CORP.GDT 5/9/07

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
 HSA - Hollow Stem Auger
 SSA - Solid Stem Auger
 HA - Hand Auger
 AR - Air Rotary
 DTR - Dual Tube Rotary
 FR - Foam Rotary
 MR - Mud Rotary
 RC - Reverse Circulation
 CT - Cable Tool
 JET - Jetting
 D - Driving
 DTC - Drill Through Casing

SAMPLING TYPES:
 AS - Auger/Grab Sample
 CS - California Sampler
 BX - 1.5" Rock Core
 NX - 2.1" Rock Core
 GP - Geoprobe
 HP - Hydro Punch
 SS - Split Spoon
 ST - Shelby Tube
 WS - Wash Sample
OTHER:
 AGS - Above Ground Surface

REMARKS

* Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
 ** Groundwater was not encountered within the depth drilled.

Reviewed by: T.W. Nichols

Date: 5-9-07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

HAND AUGER LOG

HA-3

Client: Okaloosa County **Project Name:** Arbennie Pritchett Water Reclamation Facility
Project Location: Okaloosa, FL **Project Number:** 5000-58811

Drilling Contractor: Williams Earth Sciences **Surface Elevation (ft-NAVD 1988):** 72.7* see notes below
Drilling Method/Rig: Hand Auger/2-inch diameter bucket Auger **Total Depth (ft.):** 7
Drillers: Pookie **Depth to Groundwater Level (ft. BLS):**** see notes below
Drilling Date: Start: 4-23-07 **End:** 4-23-07 **Abandonment Method:** Backfill with drill cuttings
Borehole Coordinates: **Field Screening Instrument:**
N 544,794.90 E 1,299,384.80 **Logged By:** I.S. Akbas

Sample No. (See Remarks)	Layer Thickness (inches)	Elev. Depth (ft.)	Excavation Effort	Graphic Log	ASTM Group Symbol	Material Description	Moisture content (%)	% fines	% gravel/sand	% Organic
						Grass Cover				
S-1	24	0			SP	Organic <u>TOPSOIL</u> . Poorly Graded SAND, fine, dry, brownish gray.				
S-2	24					Grades to moist, brown.				
S-3	24	5				Grades to light orangish brown.				
S-4	12					Auger boring terminated approximately at 7 feet below land surface.				
		10								

TEST PIT 2 W/ LAB 5000-58811-OKALOOSA.GPJ_CDM_CORP.GDT 5/9/07

EXPLANATION OF ABBREVIATIONS

- | | |
|--|---|
| <p>DRILLING METHODS:
 HSA - Hollow Stem Auger
 SSA - Solid Stem Auger
 HA - Hand Auger
 AR - Air Rotary
 DTR - Dual Tube Rotary
 FR - Foam Rotary
 MR - Mud Rotary
 RC - Reverse Circulation
 CT - Cable Tool
 JET - Jetting
 D - Driving
 DTC - Drill Through Casing</p> | <p>SAMPLING TYPES:
 AS - Auger/Grab Sample
 CS - California Sampler
 BX - 1.5" Rock Core
 NX - 2.1" Rock Core
 GP - Geoprobe
 HP - Hydro Punch
 SS - Split Spoon
 ST - Shelby Tube
 WS - Wash Sample
 OTHER:
 AGS - Above Ground Surface</p> |
|--|---|

REMARKS

* Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
 ** Groundwater was not encountered within the depth drilled.

Reviewed by: T.W. Nichols **Date:** 5-9-07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

HAND AUGER LOG

HA-4

Client: Okaloosa County **Project Name:** Arbennie Pritchett Water Reclamation Facility
Project Location: Okaloosa, FL **Project Number:** 5000-58811

Drilling Contractor: Williams Earth Sciences **Surface Elevation (ft-NAVD 1988):** 72.9* see notes below
Drilling Method/Rig: Hand Auger/2-inch diameter bucket Auger **Total Depth (ft.):** 7
Drillers: Pookie **Depth to Groundwater Level (ft. BLS):**** see notes below
Drilling Date: Start: 4-23-07 **End:** 4-23-07 **Abandonment Method:** Backfill with drill cuttings
Borehole Coordinates: **Field Screening Instrument:**
 N 544,550.80 E 1,299,331.20 **Logged By:** I.S. Akbas

Sample No. (See Remarks)	Layer Thickness (inches)	Elev. Depth (ft.)	Excavation Effort	Graphic Log	ASTM Group Symbol	Material Description	Moisture content (%)	% fines	% gravel/sand	% Organic
						Grass Cover				
S-1	24	0			SP	Organic <u>TOPSOIL</u> . Poorly Graded SAND, fine, dry, brown.				
S-2	24					Grades to moist, orangish brown to brown.				
S-3	24	5				Grades to light orangish brown to brown.				
S-4	12					Grades to very light brown.				
		10				Auger boring terminated approximately at 7 feet below land surface.				

TEST PIT 2 W/ LAB 5000-58811-OKALOOSA.GPJ_CDM_CORP.GDT 5/9/07

EXPLANATION OF ABBREVIATIONS

- | | |
|--|---|
| <p>DRILLING METHODS:
 HSA - Hollow Stem Auger
 SSA - Solid Stem Auger
 HA - Hand Auger
 AR - Air Rotary
 DTR - Dual Tube Rotary
 FR - Foam Rotary
 MR - Mud Rotary
 RC - Reverse Circulation
 CT - Cable Tool
 JET - Jetting
 D - Driving
 DTC - Drill Through Casing</p> | <p>SAMPLING TYPES:
 AS - Auger/Grab Sample
 CS - California Sampler
 BX - 1.5" Rock Core
 NX - 2.1" Rock Core
 GP - Geoprobe
 HP - Hydro Punch
 SS - Split Spoon
 ST - Shelby Tube
 WS - Wash Sample
 OTHER:
 AGS - Above Ground Surface</p> |
|--|---|

REMARKS

* Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
 ** Groundwater was not encountered within the depth drilled.

Reviewed by: T.W. Nichols **Date:** 5-9-07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

HAND AUGER LOG

HA-5

Client: Okaloosa County
Project Location: Okaloosa, FL

Project Name: Arbennie Pritchett Water Reclamation Facility
Project Number: 5000-58811

Drilling Contractor: Williams Earth Sciences

Surface Elevation (ft-NAVD 1988): 71.7* see notes below

Drilling Method/Rig: Hand Auger/2-inch diameter bucket Auger

Total Depth (ft.): 7

Drillers: Pookie

Depth to Groundwater Level (ft. BLS):** see notes below

Drilling Date: Start: 4-23-07 **End:** 4-23-07

Abandonment Method: Backfill with drill cuttings

Borehole Coordinates:

Field Screening Instrument:

N 544,433.10 E 1,299,556.30

Logged By: I.S. Akbas

Sample No. (See Remarks)	Layer Thickness (inches)	Elev. Depth (ft.)	Excavation Effort	Graphic Log	ASTM Group Symbol	Material Description	Moisture content (%)	% fines	% gravel/sand	% Organic
						Grass Cover				
S-1	24	0			SP	Organic <u>TOPSOIL</u> . Poorly Graded SAND, fine, dry, grayish brown to brown.				
S-2	24					Grades to moist, brown.				
S-3	24	5				Grades to light brown.				
S-4	12					Grades to very light brown.				
		10				Auger boring terminated approximately at 7 feet below land surface.				

TEST PIT 2 W/ LAB 5000-58811-OKALOOSA.GPJ_CDM_CORP.GDT 5/9/07

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
 HSA - Hollow Stem Auger
 SSA - Solid Stem Auger
 HA - Hand Auger
 AR - Air Rotary
 DTR - Dual Tube Rotary
 FR - Foam Rotary
 MR - Mud Rotary
 RC - Reverse Circulation
 CT - Cable Tool
 JET - Jetting
 D - Driving
 DTC - Drill Through Casing

SAMPLING TYPES:
 AS - Auger/Grab Sample
 CS - California Sampler
 BX - 1.5" Rock Core
 NX - 2.1" Rock Core
 GP - Geoprobe
 HP - Hydro Punch
 SS - Split Spoon
 ST - Shelby Tube
 WS - Wash Sample
OTHER:
 AGS - Above Ground Surface

REMARKS

* Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
 ** Groundwater was not encountered within the depth drilled.

Reviewed by: T.W. Nichols

Date: 5-9-07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

HAND AUGER LOG

HA-6

Client: Okaloosa County **Project Name:** Arbennie Pritchett Water Reclamation Facility
Project Location: Okaloosa, FL **Project Number:** 5000-58811

Drilling Contractor: Williams Earth Sciences **Surface Elevation (ft-NAVD 1988):** 71.7* see notes below
Drilling Method/Rig: Hand Auger/2-inch diameter bucket Auger **Total Depth (ft.):** 7
Drillers: Pookie **Depth to Groundwater Level (ft. BLS):**** see notes below
Drilling Date: Start: 4-23-07 **End:** 4-23-07 **Abandonment Method:** Backfill with drill cuttings
Borehole Coordinates: **Field Screening Instrument:**
N 544,699.80 E 1,299,829.30 **Logged By:** I.S. Akbas

Sample No. (See Remarks)	Layer Thickness (inches)	Elev. Depth (ft.)	Excavation Effort	Graphic Log	ASTM Group Symbol	Material Description	Moisture content (%)	% fines	%gravel/sand	% Organic
						Grass Cover				
S-1	24	0			SP	Organic TOPSOIL . Poorly Graded SAND , fine, dry, grayish brown to brown.				
S-2	24					Grades to moist, brown.				
S-3	24	5				Grades to light brown.				
S-4	12									
		10				Auger boring terminated approximately at 7 feet below land surface.				

TEST PIT 2 W/ LAB 5000-58811-OKALOOSA.GPJ_CDM_CORP.GDT 5/9/07

EXPLANATION OF ABBREVIATIONS

- | | |
|--|---|
| <p>DRILLING METHODS:
 HSA - Hollow Stem Auger
 SSA - Solid Stem Auger
 HA - Hand Auger
 AR - Air Rotary
 DTR - Dual Tube Rotary
 FR - Foam Rotary
 MR - Mud Rotary
 RC - Reverse Circulation
 CT - Cable Tool
 JET - Jetting
 D - Driving
 DTC - Drill Through Casing</p> | <p>SAMPLING TYPES:
 AS - Auger/Grab Sample
 CS - California Sampler
 BX - 1.5" Rock Core
 NX - 2.1" Rock Core
 GP - Geoprobe
 HP - Hydro Punch
 SS - Split Spoon
 ST - Shelby Tube
 WS - Wash Sample
 OTHER:
 AGS - Above Ground Surface</p> |
|--|---|

REMARKS

* Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
 ** Groundwater was not encountered within the depth drilled.

Reviewed by: T.W. Nichols **Date:** 5-9-07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

HAND AUGER LOG

HA-7

Client: Okaloosa County **Project Name:** Arbennie Pritchett Water Reclamation Facility
Project Location: Okaloosa, FL **Project Number:** 5000-58811

Drilling Contractor: Williams Earth Sciences **Surface Elevation (ft-NAVD 1988):**69.8* see notes below
Drilling Method/Rig: Hand Auger/2-inch diameter bucket Auger **Total Depth (ft.):** 7
Drillers: Pookie **Depth to Groundwater Level (ft. BLS):**** see notes below
Drilling Date: Start: 4-23-07 **End:** 4-23-07 **Abandonment Method:** Backfill with drill cuttings
Borehole Coordinates: **Field Screening Instrument:**
N 544,431.00 E 1,299,819.90 **Logged By:** I.S. Akbas

Sample No. (See Remarks)	Layer Thickness (inches)	Elev. Depth (ft.)	Excavation Effort	Graphic Log	ASTM Group Symbol	Material Description	Moisture content (%)	% fines	%gravel/sand	% Organic
						Grass Cover				
S-1	24	0			SP	Organic <u>TOPSOIL</u> . Poorly Graded SAND, fine, dry, grayish brown.				
S-2	24					Grades to moist, brown.				
S-3	24	5				Grades to light brown.				
S-4	12					Auger boring terminated approximately at 7 feet below land surface.				

TEST PIT 2 W/ LAB 5000-58811-OKALOOSA.GPJ_CDM_CORP.GDT 5/9/07

EXPLANATION OF ABBREVIATIONS

- | | |
|--|--|
| <p>DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing</p> | <p>SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface</p> |
|--|--|

REMARKS

* Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
** Groundwater was not encountered within the depth drilled.

Reviewed by: T.W. Nichols **Date:** 5-9-07



5400 Glenwood Avenue, Suite 300
Raleigh, NC 27612

HAND AUGER LOG

HA-8

Client: Okaloosa County **Project Name:** Arbennie Pritchett Water Reclamation Facility
Project Location: Okaloosa, FL **Project Number:** 5000-58811

Drilling Contractor: Williams Earth Sciences **Surface Elevation (ft-NAVD 1988):** 67.4* see notes below
Drilling Method/Rig: Hand Auger/2-inch diameter bucket Auger **Total Depth (ft.):** 7
Drillers: Pookie **Depth to Groundwater Level (ft. BLS):**** see notes below
Drilling Date: Start: 4-23-07 **End:** 4-23-07 **Abandonment Method:** Backfill with drill cuttings
Borehole Coordinates: **Field Screening Instrument:**
N 544,147.60 E 1,299,812.60 **Logged By:** I.S. Akbas

Sample No. (See Remarks)	Layer Thickness (inches)	Elev. Depth (ft.)	Excavation Effort	Graphic Log	ASTM Group Symbol	Material Description	Moisture content (%)	% fines	% gravel/sand	% Organic
						Grass Cover				
S-1	24	0			SP	Organic <u>TOPSOIL</u> . Poorly Graded SAND , fine, dry, grayish brown to brownish gray.				
S-2	24					Grades to moist, brown.				
S-3	24	5				Grades to light brown.				
S-4	12					Auger boring terminated approximately at 7 feet below land surface.				

TEST PIT 2 W/ LAB 5000-58811-OKALOOSA.GPJ_CDM_CORP.GDT 5/9/07

EXPLANATION OF ABBREVIATIONS

- | | |
|--|---|
| <p>DRILLING METHODS:
 HSA - Hollow Stem Auger
 SSA - Solid Stem Auger
 HA - Hand Auger
 AR - Air Rotary
 DTR - Dual Tube Rotary
 FR - Foam Rotary
 MR - Mud Rotary
 RC - Reverse Circulation
 CT - Cable Tool
 JET - Jetting
 D - Driving
 DTC - Drill Through Casing</p> | <p>SAMPLING TYPES:
 AS - Auger/Grab Sample
 CS - California Sampler
 BX - 1.5" Rock Core
 NX - 2.1" Rock Core
 GP - Geoprobe
 HP - Hydro Punch
 SS - Split Spoon
 ST - Shelby Tube
 WS - Wash Sample
 OTHER:
 AGS - Above Ground Surface</p> |
|--|---|

REMARKS

* Elevations are based on NGVD 1929 and are estimated from contour lines taken from previous data supplied by County.
 ** Groundwater was not encountered within the depth drilled.

Reviewed by: T.W. Nichols **Date:** 5-9-07

Appendix D

DRI and Geotechnical Laboratory Test Results



May 7, 2007

Camp Dresser & McKee, Inc.
2301 Maitland Center Parkway, Suite 300
Maitland, Florida 32751

Attention: Mr. Thomas Nichols, P.E.

Subject: Test Results
Okaloosa County Wastewater Treatment Facility
Okaloosa County, Florida

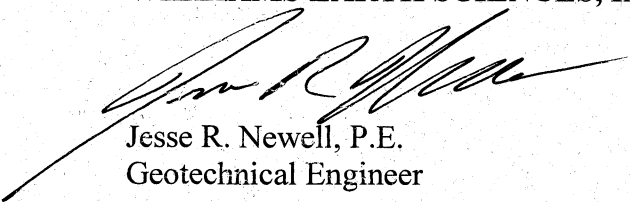
Dear Mr. Nichols:

Williams Earth Sciences is pleased to submit the following Double Ring Infiltration and Laboratory Test Results including Corrosion Test for the referenced project. These tests were performed in accordance with our contract dated April 20, 2007.

It has been our pleasure to work with you on this project. Should you have questions, or need further information, please do not hesitate to call me at 747-9419.

Yours very truly,

WILLIAMS EARTH SCIENCES, INC.



Jesse R. Newell, P.E.
Geotechnical Engineer

Distribution: Addressee (3)
File (1)

Attachments:

\\Server\panserver\PROJECTS\4307\4307-003-00 okaloosa county WTP\Test Results Letter5-7-07.doc



Double Ring Infiltration Test 1

Inner Ring Diameter: 12 in 0.3048 m
 Outer Ring Diameter: 24 in 0.6096 m

Area Outer Ring: 3.1416 ft² 0.0020268 m²
 Area Inner Ring: 0.7854 ft² 0.0005067 m²
 Net Outer Ring Area: 2.3562 ft² 0.0015201 m²

Conversions:

	1 mL or cm ³
	0.0610128 in ³
Inches of Cyl Mold	9
Volume of water (in ³)	254.4
Volume of water (cm ³)	4169.4

Inner Ring			Outer Ring			Inner Ring		Outer Ring	
ElapTime (sec)	Vol Used (in ³)	Flow Rate (cfs)	ElapTime (sec)	Vol Used (in ³)	Flow Rate (cfs)	Vol Used (cm ³)	Flow Rate (cm ³ /sec)	Vol Used (cm ³)	Flow Rate (cm ³ /sec)
300	254	0.00049	300	1357	0.0026177	4163.06	0.0080306	22241.23	0.0429036
300	254	0.00049	300	1357	0.0026177	4163.06	0.0080306	22241.23	0.0429036
300	254	0.00049	300	1357	0.0026177	4163.06	0.0080306	22241.23	0.0429036
Avg		0.00049	Avg		0.0026177	0.0080306		0.0429036	

Inner Ring Outer Ring

Hydraulic Conductivity: 6.24E-04 1.11E-03 cfs/ft²-ft head
 or feet/sec
 2.70E+01 4.80E+01 in/hr
 1.90E-02 3.39E-02 cm/sec

*Note Inner Ring to be used for infiltration rate

Double Ring Infiltration Test 2

Inner Ring Diameter: 12 in 0.3048 m
 Outer Ring Diameter: 24 in 0.6096 m

Area Outer Ring: 3.1416 ft² 0.0020268 m²
 Area Inner Ring: 0.7854 ft² 0.0005067 m²
 Net Outer Ring Area: 2.3562 ft² 0.0015201 m²

Conversions:

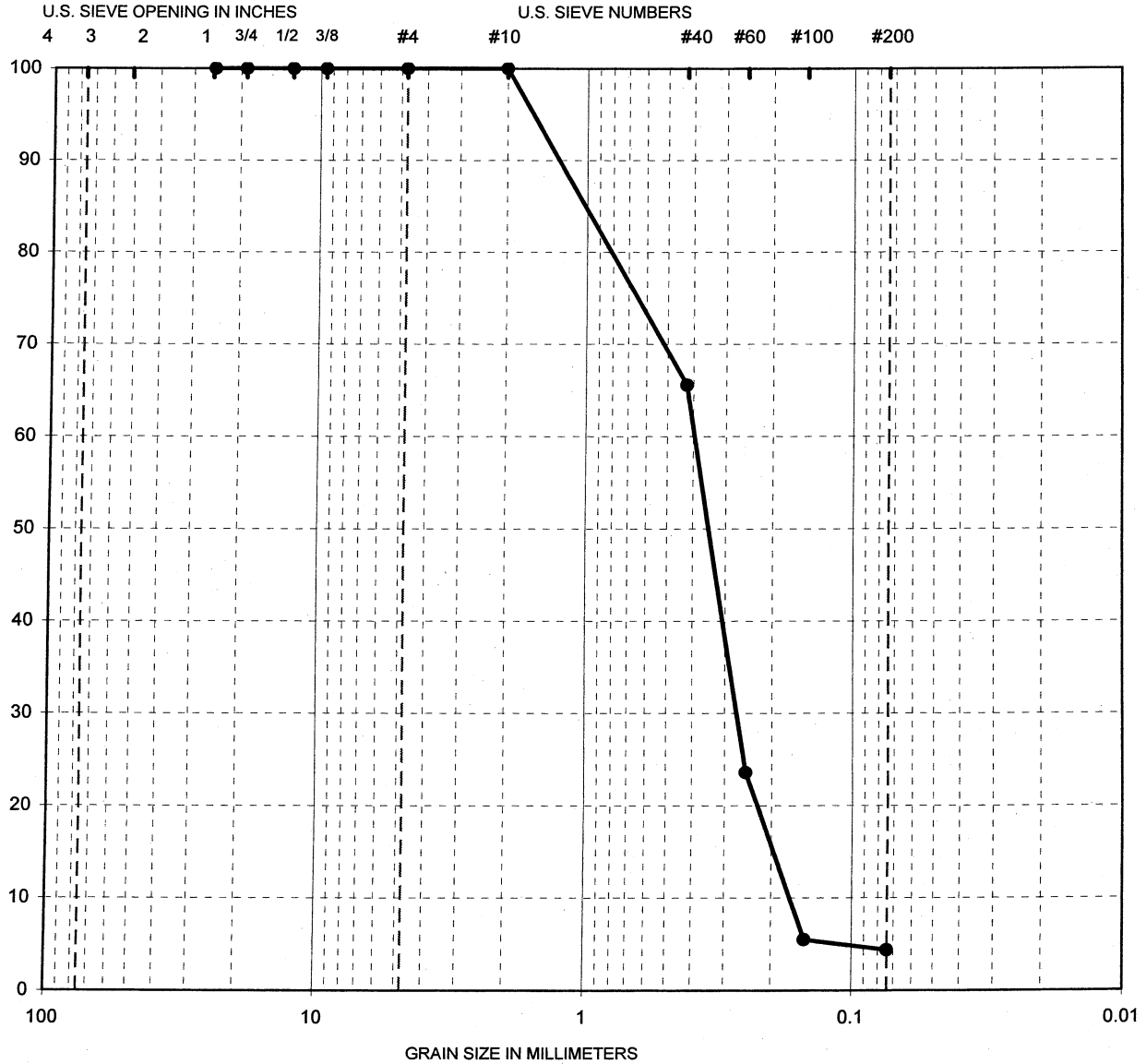
	1 mL or cm ³
	0.0610128 in ³
Inches of Cyl Mold	10
Volume of water (in ³)	282.66667
Volume of water (cm ³)	4632.6667

Inner Ring			Outer Ring			Inner Ring		Outer Ring	
ElapTime (sec)	Vol Used (in ³)	Flow Rate (cfs)	ElapTime (sec)	Vol Used (in ³)	Flow Rate (cfs)	Vol Used (cm ³)	Flow Rate (cm ³ /sec)	Vol Used (cm ³)	Flow Rate (cm ³ /sec)
300	283	0.0005459	300	1357	0.0026177	4638.37	0.0089475	22241.23	0.0429036
300	283	0.0005459	300	1357	0.0026177	4638.37	0.0089475	22241.23	0.0429036
300	283	0.0005459	300	1357	0.0026177	4638.37	0.0089475	22241.23	0.0429036
	Avg	0.0005459		Avg	0.0026177		0.0089475		0.0429036

Inner Ring Outer Ring

Hydraulic Conductivity: 6.95E-04 1.11E-03 cfs/ft²-ft head
 or feet/sec
 3.00E+01 4.80E+01 in/hr
 2.12E-02 3.39E-02 cm/sec

*Note Inner Ring to be used for infiltration rate



	GRAVEL		SAND			FINE
	coarse	fine	coarse	medium	fine	

Specimen	Description	MC%	LL	PL	PI	Cc	Cu
spt-8		4%				1.1	2.3
# 2			Total dry sample weight: 106.2 grams				
Depth (feet): 2.0' - 4.0'							

D90 (mm)	D60 (mm)	D50 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine
1.27	0.39	0.35	0.27	0.17	0	96	4

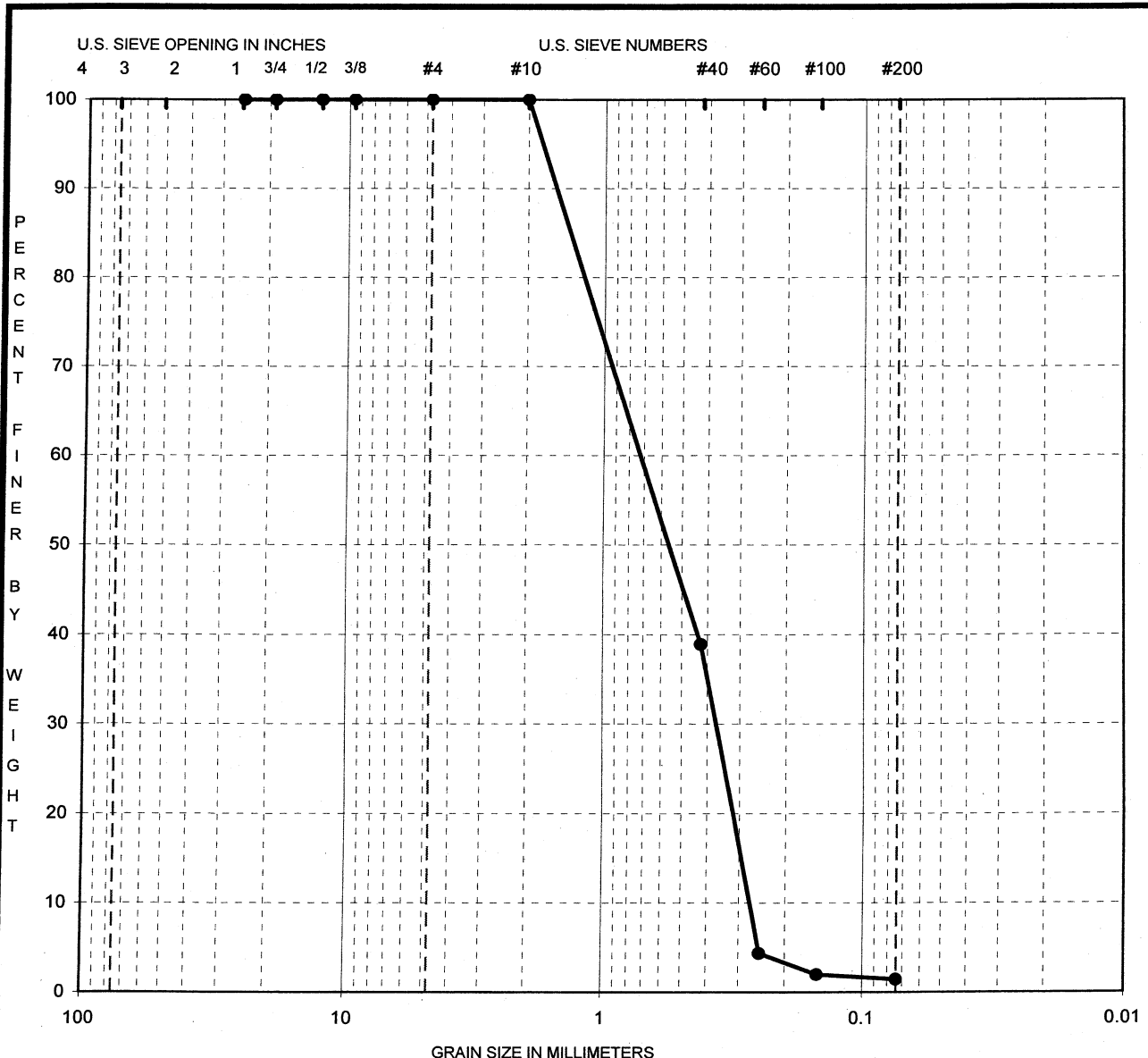
Organics (%)

PROJECT: Okaloosa County Wastewater treatment facility

JOB NO. 4307-003-00

GRADATION CURVES

Williams Earth Sciences, Inc.



GRAVEL		SAND			FINE
coarse	fine	coarse	medium	fine	

Specimen	Description	MC%	LL	PL	PI	Cc	Cu
SPT-8		12%				0.7	2.7
# 6							
Depth (feet): 13.5' - 15.0		Total dry sample weight: 104.3 grams					

D90 (mm)	D60 (mm)	D50 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine
1.55	0.72	0.56	0.37	0.27	0	99	1

Organics (%)

PROJECT: Okaloosa County Wastewater treatment facility

JOB NO. 4307-003-00

GRADATION CURVES

Williams Earth Sciences, Inc.



WILLIAMS EARTH SCIENCES, INC.

Corporate Office: 10600 Endeavour Way, Largo, FL 33777
Largo: (727) 541-3444 Fax: (727) 541-1510
Jacksonville: (904) 262-8852 Fax: (904) 262-8864
Panama City: (850) 747-9419 Fax: (850) 763-2454
Pompano Beach: (954) 972-7570 Fax: (954) 972-6608

CORROSION TEST RESULTS

Job Name: Okaloosa County Wastewater Facility
Job Number: 4307-003-00
Tested by: J. Upfold
Sampled on: 5/7/2007

Sample ID	Sample Location	Sample Type	Sample Depth (ft)	pH	Chlorides ppm	Sulphates ppm	Resistivity ohm-cm	FDOT Classification *	
								Concrete	Steel
1	Building Area	Soil	2.0 - 4.0	7.1	60	6	10,000	S	S

***S - Slightly Aggressive *M - Moderately Aggressive *E - Extremely Aggressive**

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FINAL DESIGN DOCUMENTS

OKALOOSA COUNTY

BOARD OF COMMISSIONERS

ARBENNIE PRITCHETT WRF RECLAIMED WATER EXPANSION PROJECT

OKALOOSA COUNTY WATER AND SEWER

JEFF LITRELL, DIRECTOR

COUNTY ADMINISTRATOR

JOHN HOFSTAD

CHAIRMAN

GRAHAM FOUNTAIN (DISTRICT 1)

BOARD MEMBERS

CAROLYN KETCHEL (DISTRICT 2)
 NATHAN BOYLES (DISTRICT 3)
 TREY GOODWIN (DISTRICT 4)
 KELLY WINDES (DISTRICT 5)

PREPARED BY:



1988 LEWIS TURNER BLVD.
 FORT WALTON BEACH, FL 32547
 PH. 850-244-5800

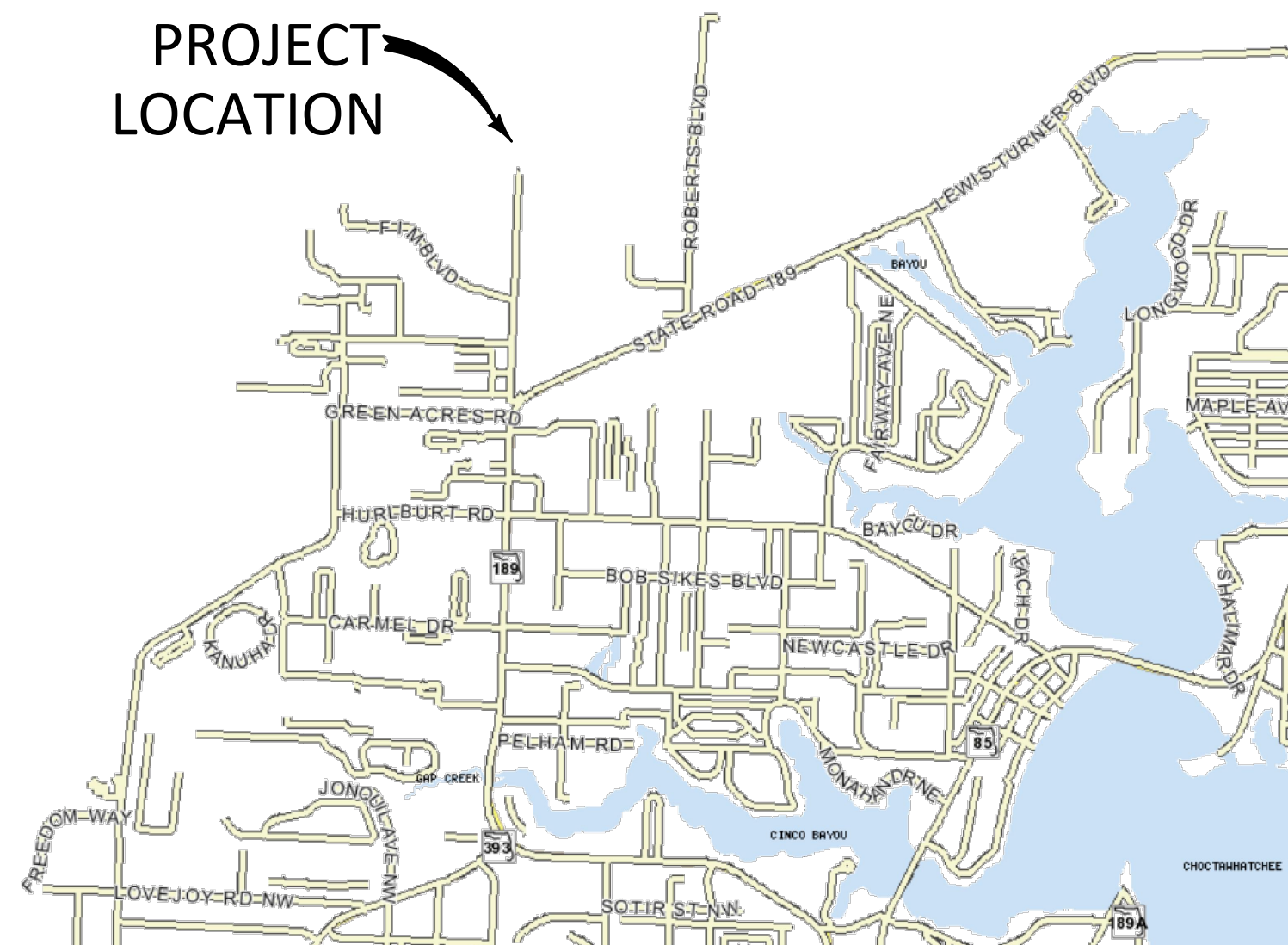
DATE PREPARED:

OCTOBER 2018

PREPARED FOR

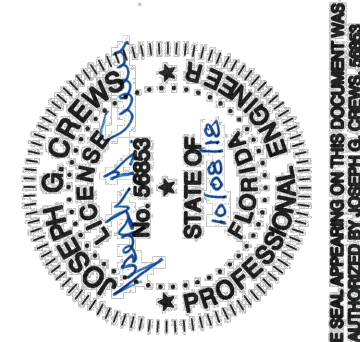


PROJECT
LOCATION



VICINITY MAP

SHEET LIST	
Sheet Number	Sheet Title
G-0.0	COVER SHEET
G-1.0	ABBREVIATIONS
G-2.0	PROCESS FLOW DIAGRAM
G-3.0	HYDRAULIC PROFILE
C-1.0	CIVIL NOTES
C-2.0	CIVIL LEGEND AND SYMBOLS
C-3.0	DEMOLITION & GRADING PLAN
C-3.1	DEMOLITION DETAILS & SECTION
C-4.0	OVERALL MECHANICAL PLAN
C-5.0	FORCE MAIN PLAN AND PROFILE
C-5.1	FORCE MAIN PLAN AND PROFILE
C-5.2	FORCE MAIN PLAN AND PROFILE
C-5.3	FORCE MAIN PLAN AND PROFILE
C-5.4	FORCE MAIN PLAN AND PROFILE
C-5.5	FORCE MAIN PLAN AND PROFILE
C-5.6	FORCE MAIN CROSS SECTIONS
CD-1.0	EROSION CONTROL NOTES & DETAILS
CD-1.1	CIVIL SITE DETAILS
CD-1.2	CIVIL DETAILS
M-1.0	TERTIARY FILTERS PLAN
M-1.1	TERTIARY FILTERS SECTIONS
M-2.0	CHLORINE CONTACT BASIN PLAN
M-2.1	CHLORINE CONTACT BASIN SECTION
M-3.0	CHLORINE FEED BUILDING
MD-99.1	SLIDE GATE DETAILS
MD-99.2	MISCELLANEOUS MECHANICAL DETAILS
MD-99.3	MISCELLANEOUS MECHANICAL DETAILS
MD-99.4	MISCELLANEOUS MECHANICAL DETAILS
MD-99.5	PIPE SUPPORT DETAILS
S-0.1	GENERAL NOTES
S-1.0	OVERALL PLAN
S-1.1	DISINFECTION BASIN PLAN
S-1.2	PUMP STATION PLAN
S-1.3	FILTER STATION PLAN
S-2.1	SECTIONS
S-5.1	DETAILS
S-5.2	DETAILS
E-0.1	ABBREVIATIONS & GENERAL NOTES
E-0.2	ELECTRICAL SYMBOLS
E-0.3	ELECTRICAL SYMBOLS
E-1.0	MCC-5306 SINGLE LINE
E-1.1	SCHEDULES
E-2.0	OVERALL ELECTRICAL SITE PLAN
E-3.0	ELECTRICAL BUILDING NO. 1 PROPOSED POWER PLAN
E-3.1	ELECTRICAL BUILDING NO. 1 PROPOSED CONTROL PLAN
E-4.0	TERTIARY FILTERS ELECTRICAL POWER PLAN
E-4.1	TERTIARY FILTERS ELECTRICAL CONTROL PLAN
E-5.0	DISINFECTION BASIN ELECTRICAL POWER PLAN
E-5.1	DISINFECTION BASIN ELECTRICAL CONTROL PLAN
E-9.0	ELECTRICAL DETAILS
E-9.1	ELECTRICAL DETAILS
E-9.2	INSTALLATION DETAILS
E-9.3	REUSE PUMP VFD'S
I-0.1	ABBREVIATIONS AND LEGEND
I-0.2	P&ID SYMBOLS
I-1.0	FILTERS
I-2.0	CHLORINE CONTACT CHAMBER
I-3.0	HYPO TANKS



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		TCG	TCG		JC	JK

COVER SHEET

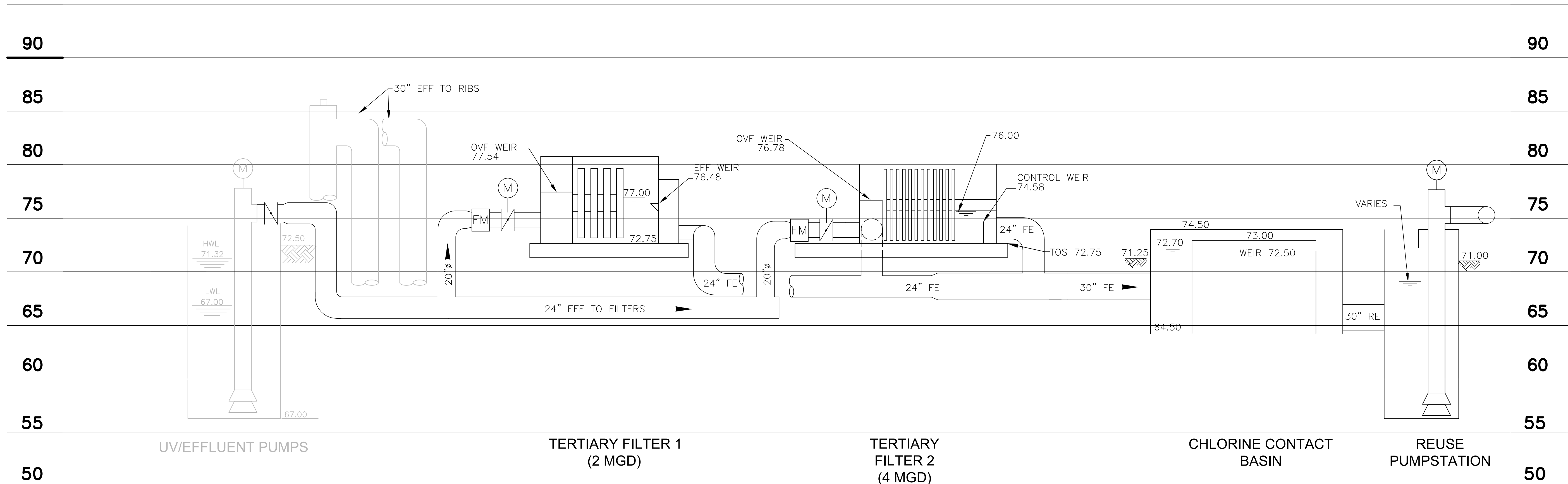
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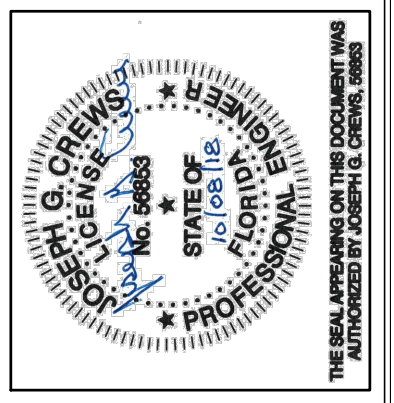
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FINAL DESIGN

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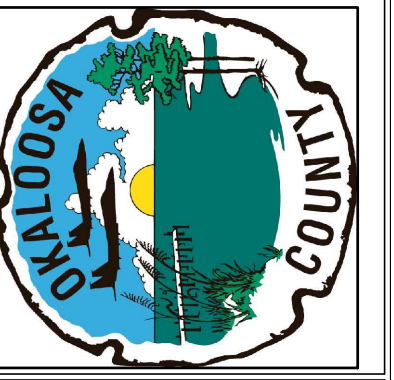


HYDRAULIC PROFILE



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	TCG		TCG		JC	JK

HYDRAULIC PROFILE
 OCWS APWRF RECLAIM EXPANSION



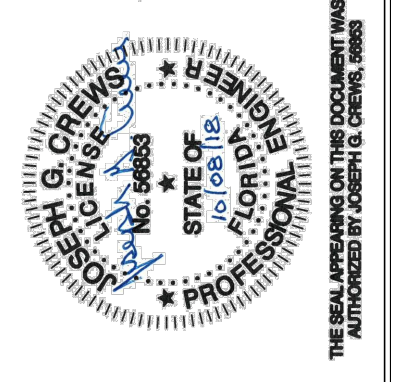
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 FORT WALTON BEACH, FL 32547
 PH. 850-244-5800
 FL CERTIFICATE OF AUTHORIZATION # 9816

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CIVIL NOTES:

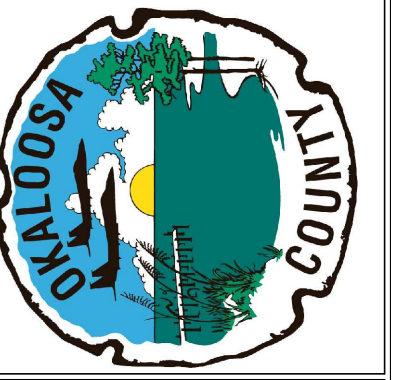
1. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE EXACT LOCATION, SIZE AND MATERIAL OF ANY EXISTING WATER OR SEWER FACILITY PROPOSED FOR CONNECTION OR USE BY THIS PROJECT.
2. OCWS SHALL BE NOTIFIED 24 HOURS PRIOR TO ANY CONSTRUCTION, TIE-INS, SHUT-DOWNS OR TESTING OF WATER OR SANITARY SEWER LINES.
3. THE CONTRACTOR SHALL COORDINATE THE WORK OF THE UTILITY COMPANIES.
4. THE CONTRACTOR SHALL VERIFY ALL ELEVATIONS (I.E.) OF ALL EXISTING PIPES IN THE WORK AREA BEFORE BEGINNING CONSTRUCTION.
5. ALL MATERIALS DEEMED SALVAGEABLE BY OCWSS SHALL REMAIN THEIR PROPERTY AND WILL BE REMOVED AND STORED ON SITE IN A SECURED AREA DETERMINED DURING CONSTRUCTION BY THE CONTRACTOR.
6. EXACT LOCATIONS OF PROPOSED WATER AND SEWER MAINS SHALL BE DETERMINED DURING CONSTRUCTION. FINAL PLACEMENT SHALL BE COORDINATED BY THE CONTRACTOR AND LOCATED IN SUCH A MANNER AS TO NOT CONFLICT WITH OTHER UTILITIES.
7. ALL EXISTING ROAD STRUCTURES SUCH AS STORM MANHOLES, INLET BOXES, DRAINAGE DITCHES, ETC. SHALL BE PRESERVED, ADJUSTED, OR RECONSTRUCTED AS NEEDED IN ORDER TO MAINTAIN CURRENT ACCESSIBILITY, USABILITY, AND CAPACITY.
8. ALL ROAD CUTS SHALL BE OVERLAYED PER THE DETAILS PROVIDED.
9. ALL MAINS INSTALLED UNDER THIS CONTRACT SHALL HAVE A MINIMUM COVER OF 30 INCHES, EXCEPT WHERE THERE IS A CONFLICT WITH EXISTING OR PROPOSED STRUCTURES. IN THE CASE OF SUCH CONFLICT, IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY AND DETERMINE ALL PERTINENT GRADES PRIOR TO INSTALLATION WITH APPROVAL OF THE ENGINEER. THE CONTRACTOR SHALL ENSURE THAT SUFFICIENT BURIAL DEPTH OF SEWER FORCE MAINS AND APPURTENANCES IS ACHIEVED TO ELIMINATE ANY GRADE OR PLAN CONFLICTS.
10. THE CONTRACTOR IS TO BE AWARE THAT IT IS THEIR RESPONSIBILITY FOR CLEARING ALL TREE ANY OTHER OBSTRUCTIONS THEY MAY ENCOUNTER IN ORDER TO PERFORM THE REQUIRED WORK.
11. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE LOCATION OF ALL UNDERGROUND UTILITIES PRIOR TO CONSTRUCTION.
12. ALL TAPPING SLEEVES AND VALVES SHALL BE RESILENT SEATED TYPE AS SPECIFIED.
13. PROVIDE PROPRIETARY RESTRAINT AT ALL PRESSURE FITTINGS.
14. BURIED VALVES SHALL INCLUDE A VALVE BOX, MARKER, AND CONCRETE PAD.
15. ALL PRESSURE FITTINGS AND VALVES SHALL BE DUCTILE IRON MECHANICAL JOINT UNLESS OTHERWISE NOTED.
16. THE IMPLEMENTATION OF BEST MANAGEMENT PRACTICES (BMP's) FOR EROSION AND SEDIMENT CONTROL IN ACCORDANCE WITH THE EROSION CONTROL AND STORM WATER MANAGEMENT PLAN PREPARED BY CONSTANTINE ENGINEERING SHALL BE INSTALLED AND MAINTAINED AT ALL TIMES.



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CIVIL NOTES

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GENERAL SYMBOLS

DESCRIPTION	EXISTING	NEW
WATER VALVE		WV
WATER METER	WM	WM
FIRE HYDRANT	FH	FH
AIR RELEASE VALVE (BOX)		ARV
GRAVITY SEWER LINE	8S	N8S
FORCE MAIN	8FM	N8FM
SEWER MANHOLE	MH	MH
CLEAN OUT	CO	O
STORM DRAIN	18SD	N18SD
CATCH BASIN	CB	CB
JUNCTION BOX	JB	JB
GAS LINE	2G	N2G
GAS VALVE	G	
PAVED ROAD		
CURB & GUTTER		
DIRT/GRAVEL ROAD	DIRT ROAD	
SIDEWALK		
GUARD RAIL		
FENCE LINE (LINK)	X-X-X-X-X-X-X-X	XX-XX-XX-XX-XX-XX
FENCE LINE (WOOD)		
TREE LINE		
SIFT FENCE		SF
UNDERGROUND FIBER OPTIC	FO	
POWER POLE	PP	
SERVICE POLE	SP	
LIGHT POLE	LP	
CONCRETE MONUMENT	CM	
BUILDING		
BENCHMARK	BM	

MATERIALS

	EXISTING	PROPOSED
EARTH OR GRADE		
CONCRETE		
ASPHALTIC PAVEMENT		
GRATING		

GENERAL SYMBOLS

	NEW MAIN THIS PROJECT
	EXISTING POTABLE WATER
	EXISTING NON-POTABLE WATER
	EXISTING SPRINKLER LINE
	EXISTING DIGESTED SLUDGE
	EXISTING WASTE ACTIVATED SLUDGE
	EXISTING RETURN ACTIVATED SLUDGE
	EXISTING ELECTRICAL LINE
	EXISTING GAS LINE
	EXISTING DRAIN LINE
	EXISTING AIR LINE
	SOIL BORING
	PIEZOMETER
	EXISTING CONTOUR
	NEW CONTOUR
	EXISTING SPOT ELEVATION
	NEW SPOT ELEVATION
	EXISTING STRUCTURES (TO BE MODIFIED)
	EXISTING STRUCTURES (TO BE REMOVED)
	FUTURE STRUCTURES

GENERAL NOTES:

- SIMPLIFIED JOINT SYMBOL IS USED FOR ALL SINGLE LINE PIPING SHOWN ON THE INTERIOR AND EXTERIOR PIPING DRAWINGS.
- BOTH SIMPLIFIED AND COMPLEX JOINT REPRESENTATIONS MAY BE SHOWN ON THE DRAWINGS.
- UNLESS MODIFIED BY THE GENERAL PROJECT NOTES OR DETAILED ON THE LAYOUT AND SCHEMATIC DRAWINGS PIPE AND FITTING JOINT REQUIREMENTS FOR THE VARIOUS PIPE MATERIALS ARE DEFINED IN THE SPECIFICATIONS.
- THE CONTRACTOR SHALL CLEAN AND BACTERIOLOGICALLY CLEAR ALL POTABLE WATER LINES IN ACCORDANCE WITH AWWA C651, LATEST EDITION.

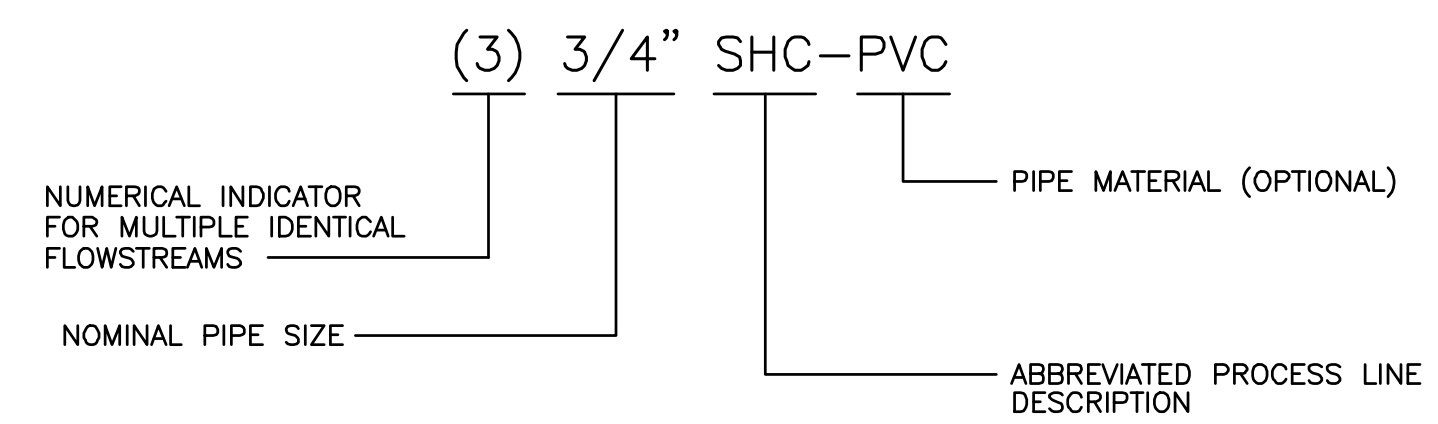
PIPING SYMBOLOGY

DOUBLE LINE SYMBOL	SINGLE LINE SYMBOL	FEATURE
		FLANGED JOINT SIMPLIFIED REPRESENTATION.
		FLANGED JOINT COMPLEX REPRESENTATION.
		MECHANICAL JOINT COMPLEX REPRESENTATION.
		DIRECTION OF FLOW
		FLEXIBLE COUPLING OR EXPANSION JOINT (SLEEVE TYPE)
		FLEXIBLE COUPLING OR EXPANSION JOINT (BELLOWS TYPE)
		FLOW METER, GENERAL SYMBOL
		VENTURI FLOW METER

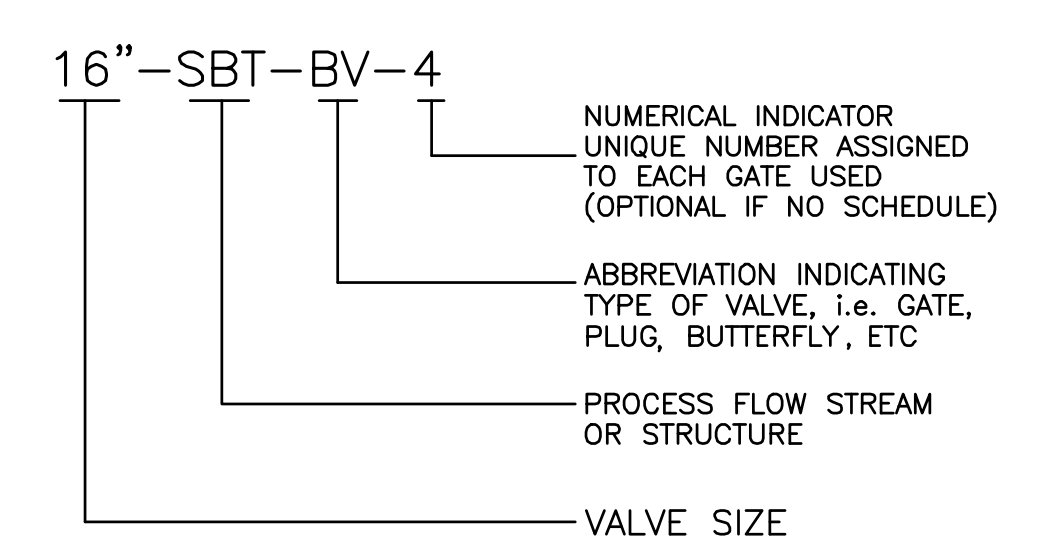
VALVE SYMBOLOGY

SYMBOL	FEATURE
	UNCLASSIFIED, TYPE AS SHOWN ON THE DRAWINGS ADJACENT TO SYMBOL
	FLOW METER
	TELESCOPING VALVE
	GATE VALVE
	KNIFE GATE VALVE
	GLOBE VALVE
	BALL VALVE
	3-WAY BALL VALVE
	4-WAY BALL VALVE
	NEEDLE VALVE
	PINCH VALVE
	DIAPHRAGM VALVE
	BUTTERFLY VALVE
	PLUG VALVE, GENERAL SYMBOLS
	CHECK VALVE
	BALL CHECK VALVE
	SOLENOID VALVE
	MOTOR OPERATED VALVE
	MUD VALVE
	FLOOR DRAIN
	CALIBRATION CYLINDER
	AIR RELEASE VALVE

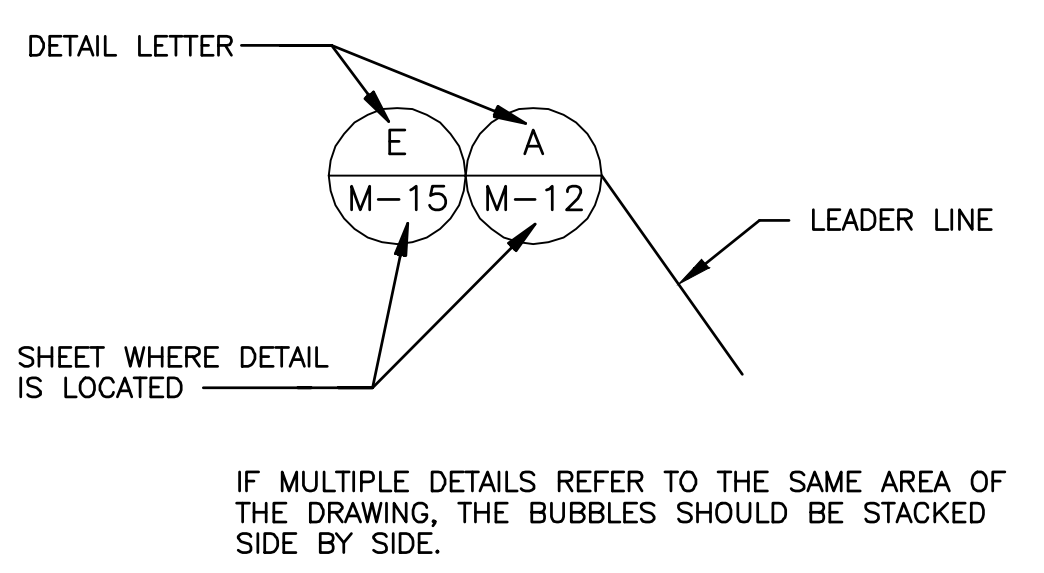
PIPE TAG



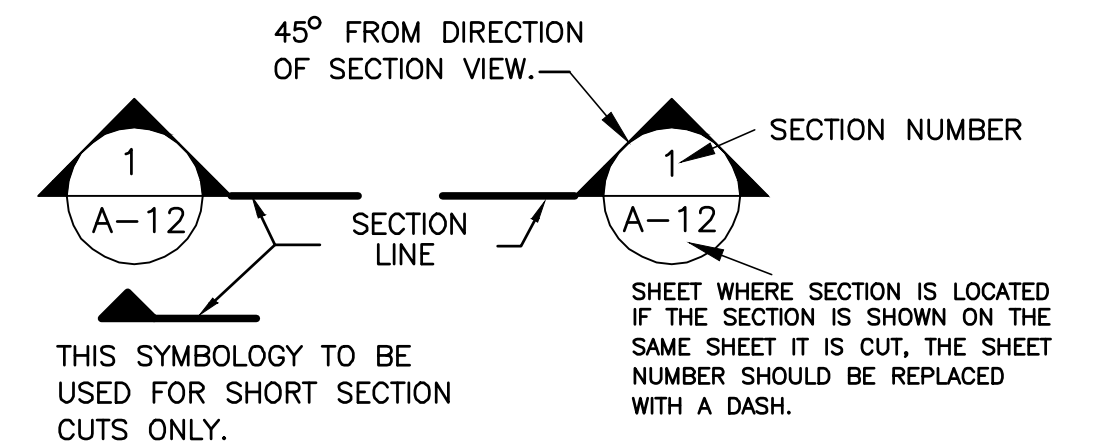
VALVE TAG (OPTIONAL)



DETAIL CALL OUT SYMBOLS



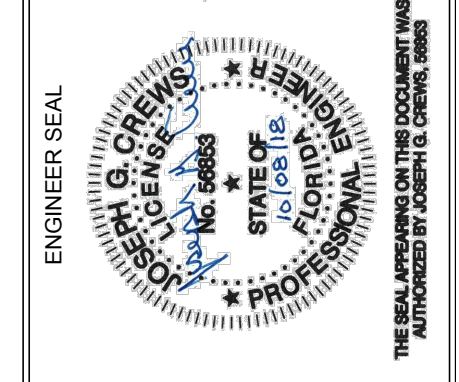
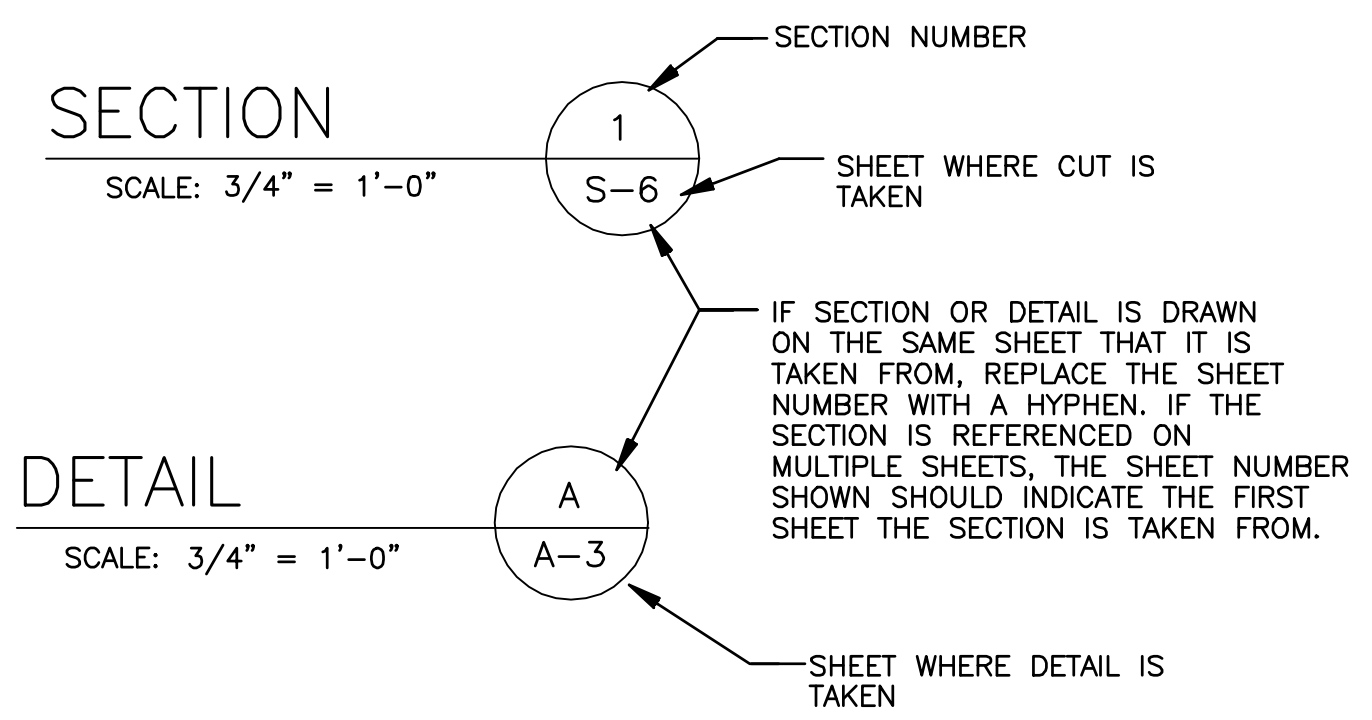
SECTION CUT SYMBOLS



SUBTITLE OR DESCRIPTION (AS REQ'D)

PLAN
SCALE: 1/4" = 1'-0"

DRAWING, SECTION AND DETAIL TITLES



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			TCG	JK
			TCG	JK

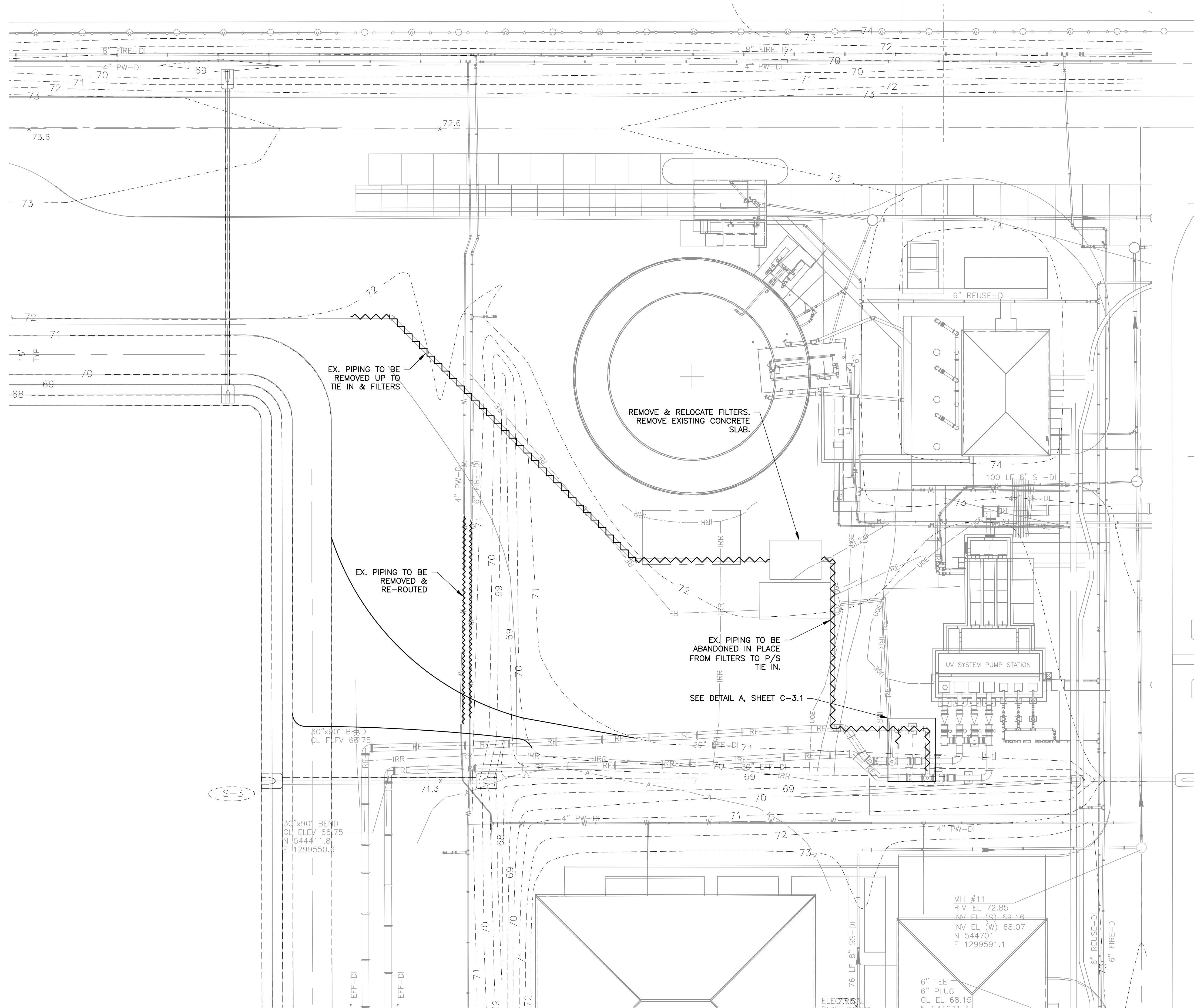
GENERAL SYMBOLS
OCWS APWRF RECLAIM EXPANSION



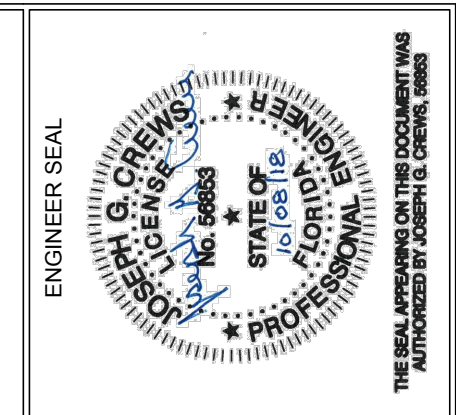
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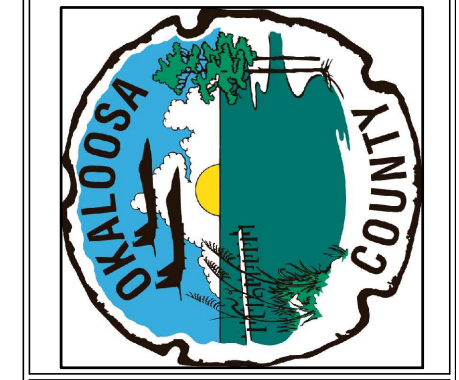


PLAN
 SCALE: 1" = 20'
 0 20 40
 GRAPHIC SCALE



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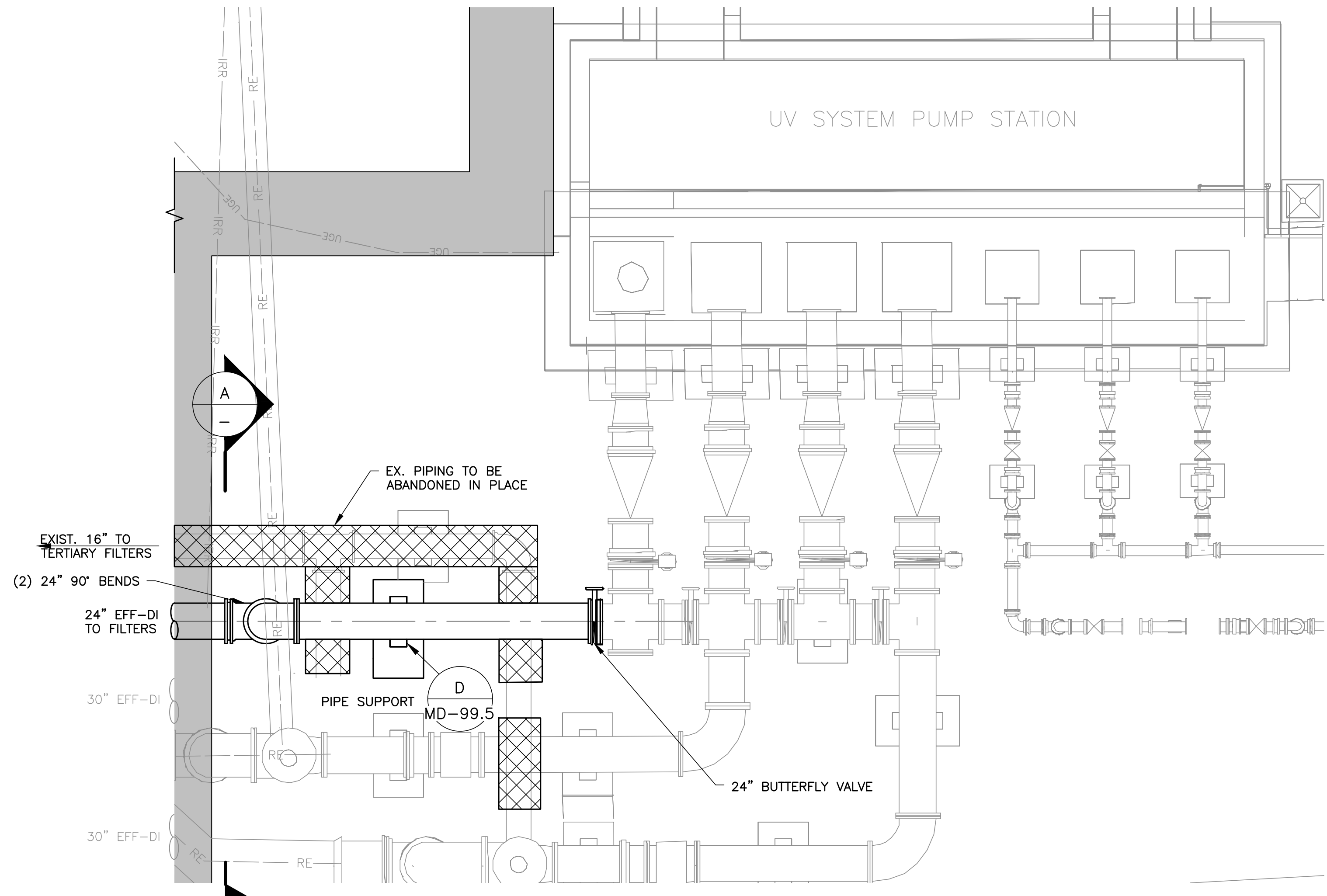
DEMOLITION & GRADING PLAN
OCWS APWRF RECLAIM EXPANSION



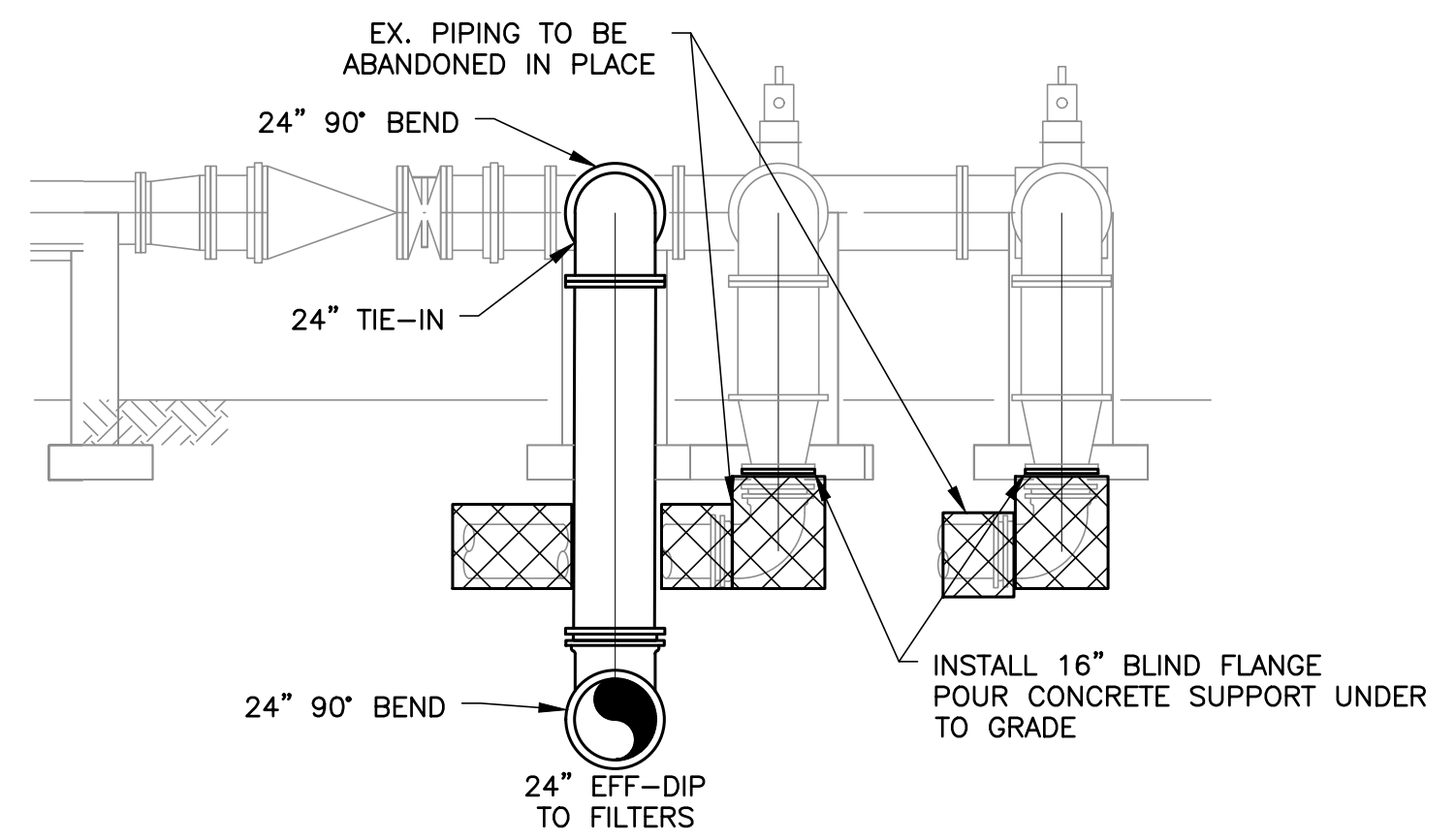
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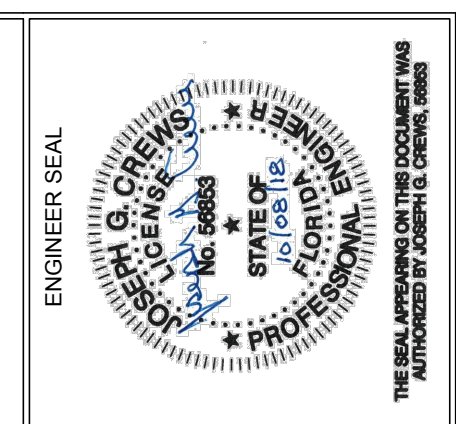
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DETAIL A
 SCALE: 1" = 5'

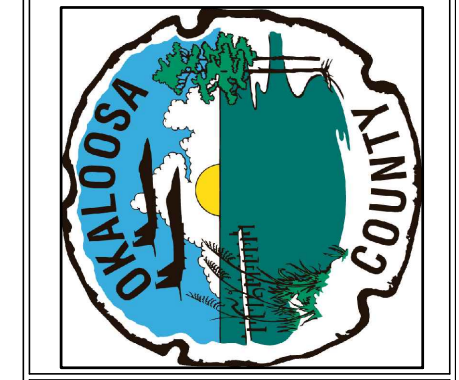


SECTION A
 SCALE: 1" = 5'



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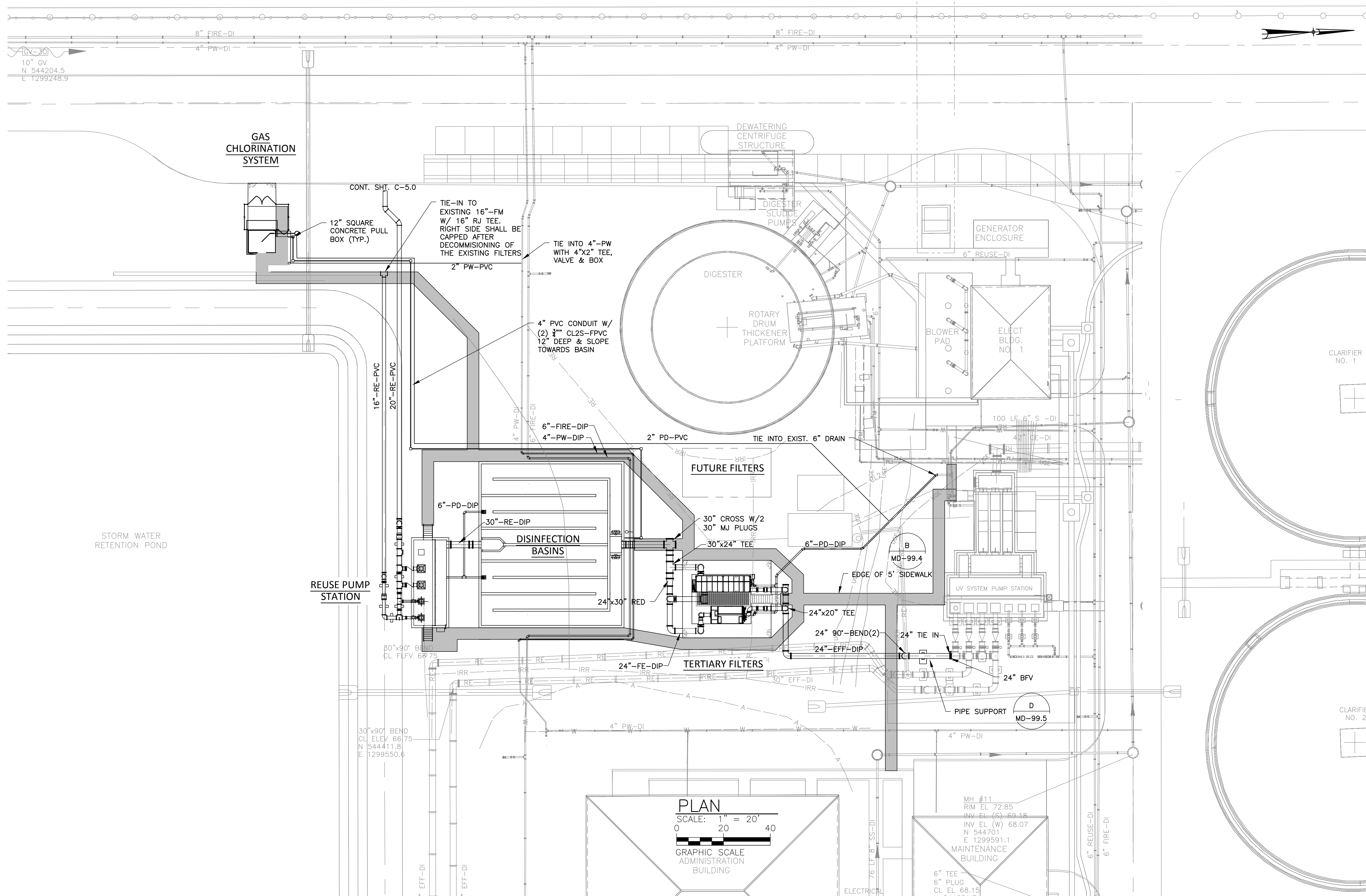
DEMOLITION DETAILS & SECTION
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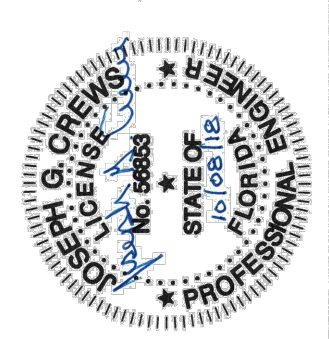


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PROJ.	100501.00
DWG.	C-3.1

Z:\PROJECT FILES\100501.00 OCWS APWRF RECLAIM EXPANSION\300 DESIGN\300 FINAL DRAWINGS\01 CIVIL & DEMOVC- SITE PLAN BASE.DWG
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PLAN
 SCALE: 1" = 20'
 0 20 40
 GRAPHIC SCALE
 ADMINISTRATION
 BUILDING

MH #11
 RIM EL 72.85
 INV. EL. (S) 69.18
 INV. EL. (W) 68.07
 N 544701
 E 1299591.1
 MAINTENANCE
 BUILDING

				
NO.	DATE	REVISION	CHECKED BY:	APPROVED BY:
DESIGNED BY:	TCG	DRAWN BY:	TCG	JK
OVERALL MECHANICAL PLAN OCWS APWRF RECLAIM EXPANSION				
				
				
FILE	SEE LEFT			
	VERIFY SCALE			
	BAR IS ONE INCH ON ORIGINAL DRAWING			
DATE	OCTOBER 2018			
PROJ.	100501.00			
DWG.	C-4.0			

1988 LEWIS TURNER BLVD.
 FORT WALTON BEACH, FL 32547
 PH. 850-244-5800
 FL CERTIFICATE OF AUTHORIZATION # 9816

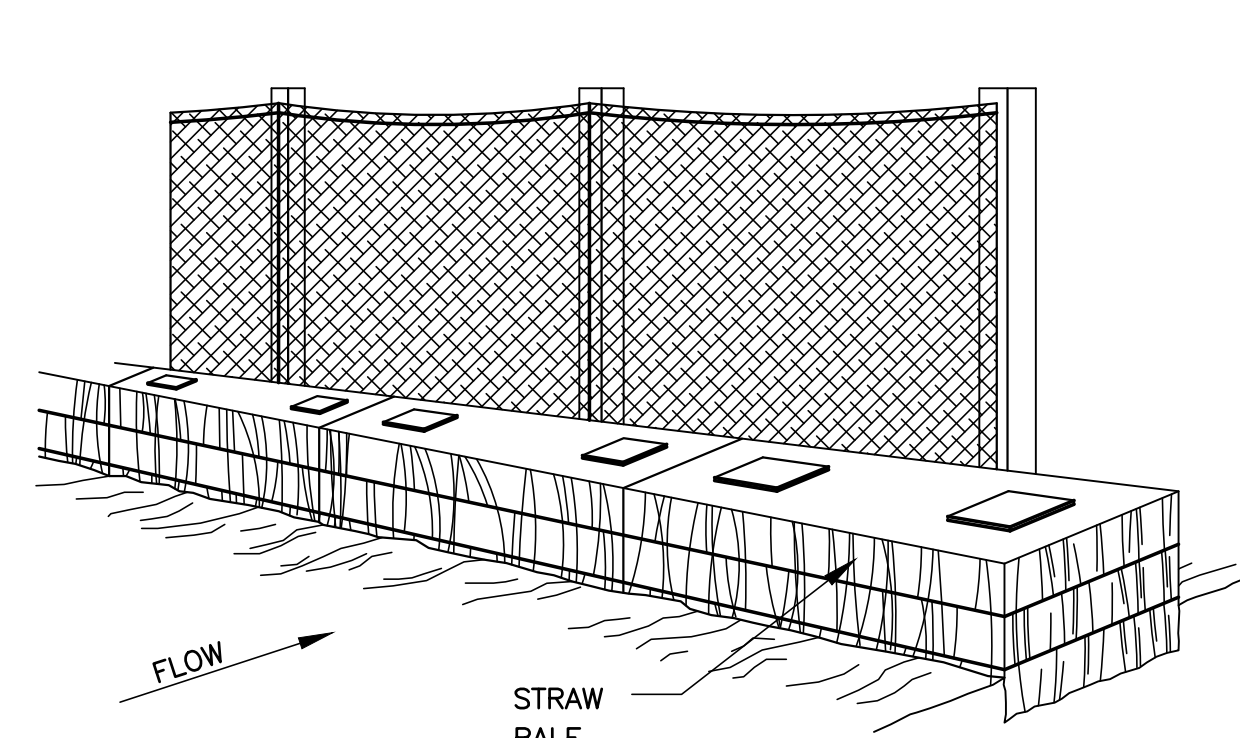
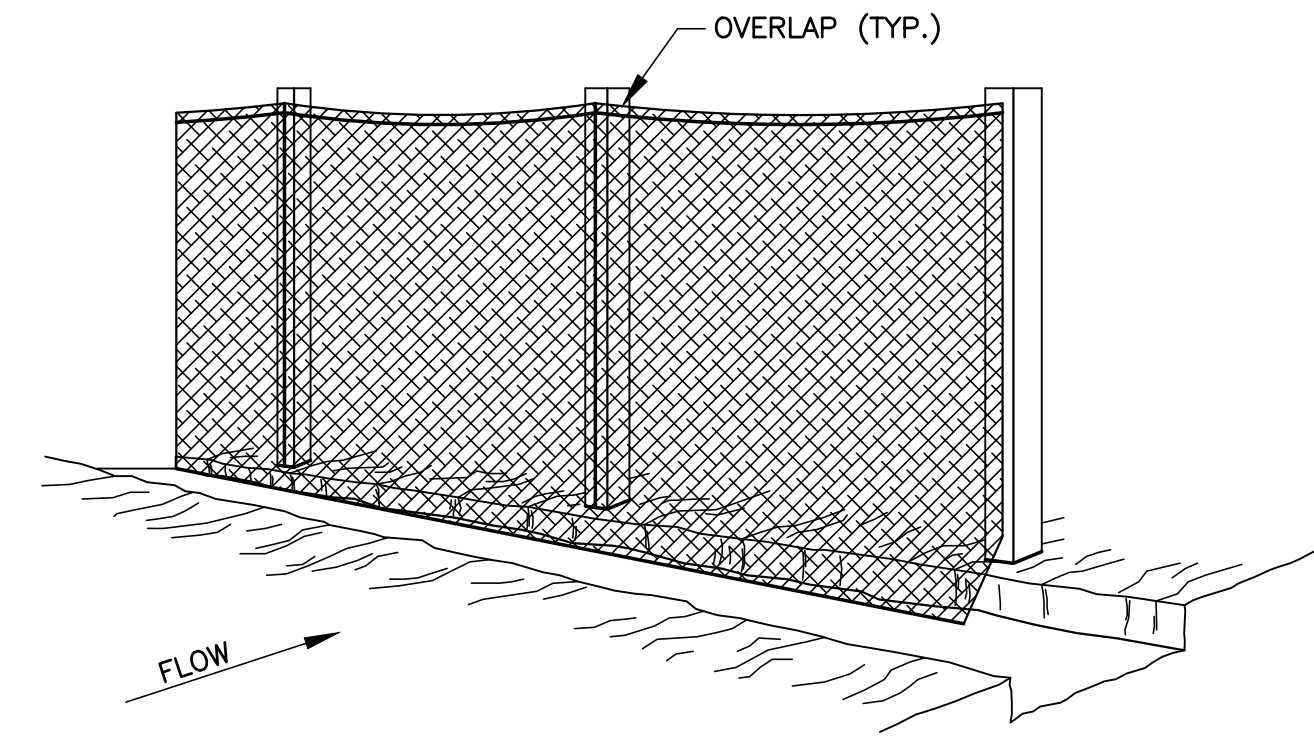
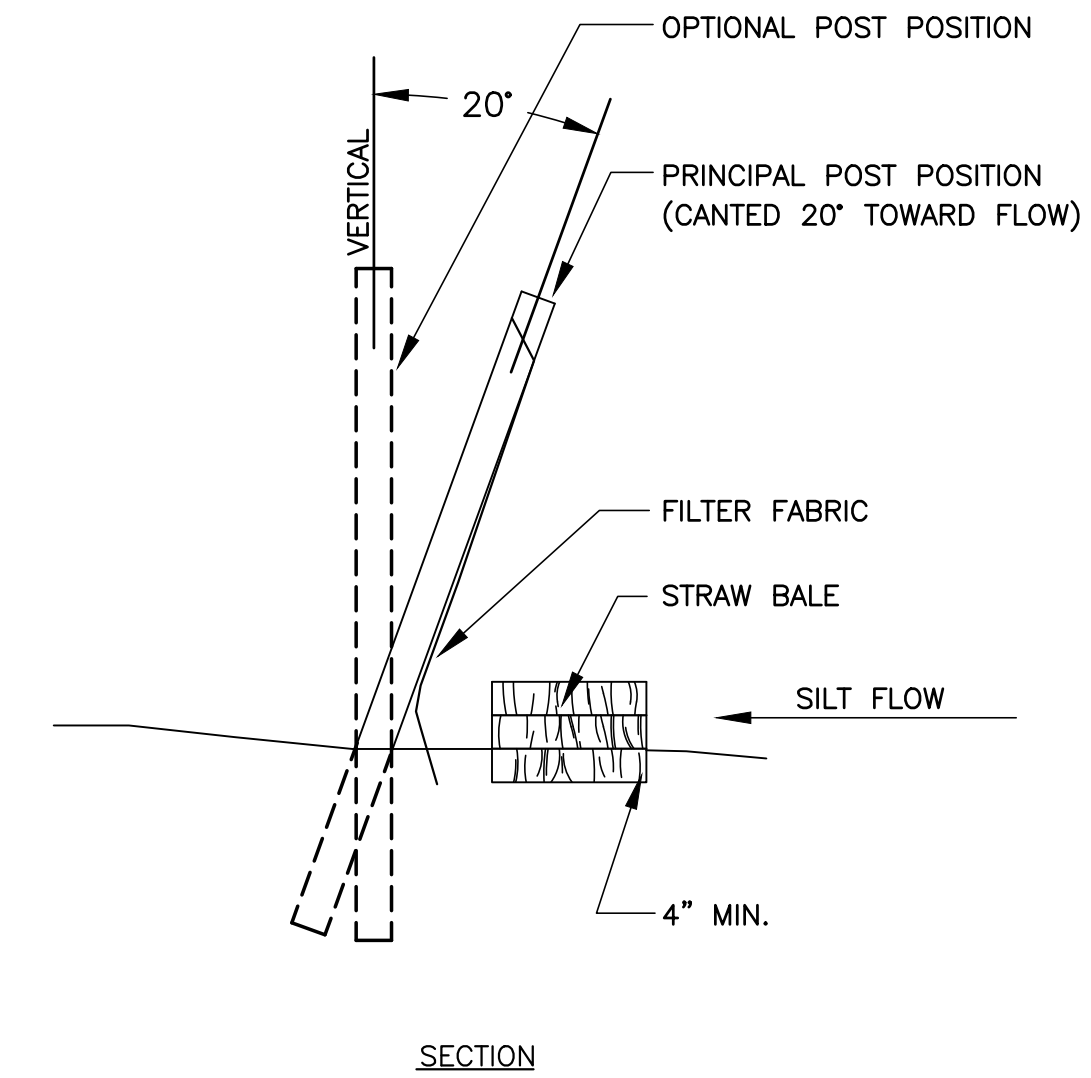
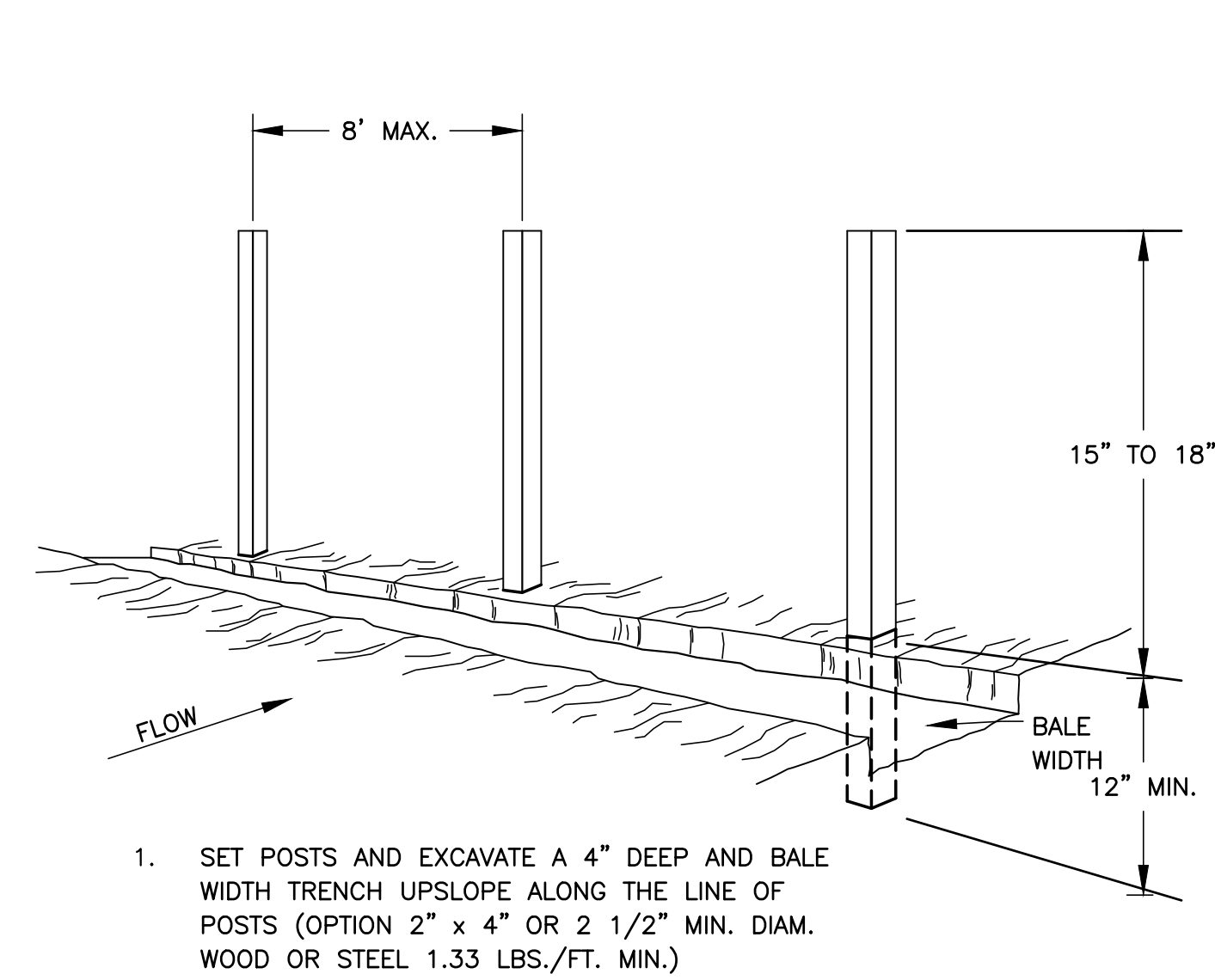
Z:\PROJECT FILES\100501.00 OCWS APWRF RECLAIM EXPANSION\300 DESIGN\390 FINAL DRAWINGS\01 CIVIL & DEMOVC- CIVIL NOTES SYMBOLS AND DETAILS.DWG
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SOIL EROSION AND SEDIMENTATION CONTROL NOTES

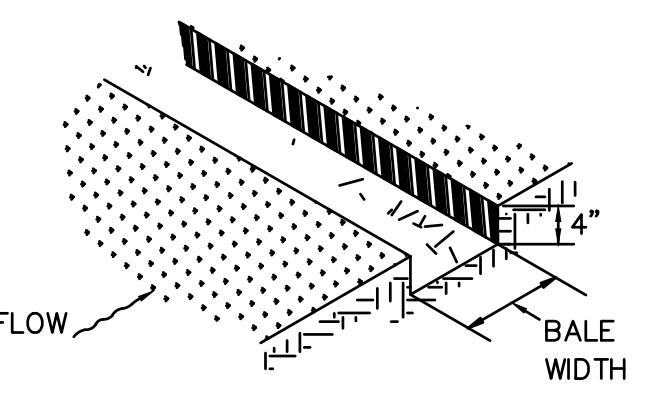
- ALL DISTURBED AREAS ARE TO BE GRASSED UNLESS OTHERWISE SHOWN ON PLANS. SOIL EROSION AND SEDIMENT CONTROL DEVICES ARE TO BE PLACED AS REQUIRED OR AS DIRECTED BY HOUSTON COUNTY WATER AND SEWER. CARE SHALL BE TAKEN TO PREVENT SOIL EROSION OR SEDIMENT TRANSFER FROM THE PROJECT ONTO ADJACENT PROPERTIES. BEST MANAGEMENT PRACTICES (BMP'S) SHALL BE IMPLEMENTED IN ACCORDANCE WITH THE PROJECT EROSION CONTROL PLAN PREPARED BY CONSTANTINE ENGINEERING FOR SANDY RUN CREEK WPCP PROJECT.
- FAILURE TO INSTALL, OPERATE OR MAINTAIN ALL EROSION CONTROL MEASURES WILL RESULT IN ALL CONSTRUCTION BEING STOPPED ON THE JOB SITE UNTIL SUCH MEASURES ARE CORRECTED.
- IF FINES OR PENALTIES ARE LEVIED AGAINST THE PROPERTY OR THE PROPERTY OWNER BECAUSE OF A LACK OF EROSION OR SEDIMENTATION CONTROL, THE CONTRACTOR SHALL BE RESPONSIBLE FOR PAYMENT OF SUCH FINES OR PENALTIES, OR THE COST OF SUCH FINES OR PENALTIES SHALL BE DEDUCTED FROM THE CONTRACT AMOUNT.
- ALL MATERIALS SPILLED, DROPPED, WASHED OR TRACKED FROM VEHICLE OR SITE ONTO PUBLIC ROADWAY OR INTO STORM DRAIN MUST BE REMOVED IMMEDIATELY.
- PRIOR TO COMMENCING LAND DISTURBING ACTIVITY, THE LIMITS OF LAND DISTURBANCE SHALL BE CLEARLY AND ACCURATELY DEMARCATED WITH STAKES, RIBBONS OR OTHER APPROPRIATE MEANS. THE LOCATION AND EXTENT OF ALL AUTHORIZED LAND DISTURBANCE ACTIVITY SHALL BE DEMARCATED FOR THE DURATION OF THE CONSTRUCTION ACTIVITY. NO DISTURBANCE ACTIVITY SHALL OCCUR OUTSIDE THE LIMITS INDICATED ON THE DRAWINGS.
- CONSTRUCTION OF THE SITE WILL BEGIN WITH INSTALLATION OF EROSION CONTROL MEASURES SUFFICIENT TO CONTROL SEDIMENT DEPOSITS AND EROSION. ALL SEDIMENT CONTROL MEASURES WILL BE MAINTAINED UNTIL ALL UPSTREAM DISTURBED GROUND WITHIN THE CONSTRUCTION AREA HAS BEEN COMPLETELY STABILIZED WITH PERMANENT VEGETATION AND ALL ROADS/PARKING HAVE BEEN PAVED.
- CONTRACTOR SHALL INSPECT AND REPAIR EROSION CONTROL MEASURES AT LEAST WEEKLY AND PRIOR TO EACH ANTICIPATED RAINFALL.
- THE CONTRACTOR SHALL REMOVE ACCUMULATED SILT FROM SEDIMENT BARRIERS AND CHECK DAMS WHICH BECOME SILTED ABOVE ONE-HALF OF THEIR ORIGINAL HEIGHT.
- ALL AREAS TO BE PAVED SHALL BE STABILIZED WITH BASE MATERIAL AS SOON AS PRACTICAL. TEMPORARY OR PERMANENT VEGETATIVE STABILIZATION SHALL BE PROVIDED IMMEDIATELY AFTER REACHING FINAL GRADE FOR ALL AREAS NOT TO BE PAVED.
- TEMPORARY MULCHING SHALL BE PROVIDED TO DISTURBED AREAS NOT TO RECEIVE PERMANENT STABILIZATION WITHIN 14 DAYS OF COMPLETION OF CONSTRUCTION IN THAT AREA.
- WHEN ANY CONSTRUCTION BORDERS A DRAINAGE COURSE, THE CONTRACTOR SHALL NOT DEPOSIT ANY BUILDING OR OTHER EXCAVATION SPOIL DIRT, CONSTRUCTION TRASH OR DEBRIS, ETC. IN THE DRAINAGE COURSE OR ASSOCIATED FLOOD PLAIN.
- SILT FENCE FABRIC SHALL BE COMPRISED OF GA. DOT QUALIFIED PRODUCTS FOR SILT FENCE FABRIC.
- ANY ADDITIONAL CONSTRUCTION OTHER THAN SHOWN ON THIS PLAN WILL REQUIRE SEPARATE AND ADDITIONAL EROSION AND SEDIMENT CONTROL MEASURES AND APPROVAL.
- CUT AND FILL SLOPES NOT TO EXCEED 2H:1V.
- THE PROJECT DOES IMPACT WETLAND AREAS.
- ADJACENT PROPERTIES TO THE PROPOSED CONSTRUCTION ROUTE ARE COMPRISED OF RESIDENTIAL AND COMMERCIAL.
- EROSION CONTROL MEASURES WILL BE MAINTAINED AT ALL TIMES. IF FULL IMPLEMENTATION OF THE APPROVED PLAN DOES NOT PROVIDE FOR EFFECTIVE EROSION CONTROL, ADDITIONAL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE IMPLEMENTED TO CONTROL OR TREAT THE SEDIMENT SOURCE.
- EROSION CONTROL MEASURES SHOWN ON THE DRAWINGS ARE MINIMUM REQUIREMENTS. ADDITIONAL EROSION CONTROL MEASURES SHALL BE EMPLOYED BY THE CONTRACTOR WHERE DETERMINED NECESSARY BY LOCAL AUTHORITIES OR THE ENGINEER BASED UPON ACTUAL SITE CONDITIONS.
- EROSION CONTROL MEASURES MAY HAVE TO BE ALTERED FROM THAT SHOWN ON THE DRAWINGS IF DRAINAGE PATTERNS DURING CONSTRUCTION ARE DIFFERENT FROM THE DRAINAGE PATTERNS SHOWN ON THE DRAWINGS. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ACCOMPLISH EROSION CONTROL FOR ALL DRAINAGE PATTERNS CREATED AT VARIOUS STAGES DURING CONSTRUCTION.
- PROVISIONS TO PREVENT EROSION OF SOIL FROM SITE SHALL BE, AS MINIMUM, IN CONFORMANCE WITH THE LATEST REVISION OF THE "MANUAL FOR EROSION AND SEDIMENTATION CONTROL IN GEORGIA."

GENERAL NOTES:

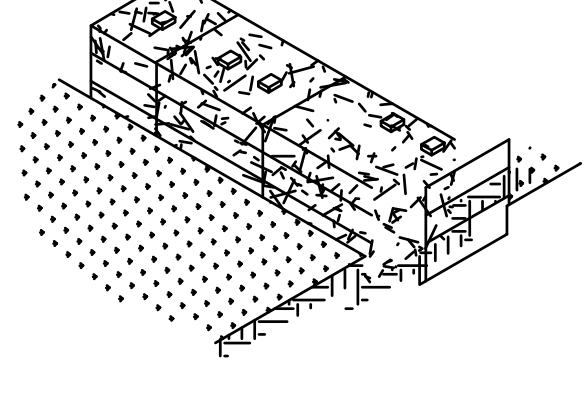
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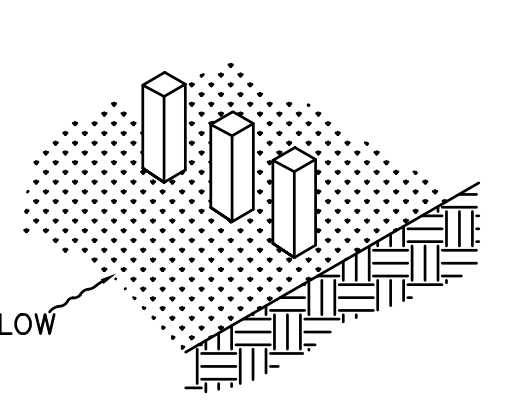
1. EXCAVATE THE TRENCH.



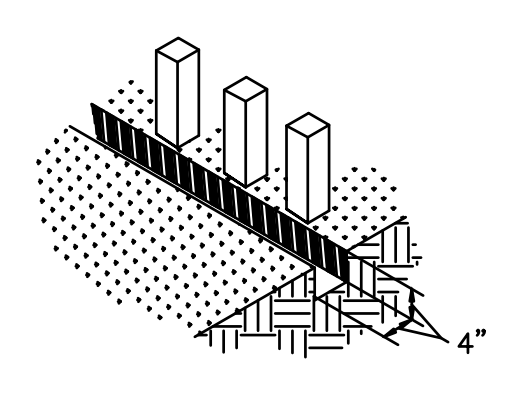
2. PLACE AND STAKE STRAW BALES.



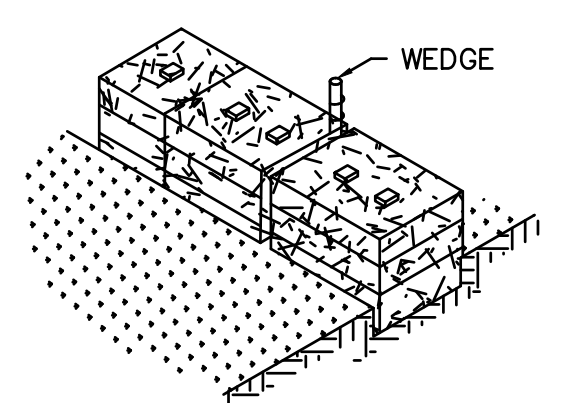
1. SET THE STAKES.



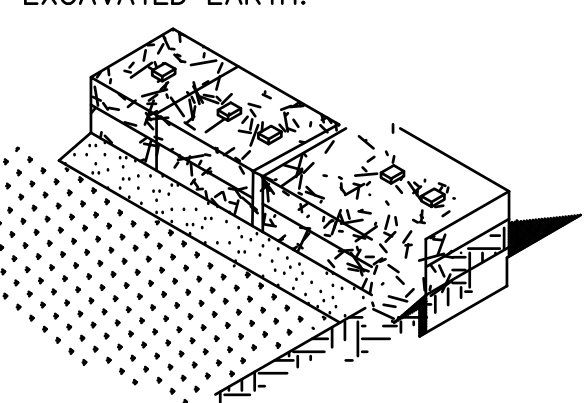
2. EXCAVATE A 4"x4" TRENCH UPSLOPE ALONG THE LINE OF STAKES.



3. WEDGE LOOSE STRAW BETWEEN BALES

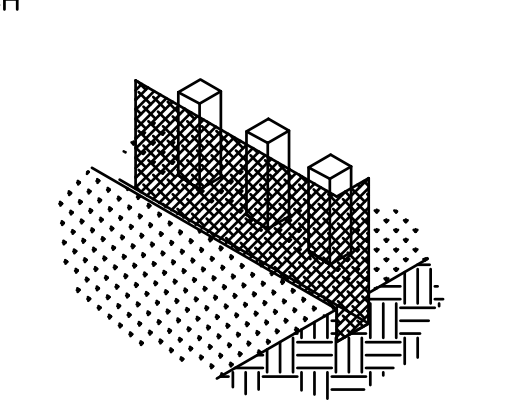


4. BACKFILL AND COMPACT THE EXCAVATED EARTH.

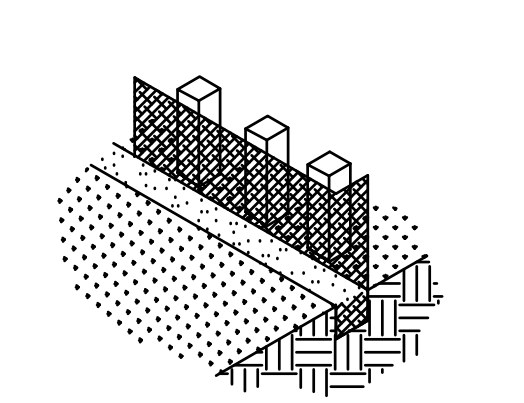


CONSTRUCTION OF A STRAW BALE BARRIER
NTS

3. STAPLE FILTER MATERIAL TO STAKES AND EXTEND IT INTO THE TRENCH



4. BACKFILL AND COMPACT THE EXCAVATED SOIL.

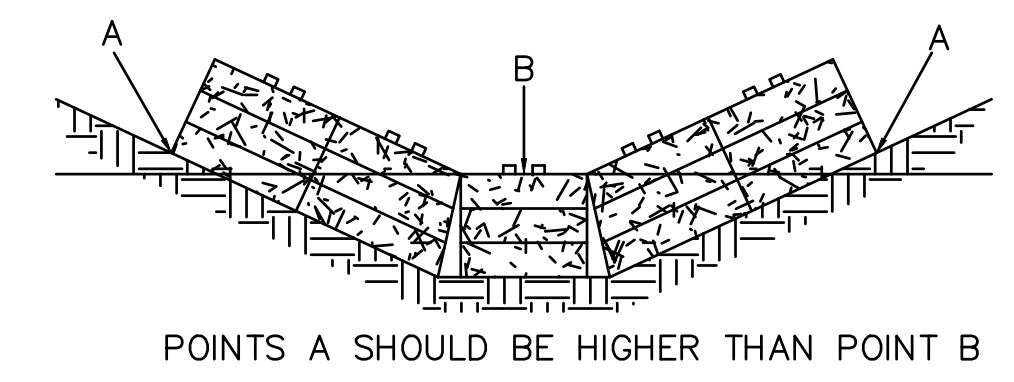


CONSTRUCTION OF A FILTER BARRIER
NTS

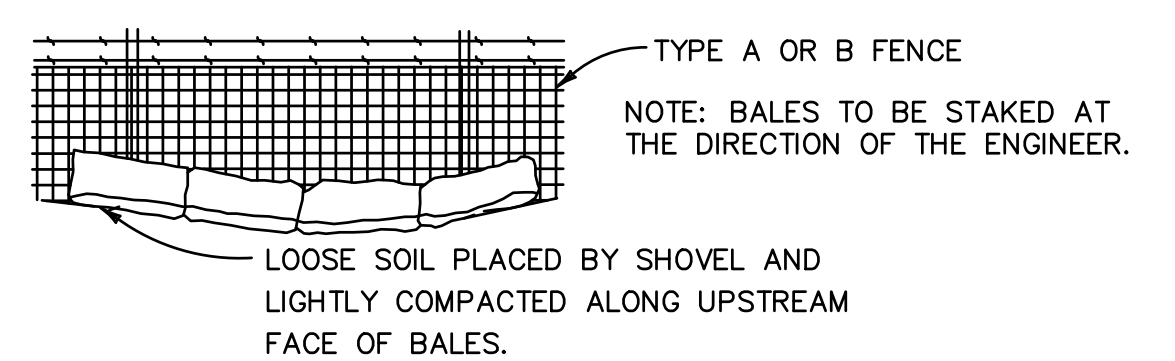
2. ATTACH THE FILTER FABRIC TO THE POST AND EXTEND IT INTO THE DITCH. FILTER FABRIC TO CONFORM WITH FDOT SPECIFICATIONS SECTION 985.

3. PLACE AND STAKE STRAW BALES, WEDGE LOOSE STRAW BETWEEN BALES, BACKFILL AND COMPACT THE EXCAVATED SOIL.

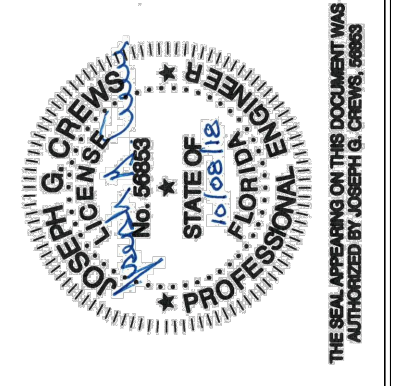
TYPE II SILT FENCE DETAIL NOT TO SCALE



PROPER PLACEMENT OF A STRAW BALE BARRIER IN DRAINAGE WAY
NOT TO SCALE



BALES BACKED BY FENCE
NOT TO SCALE



NO.	DATE	DESIGNED BY:	TCG	DRAWN BY:	TCG	REVISION	CHECKED BY:	JC	APPROVED BY:	JK
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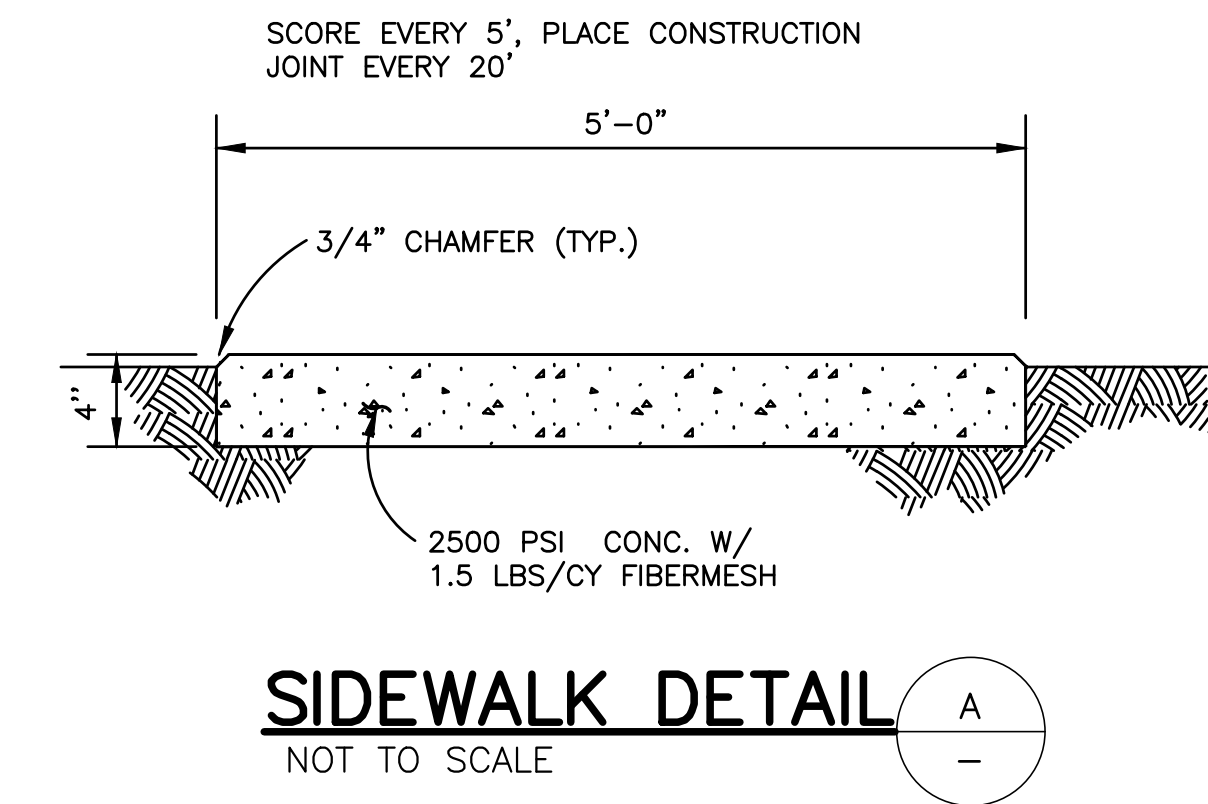
EROSION CONTROL NOTES & DETAILS
 OCWS APWRF RECLAIM EXPANSION



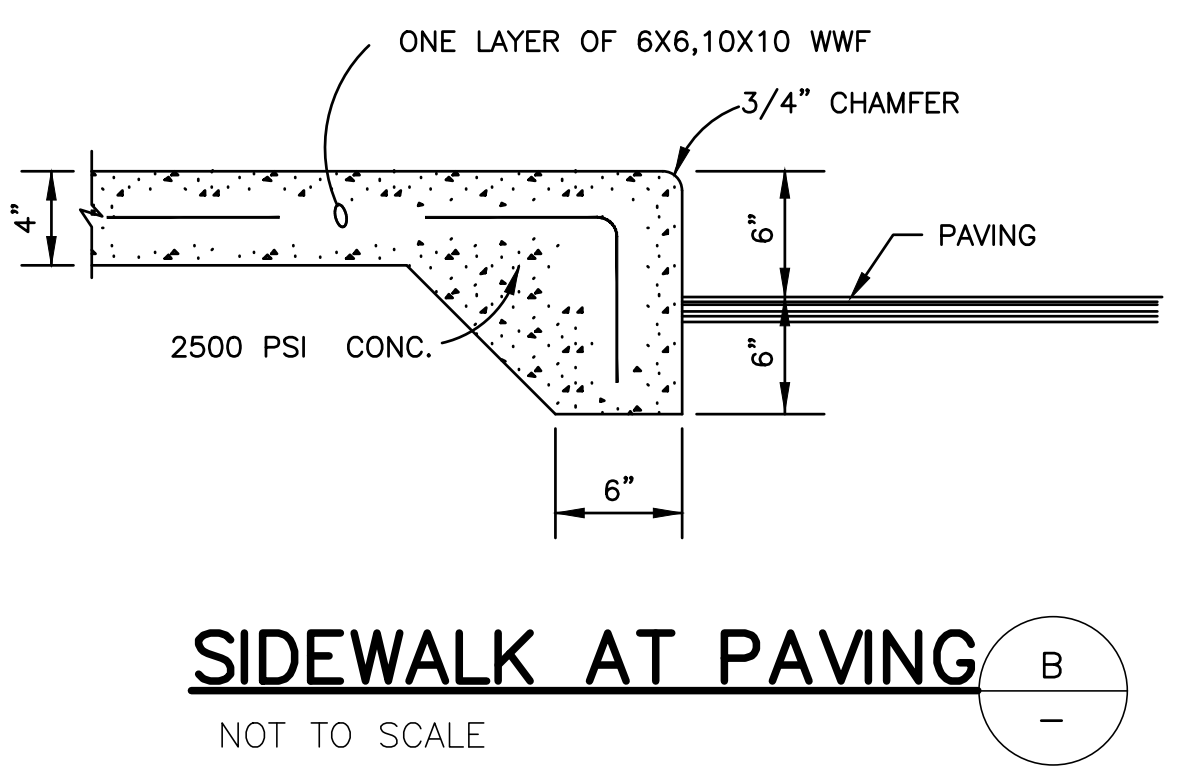
Constantine Engineering
 1988 LEWIS TURNER BLVD., FORT WALTON BEACH, FL 32547
 PH. 850-244-5800
 FL CERTIFICATE OF AUTHORIZATION # 9816

FILE	SEE LEFT
VERIFY SCALE	BAR IS ONE INCH ON ORIGINAL DRAWING
DATE	OCTOBER 2018
PROJ.	100501.00
DWG.	CD-1.0

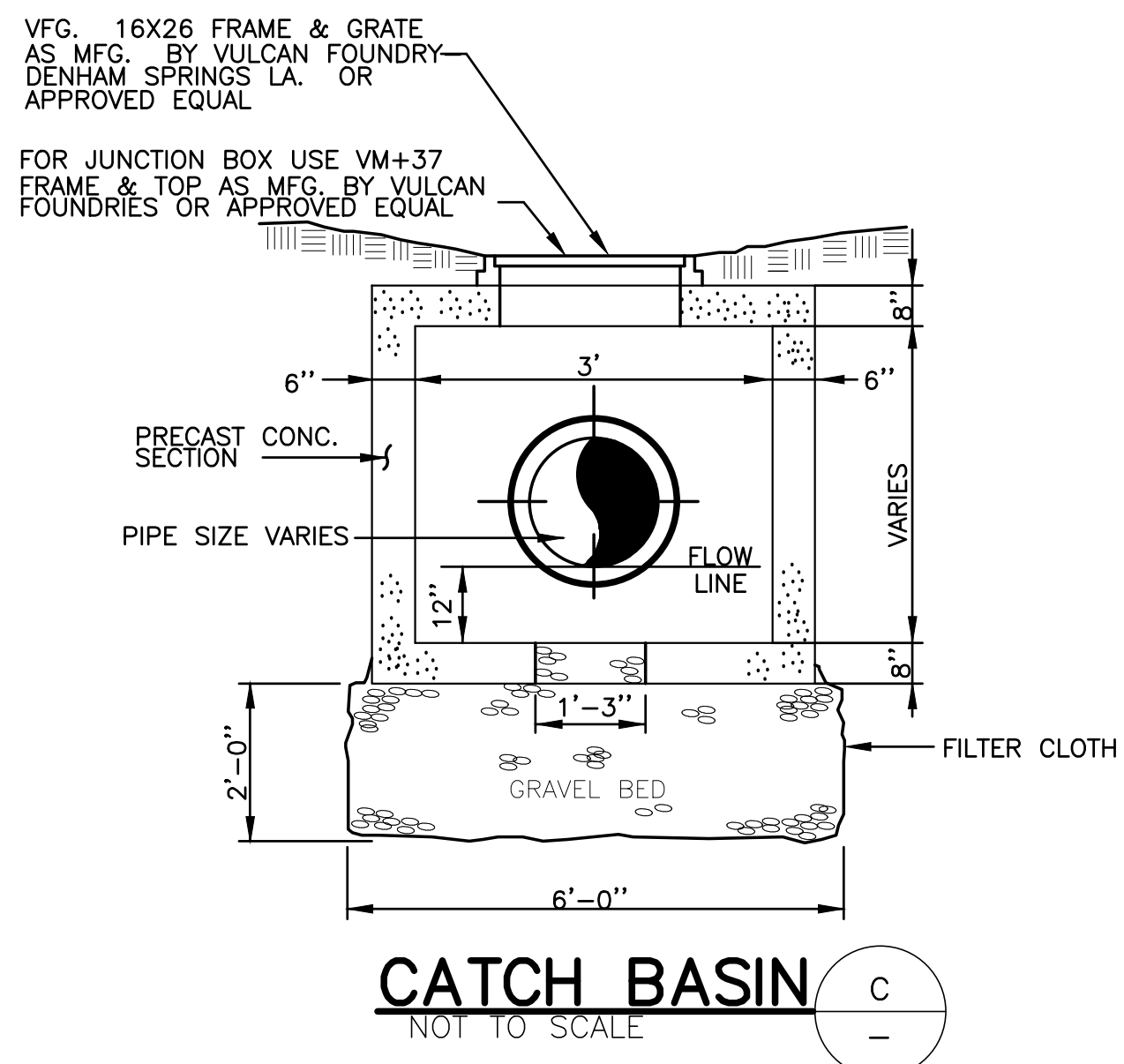
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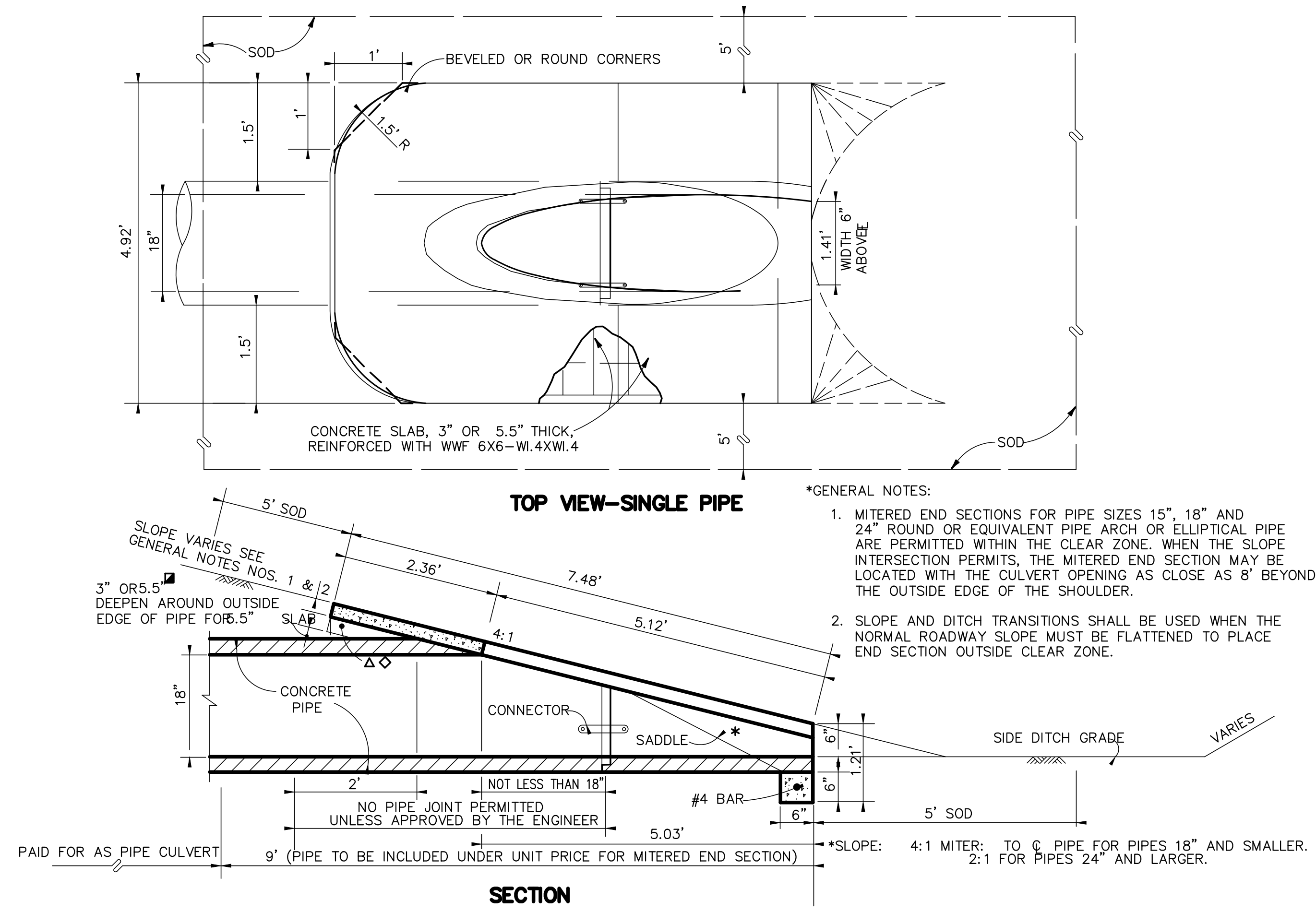
SIDEWALK DETAIL A
NOT TO SCALE



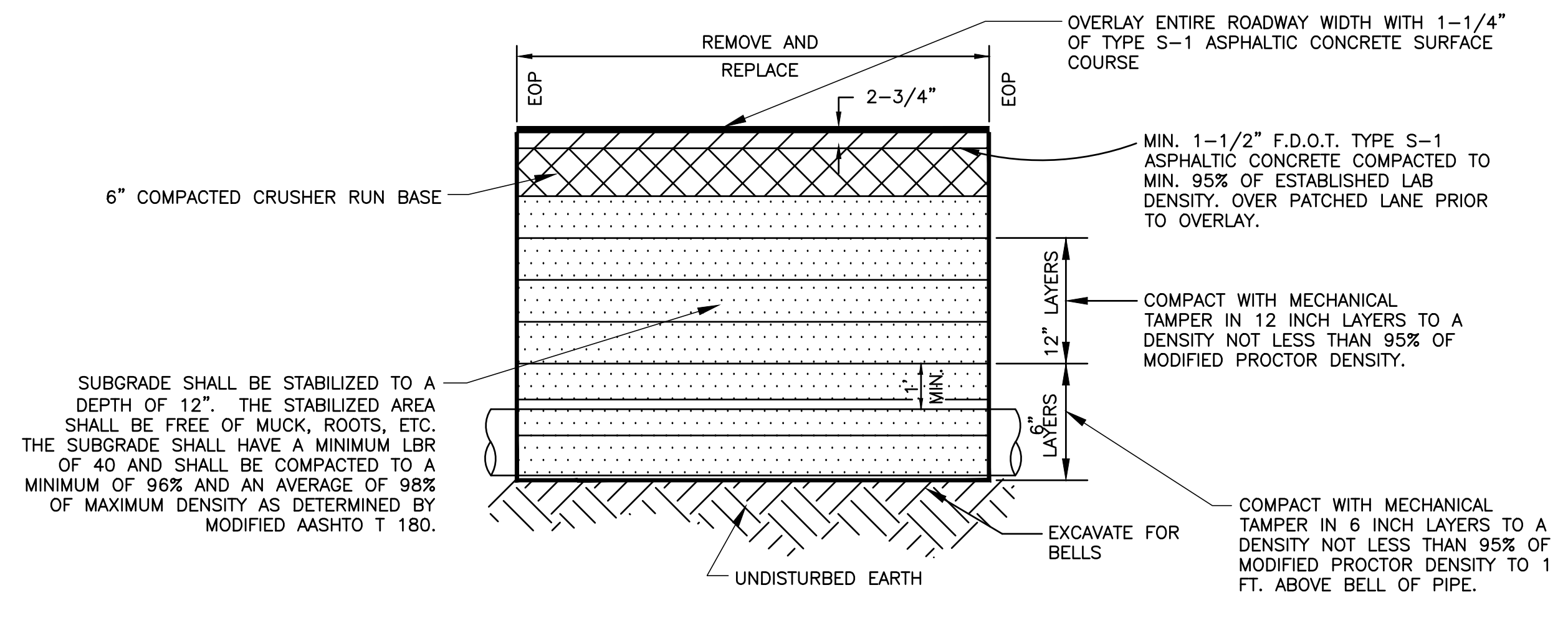
SIDEWALK AT PAVING B
NOT TO SCALE



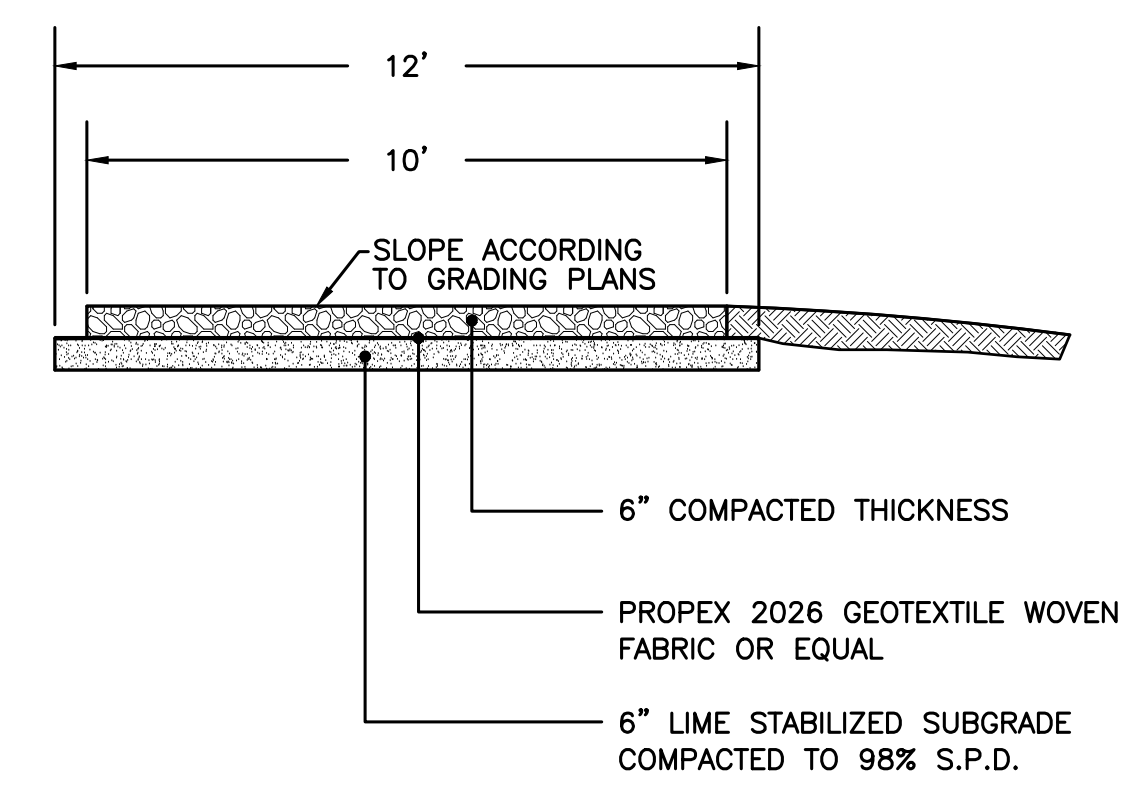
CATCH BASIN C
NOT TO SCALE



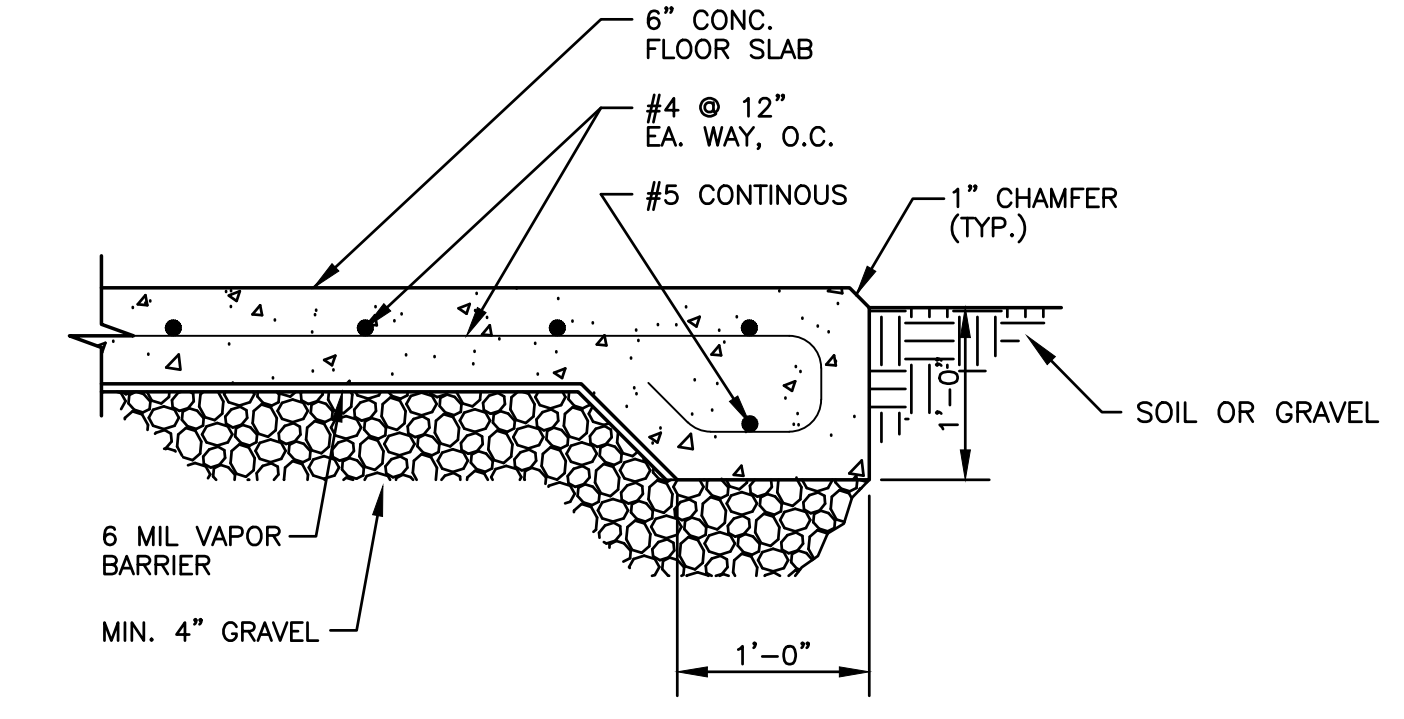
18" MITERED END SECTION D
NOT TO SCALE



ASPHALT ROAD REPAIR DETAIL E
NOT TO SCALE

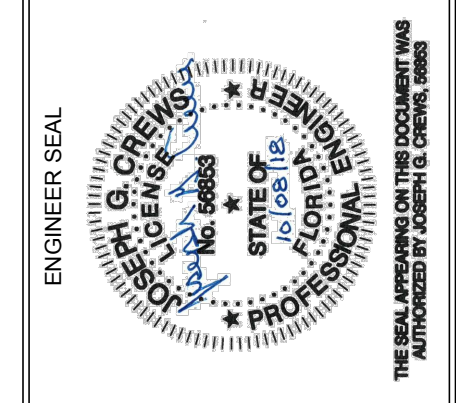


CRUSHED AGGREGATE DRIVE
N.T.S.



TURNED DOWN SLAB DETAIL
NOT TO SCALE

- NOTES:
1. EACH LAYER OF BACKFILL UNDER ROADWAYS SHALL BE MECHANICALLY TAMPED.
 2. DENSITY TESTS WILL BE REQUIRED ON EACH LAYER AT EACH ROAD AT 500 FT INTERVALS.
 3. ALL ASPHALT REMOVED SHALL BE SAWCUT.
 4. ASPHALT AND SAND CLAY BASE MATERIALS SHALL MEET THE REQUIREMENTS OF F.D.O.T. SPECIFICATIONS.
 5. CONTRACTOR SHALL REMOVE AND REPLACE ENTIRE DRIVING LANE BETWEEN SAW CUTS. ANY CURBING DAMAGED OR DESTROYED DURING CONSTRUCTION, SHALL BE REPLACED AT CONTRACTORS EXPENSE.



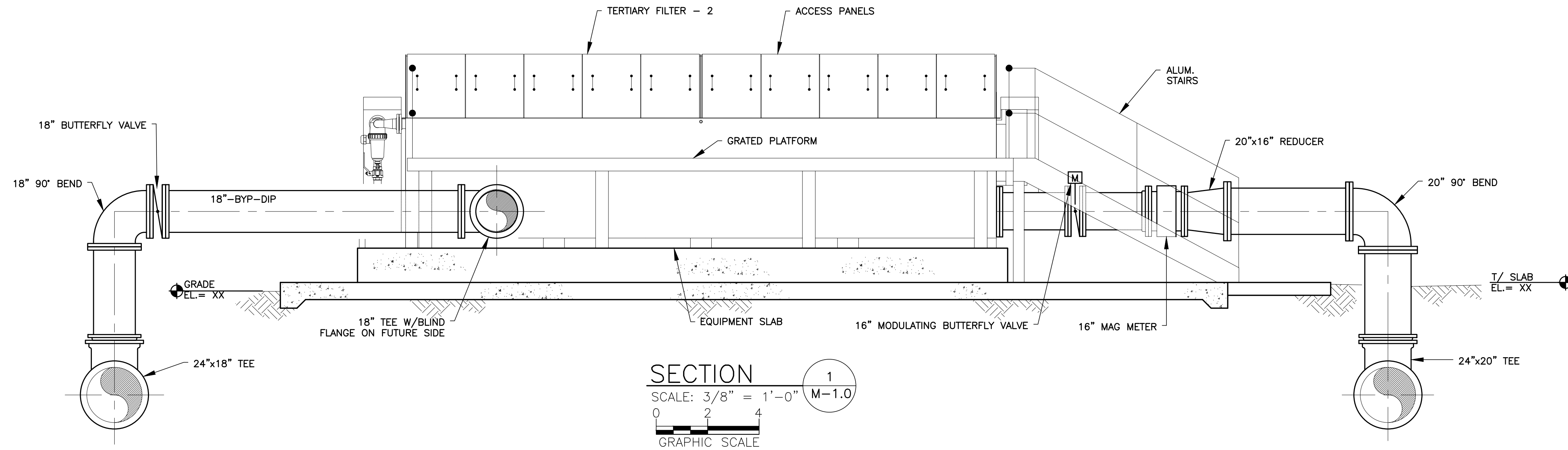
NO.	DATE	DESIGNED BY:	TCG	DRAWN BY:	TCG	REVISION	CHECKED BY:	JC	APPROVED BY:	JK
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CIVIL SITE DETAILS
 OCWS APWRF RECLAIM EXPANSION

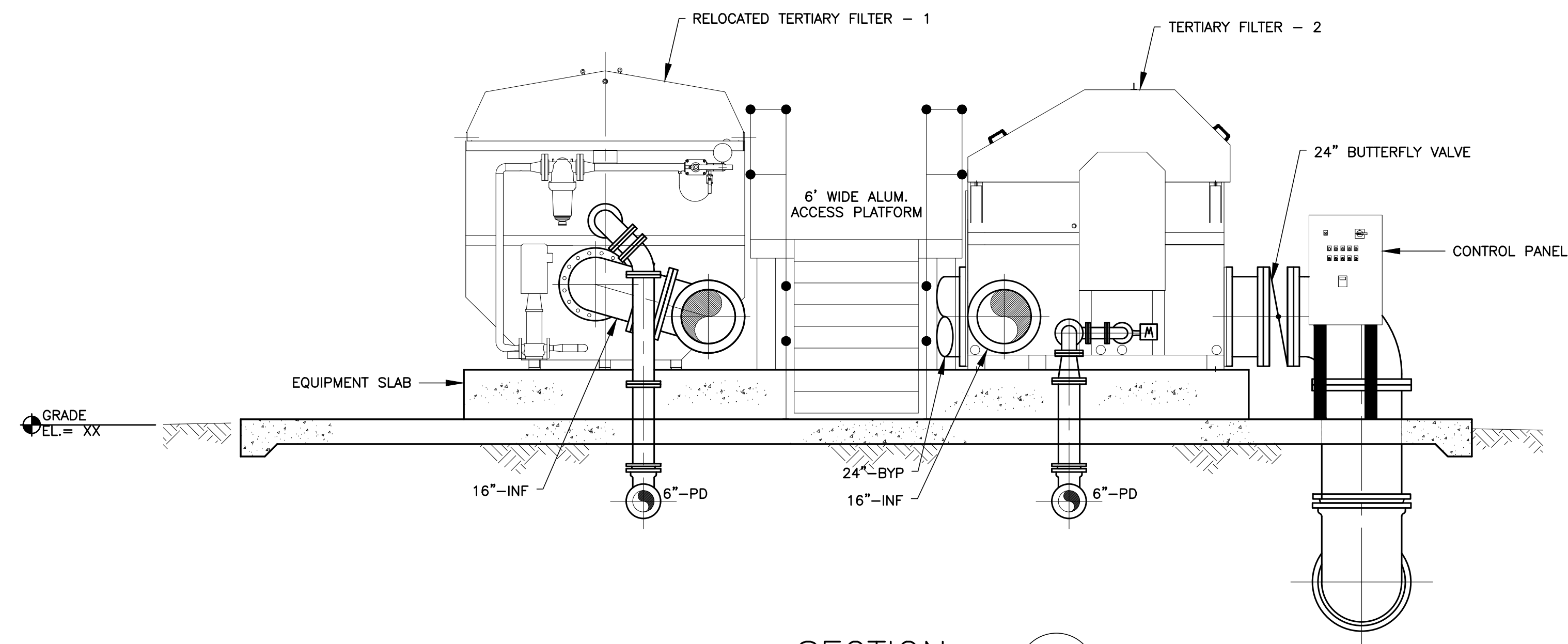


FILE	SEE LEFT
VERIFY SCALE	0 1" = 1'
DATE	OCTOBER 2018
PROJ.	100501.00
DWG.	CD-1.1

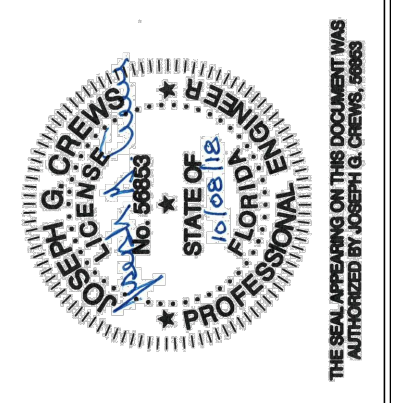
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SECTION 1
 SCALE: 3/8" = 1'-0" M-1.0
 GRAPHIC SCALE

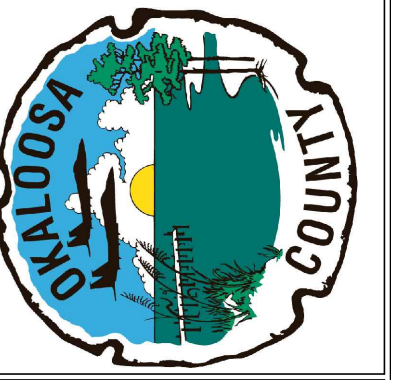


SECTION 2
 SCALE: 3/8" = 1'-0" M-1.0



NO.	DATE	DESIGNED BY:	DRAWN BY:	REVISION	CHECKED BY:	APPROVED BY:
		TCG	TCG	TCG	JC	JK

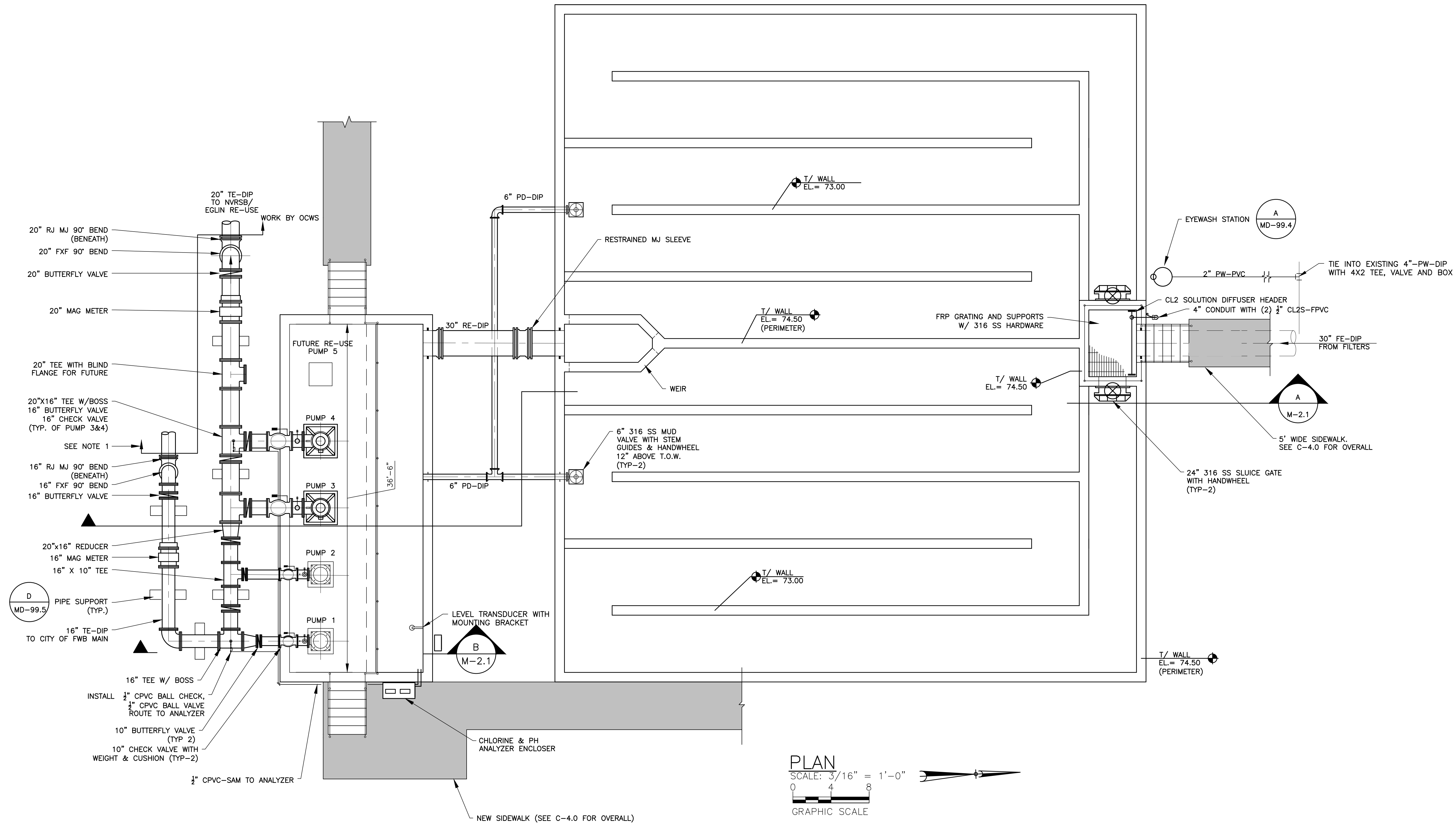
TERTIARY FILTERS SECTIONS
OCWS APWRF RECLAIM EXPANSION



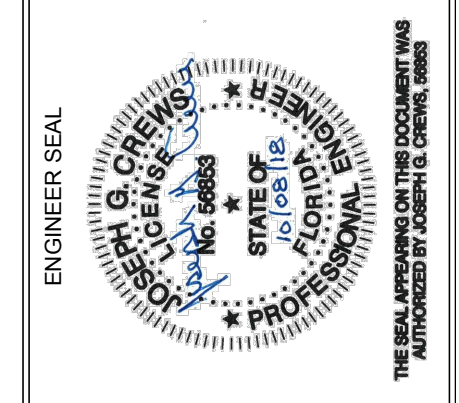
Constantine Engineering
 1988 LEWIS TURNER BLVD.
 FORT WALTON BEACH, FL 32547
 PH. 850-244-5800
 FL. CERTIFICATE OF AUTHORIZATION # 9816

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DATE	OCTOBER 2018
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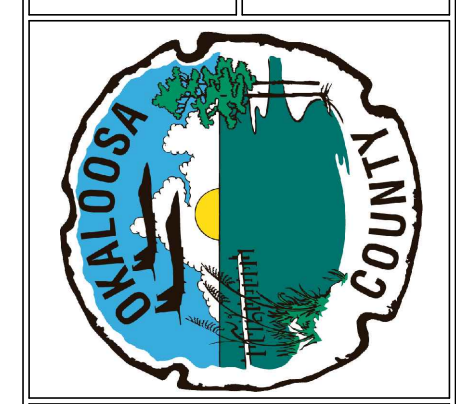


- NOTES:**
1. CONTRACTOR SHALL PROVIDE PIPE & PLUGS UP TO DEMARCATION LINES FOR FUTURE OWNER TIE-IN.
 2. CONTRACTOR SHALL PROVIDE TEMPORARY PIPING TO THE BASIN TO ALLOW FOR TESTING OF PUMPS AS PIPELINE WORK MAY NOT BE COMPLETED BEFORE CONTRACT IS COMPLETE.
 3. ALL ABOVE GROUND PIPING GREATER THAN 6-INCHES SHALL BE FLANGED DUCTILE IRON AND PAINTED PER THE PAINTING SCHEDULE. ALL BELOW GRADE DUCTILE IRON SHALL BE RESTRAINED.



NO.	DATE	DESIGNED BY:	TCG	DRAWN BY:	TCG	CHECKED BY:	JC	APPROVED BY:	JK
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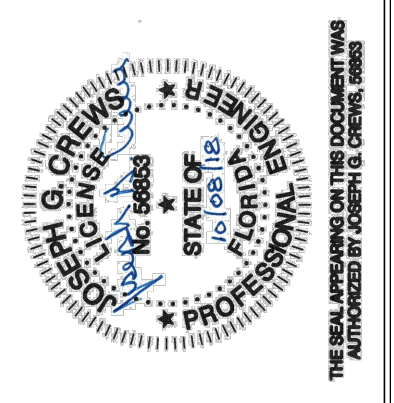
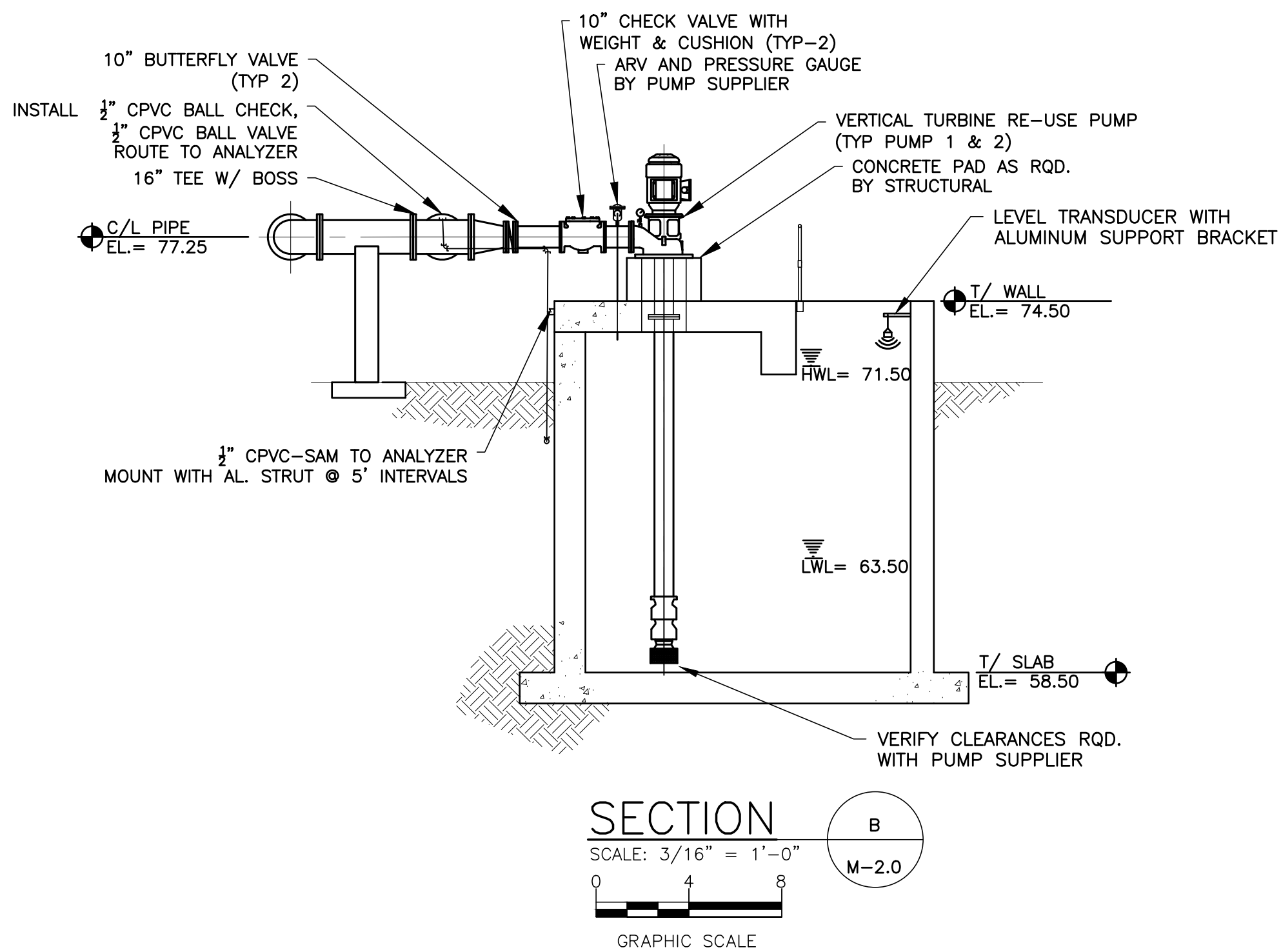
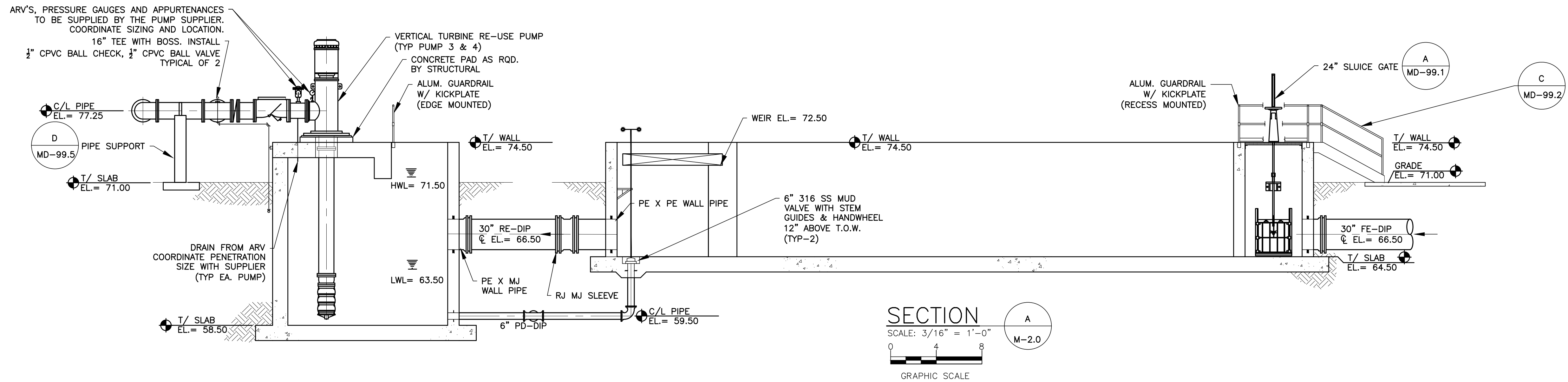
CHLORINE CONTACT BASIN PLAN
OCWS APWRF RECLAIM EXPANSION



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 1988 LEWIS TURNER BLVD., FL 32547
 FORT WALTON BEACH, FL 32547
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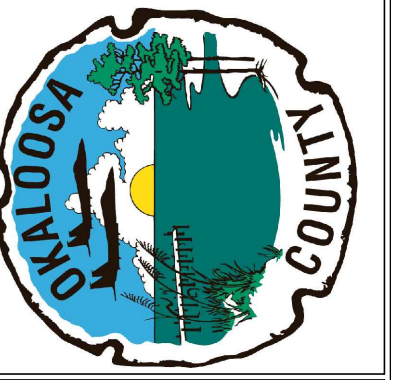
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DWG.	M-2.0

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DESIGNED BY:	TCG	DRAWN BY:	TCG	JK

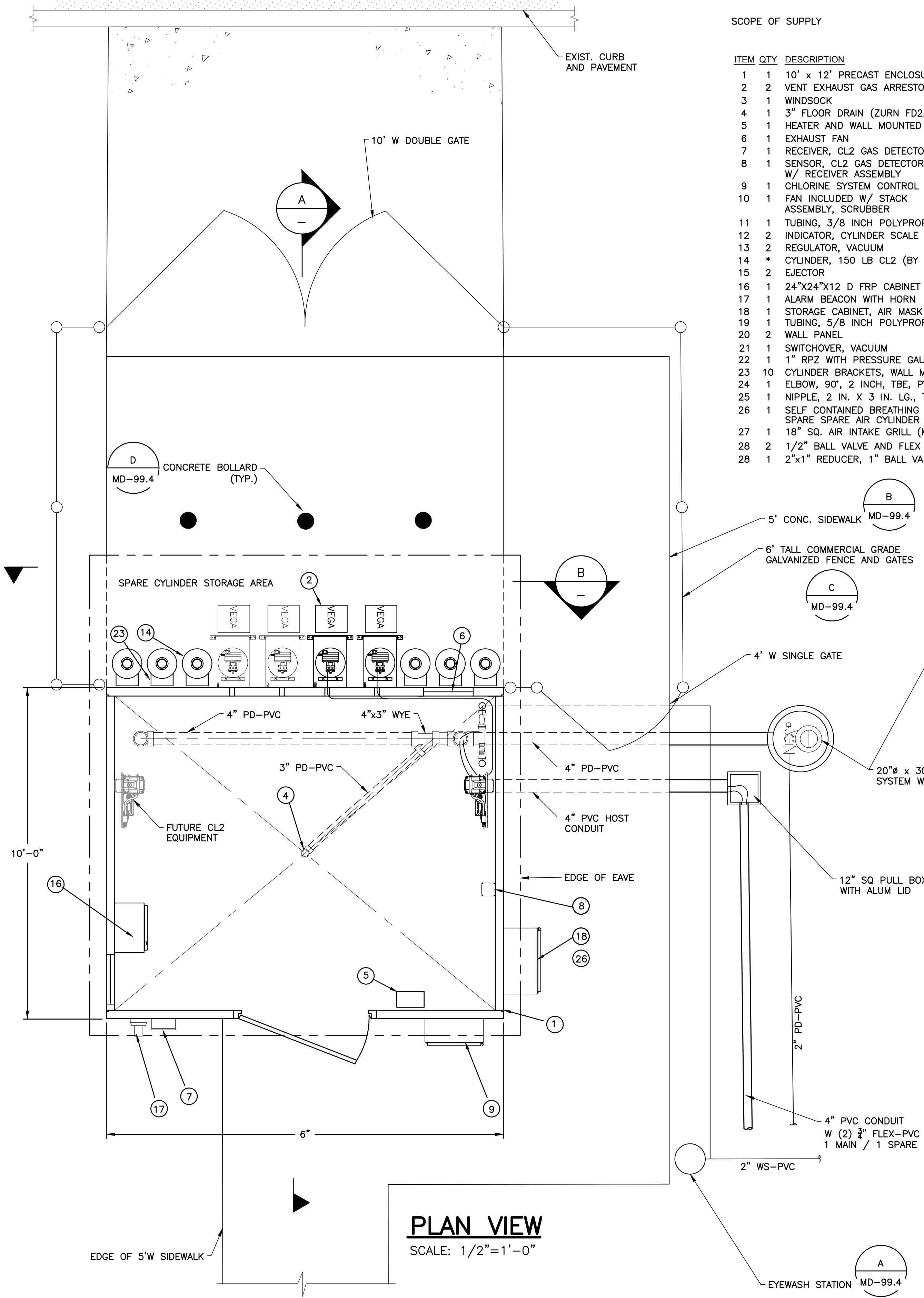
CHLORINE CONTACT BASIN SECTION
OCWS APWRF RECLAIM EXPANSION



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 1988 LEWIS TURNER BLVD.
 FORT WALTON BEACH, FL 32547
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Z:\PROJECT FILES\100501.00 OCWS APWRF RECLAIM EXPANSION\300 FINAL DRAWINGS\02 PROCESS MECH\W-BULKHYDROSTORAGE.DWG
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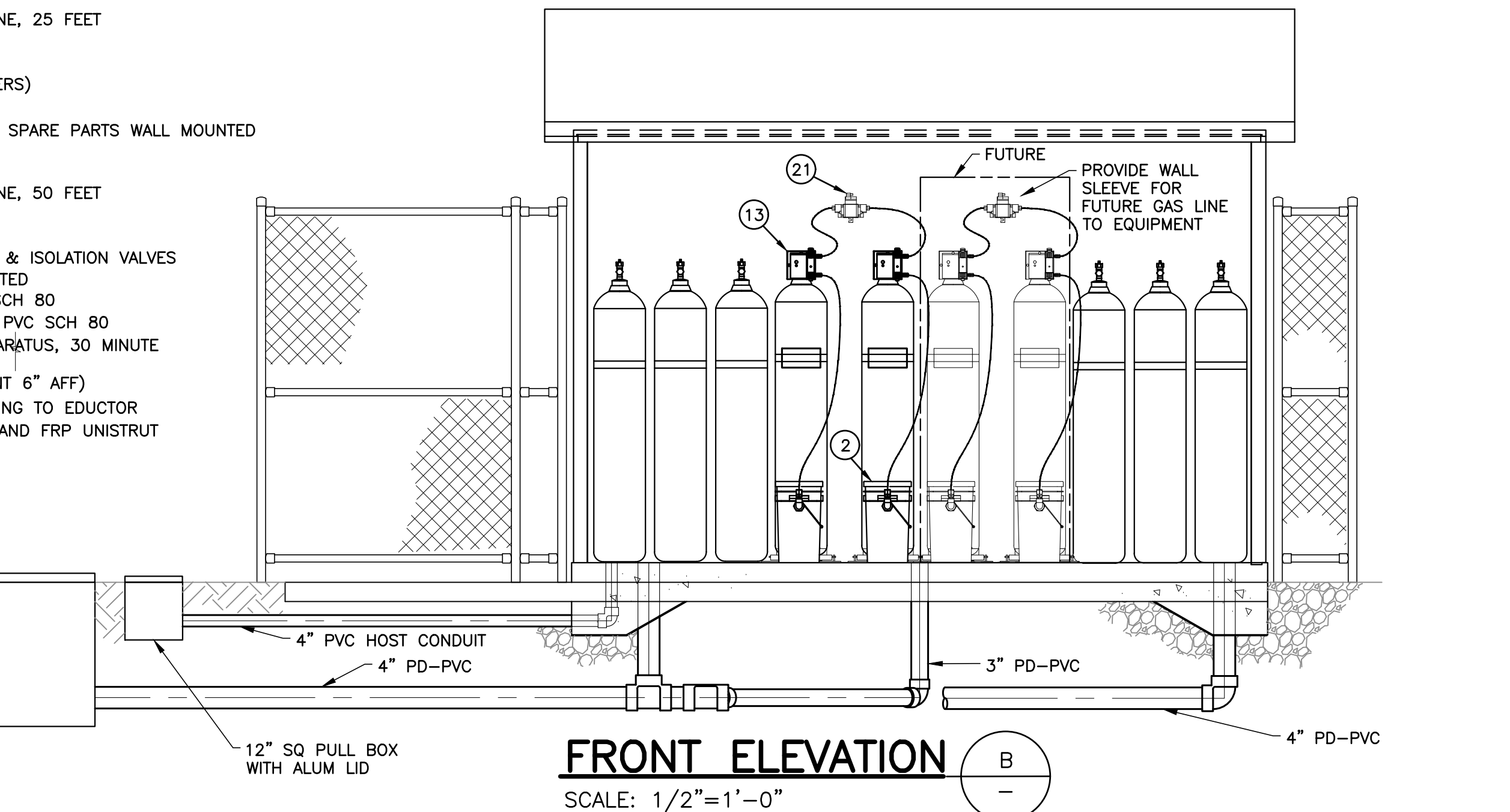
PLAN VIEW
 SCALE: 1/2"=1'-0"

SCOPE OF SUPPLY

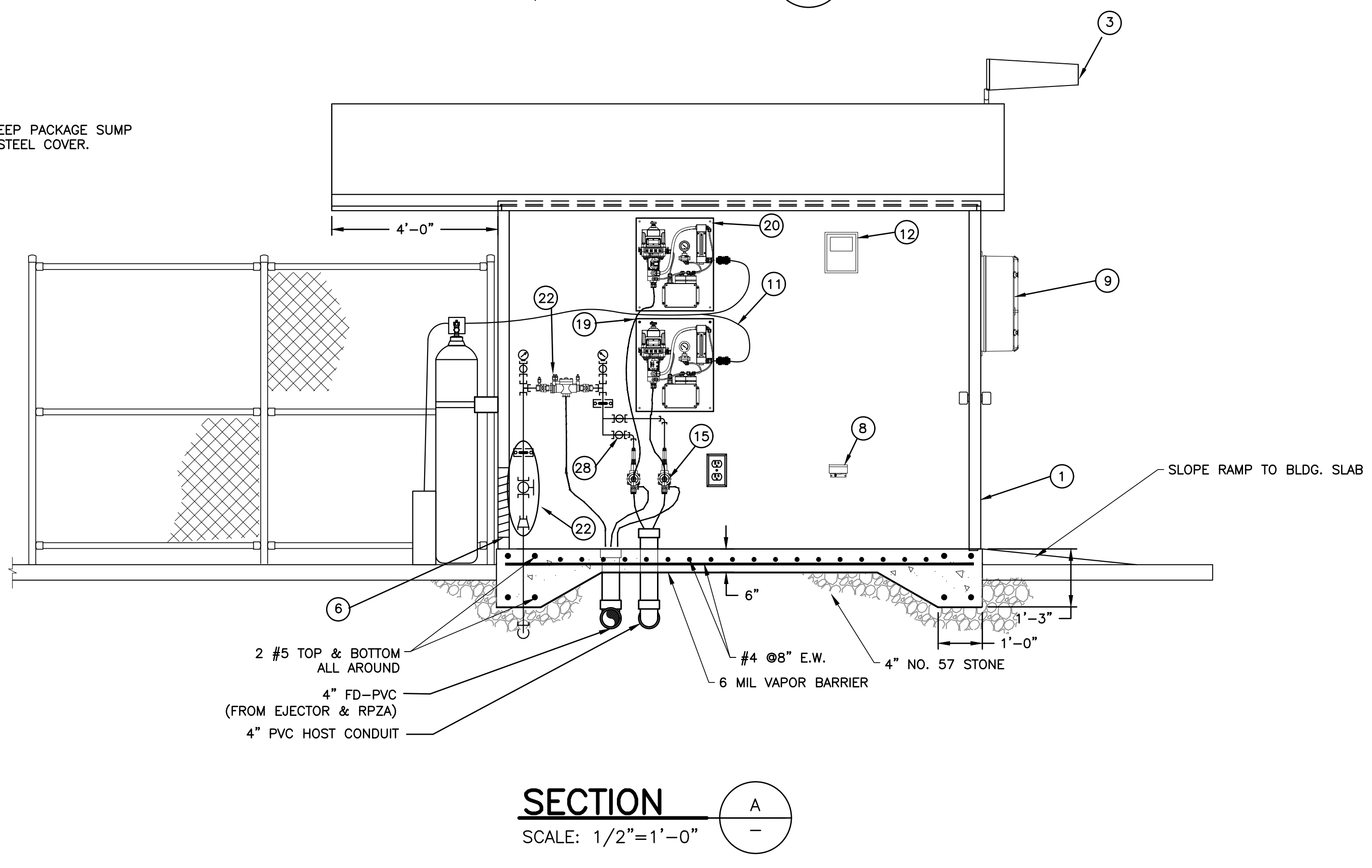
ITEM	QTY	DESCRIPTION
1	1	10' x 12' PRECAST ENCLOSURE
2	2	VENT EXHAUST GAS ARRESTOR (VEGA)
3	1	WINDSOCK
4	1	3" FLOOR DRAIN (ZURN FD2210-PV3-CP)
5	1	HEATER AND WALL MOUNTED THERMOSTAT
6	1	EXHAUST FAN
7	1	RECEIVER, CL2 GAS DETECTOR
8	1	SENSOR, CL2 GAS DETECTOR INCLUDED W/ RECEIVER ASSEMBLY
9	1	CHLORINE SYSTEM CONTROL PANEL
10	1	FAN INCLUDED W/ STACK ASSEMBLY, SCRUBBER
11	1	TUBING, 3/8 INCH POLYPROPYLENE, 25 FEET
12	2	INDICATOR, CYLINDER SCALE
13	2	REGULATOR, VACUUM
14	*	CYLINDER, 150 LB CL2 (BY OTHERS)
15	2	EJECTOR
16	1	24"x24"x12 D FRP CABINET FOR SPARE PARTS WALL MOUNTED
17	1	ALARM BEACON WITH HORN
18	1	STORAGE CABINET, AIR MASK
19	1	TUBING, 5/8 INCH POLYPROPYLENE, 50 FEET
20	2	WALL PANEL
21	1	SWITCHOVER, VACUUM
22	1	1" RPZ WITH PRESSURE GAUGES & ISOLATION VALVES
23	10	CYLINDER BRACKETS, WALL MOUNTED
24	1	ELBOW, 90°, 2 INCH, TBE, PVC SCH 80
25	1	NIPPLE, 2 IN. X 3 IN. LG., TBE, PVC SCH 80
26	1	SELF CONTAINED BREATHING APPARATUS, 30 MINUTE SPARE SPARE AIR CYLINDER
27	1	18" SQ. AIR INTAKE GRILL (MOUNT 6" AFF)
28	2	1/2" BALL VALVE AND FLEX TUBING TO EDUCTOR
28	1	2"x1" REDUCER, 1" BALL VALVE AND FRP UNISTRUT

NOTES:

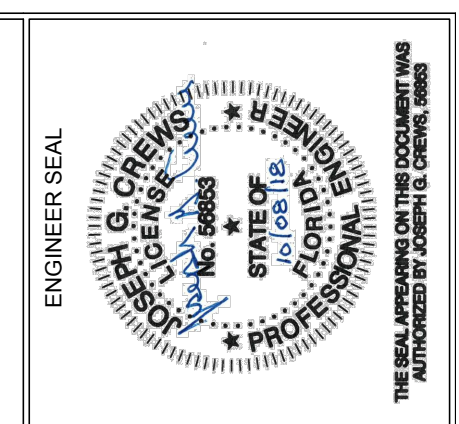
- 1) THE CHLORINE SYSTEM AND ALL RELATED SAFETY EQUIPMENT SHALL BE SUPPLIED BY A SINGLE SUPPLIER. SCOPE OF SUPPLY MAY VARY SLIGHTLY BY VENDOR AS THE DRAWING HEREIN IS A REPRESENTATION OF A TYPICAL SYSTEM.
- 2) THE CHLORINE SYSTEM SUPPLIER, INSTALLING CONTRACTOR SHALL BOTH COORDINATE THE EQUIPMENT LAYOUT INCLUDING WALL PENETRATIONS, POWER SUPPLY, SUPPORTS, AND ANY APPURTENANCES REQUIRED FOR A COMPLETE INSTALLATION WITH THE PRECAST BUILDING SUPPLIER.
- 3) THE BUILDING SHALL BE FITTED WITH ADEQUATE VENTILATION, LIGHTING, ALARMS, DETECTORS, WIND SOCK, AND BEACONS AS REQUIRED FOR SAFE WORKING ENVIRONMENT.
- 4) THE SUMP PUMP STATION SHALL BE OR EQUAL TO LITTLE GIANT WCR-9SS PACKAGE SYSTEM. POWER TO THE STATION SHALL BE PROVIDED FROM THE ELECTRICAL SERVICE PANEL AS SUPPLIED WITH THE PRECAST BUILDING. POUR 8" FLOATION COLLAR AROUND BASE.
- 5) THE BUILDING SHALL BE A VERTICAL BROOM FINISH PAINTED TO MATCH THE STANDARD PLANT TAN COLOR.



FRONT ELEVATION
 SCALE: 1/2"=1'-0"

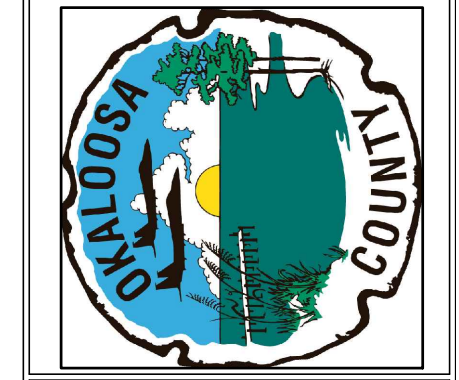


SECTION
 SCALE: 1/2"=1'-0"



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		TCG	TCG		JC	JK

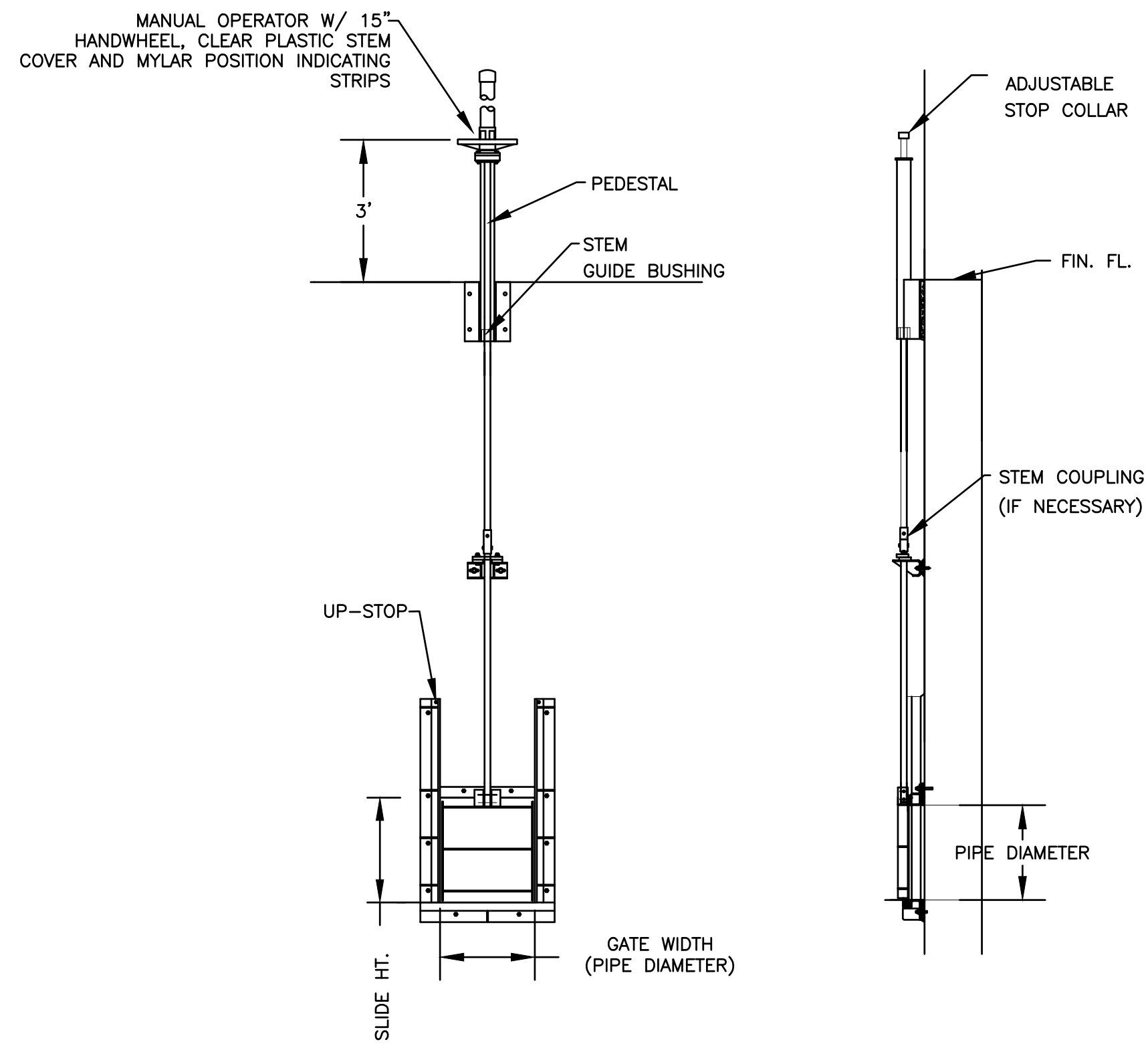
CHLORINE FEED BUILDING
OCWS APWRF RECLAIM EXPANSION



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DWG.	M-3.0

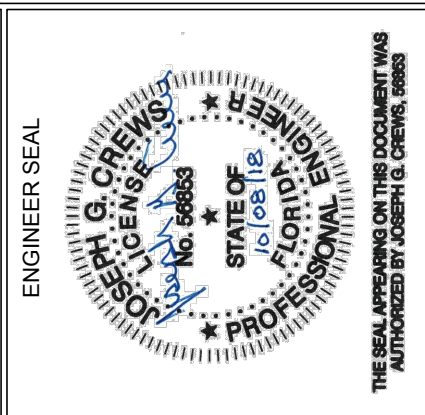
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SLUICE GATE (A)
 NTS

SLUICE GATE									
NO.	LOCATION	SHEET	DIAMETER (IN.)	CENTERLINE	TOP OF WALL	FRAME STYLE	ACTUATOR MOUNTING	ACTUATOR	MATERIAL
F-SC-1	DISINFECTION BASIN	M-2.0	2'-0"		74.50	WALL	PEDESTAL	HANDWHEEL	316 S.S.
F-SC-2	DISINFECTION BASIN	M-2.0	2'-0"		74.50	WALL	PEDESTAL	HANDWHEEL	316 S.S.

GATE SCHEDULE



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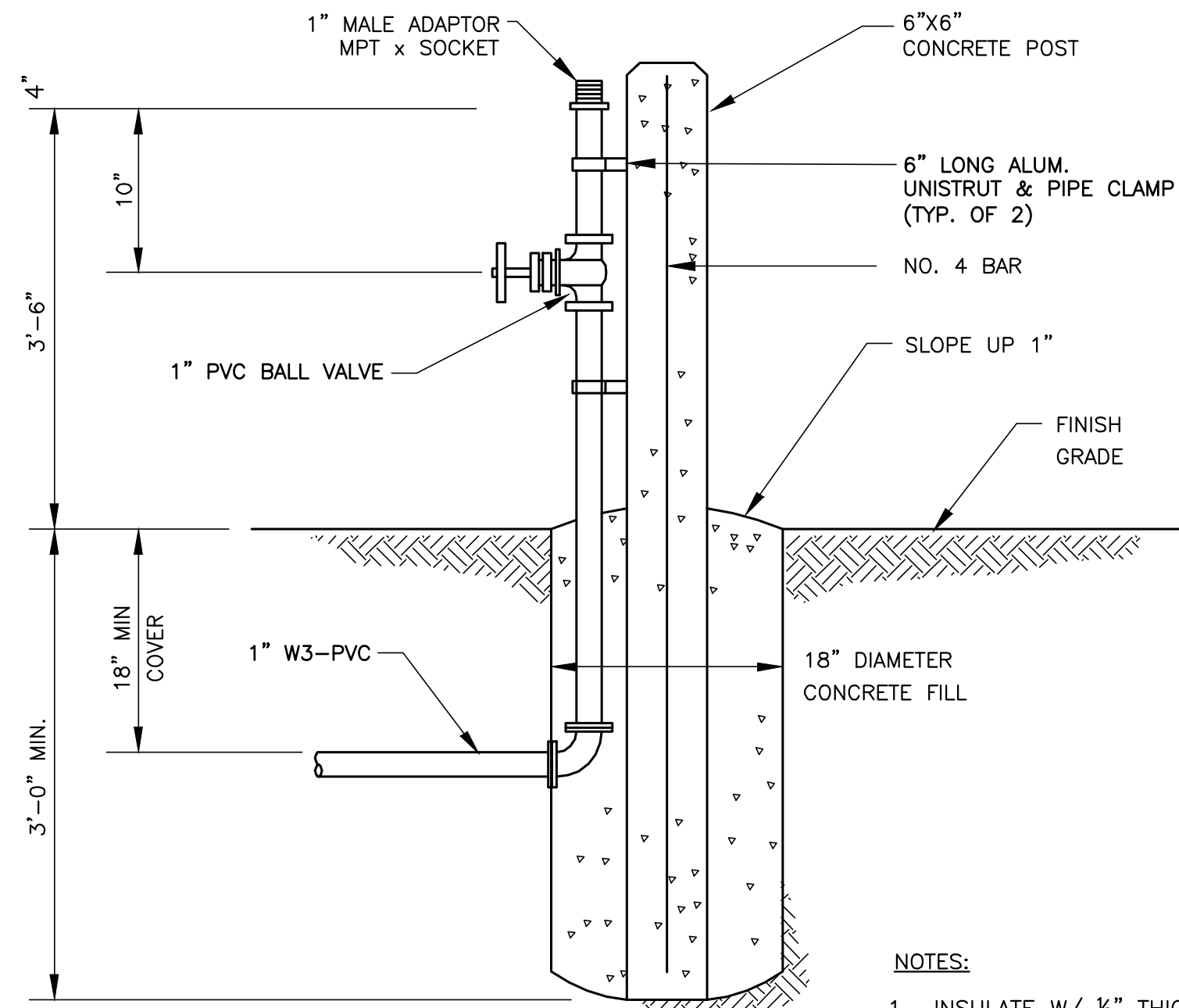
SLIDE GATE DETAILS
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DWG.	MD-99.1

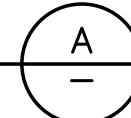
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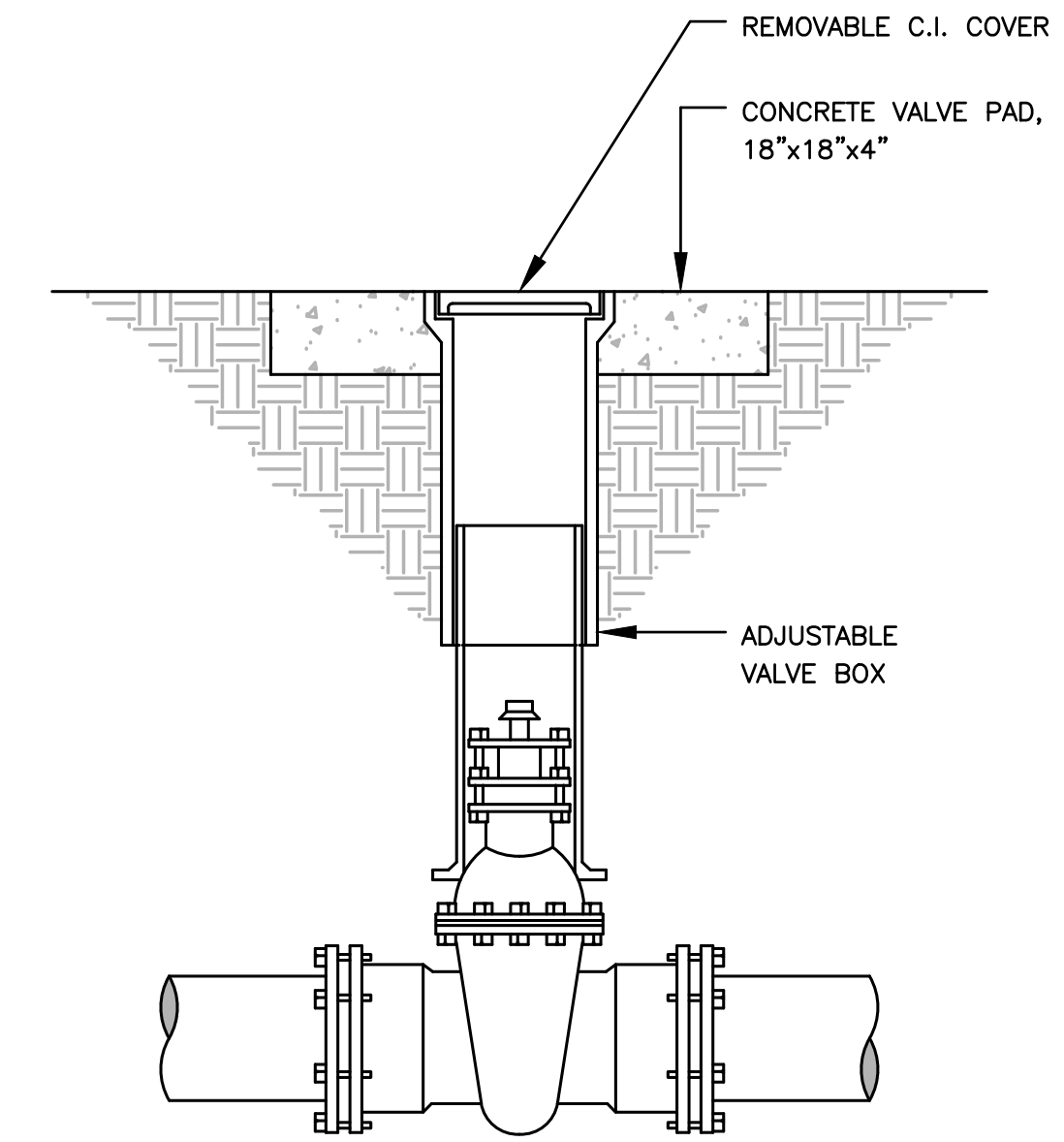
HOSE BIBB

POST MOUNTED HOSE VALVE

NOT TO SCALE

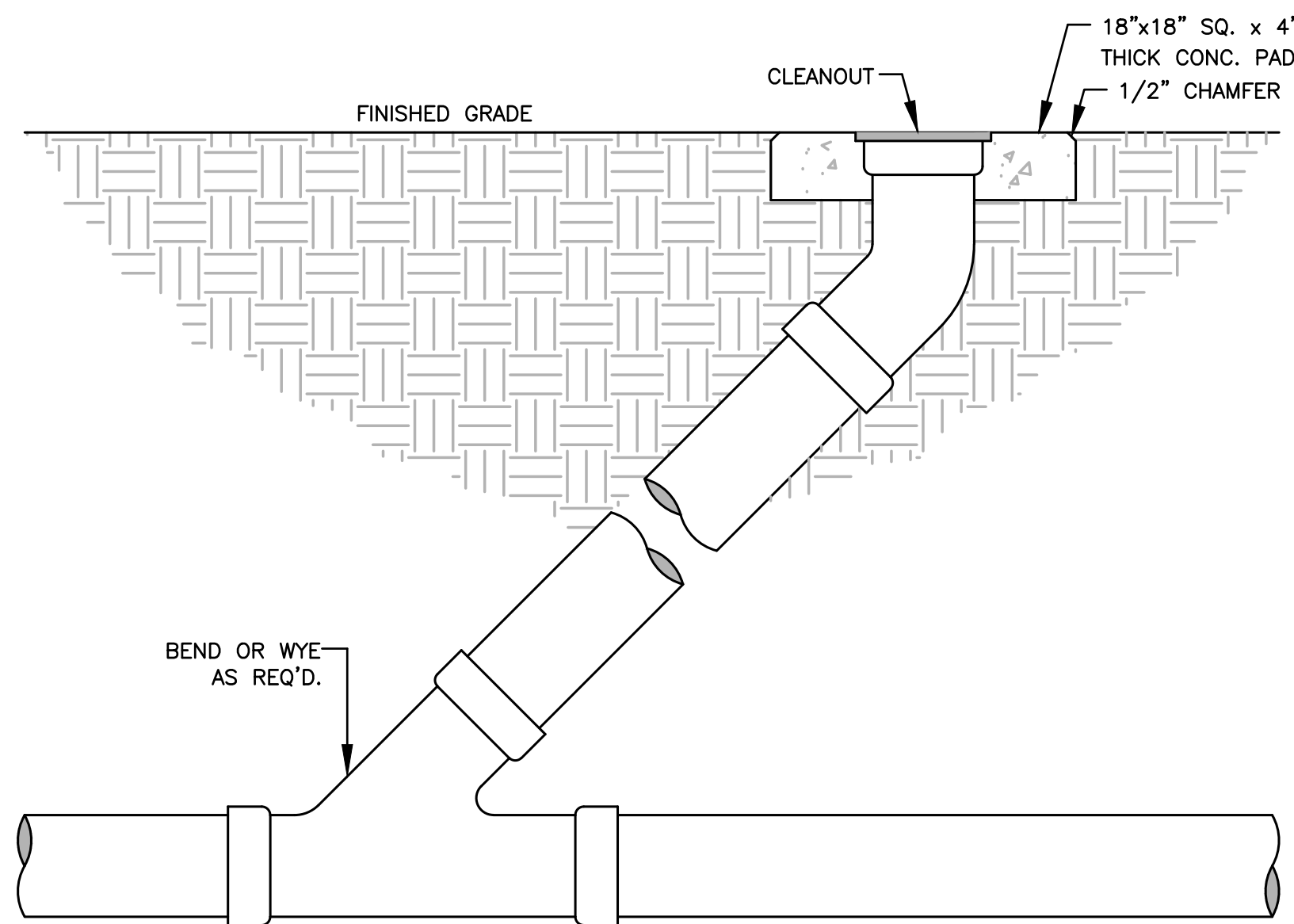
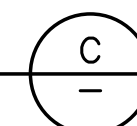


- NOTES:
1. INSULATE W/ 1/2" THICK NBR/PVC BODY INSULATION. (PER-SLIT & PRE-GLUED)



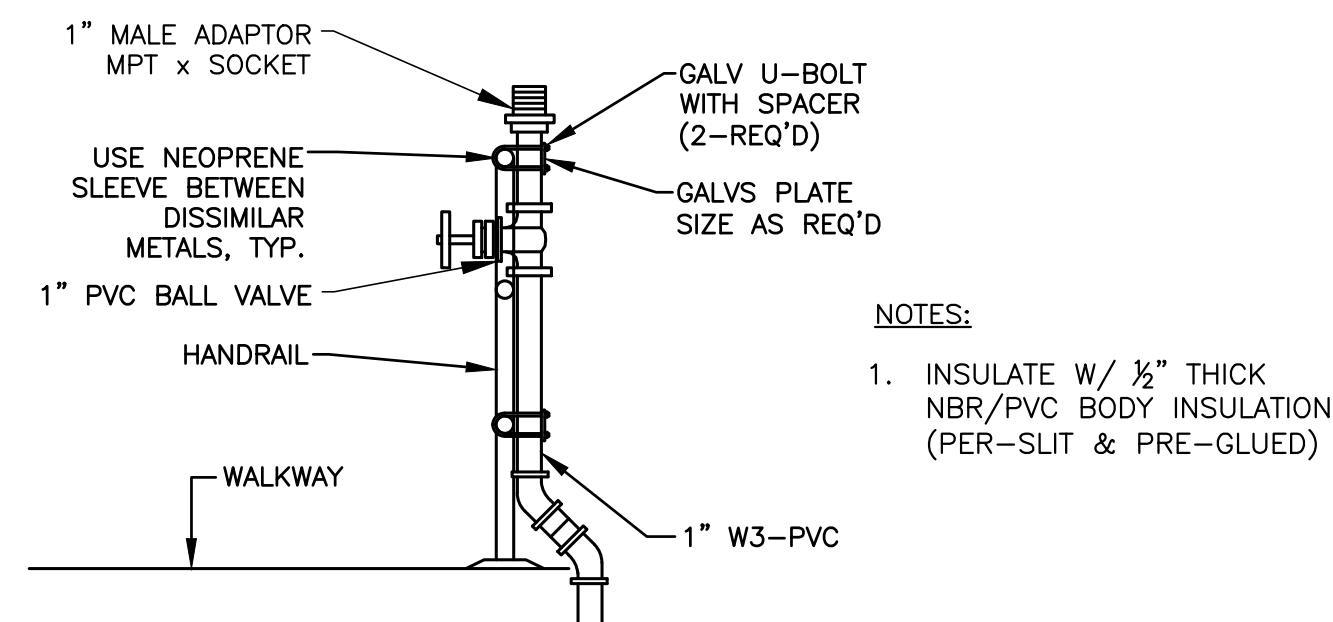
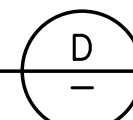
TYP. BURIED VALVE & BOX DETAIL

NOT TO SCALE

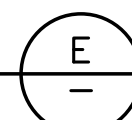


TYP. LINE CLEANOUT DETAIL

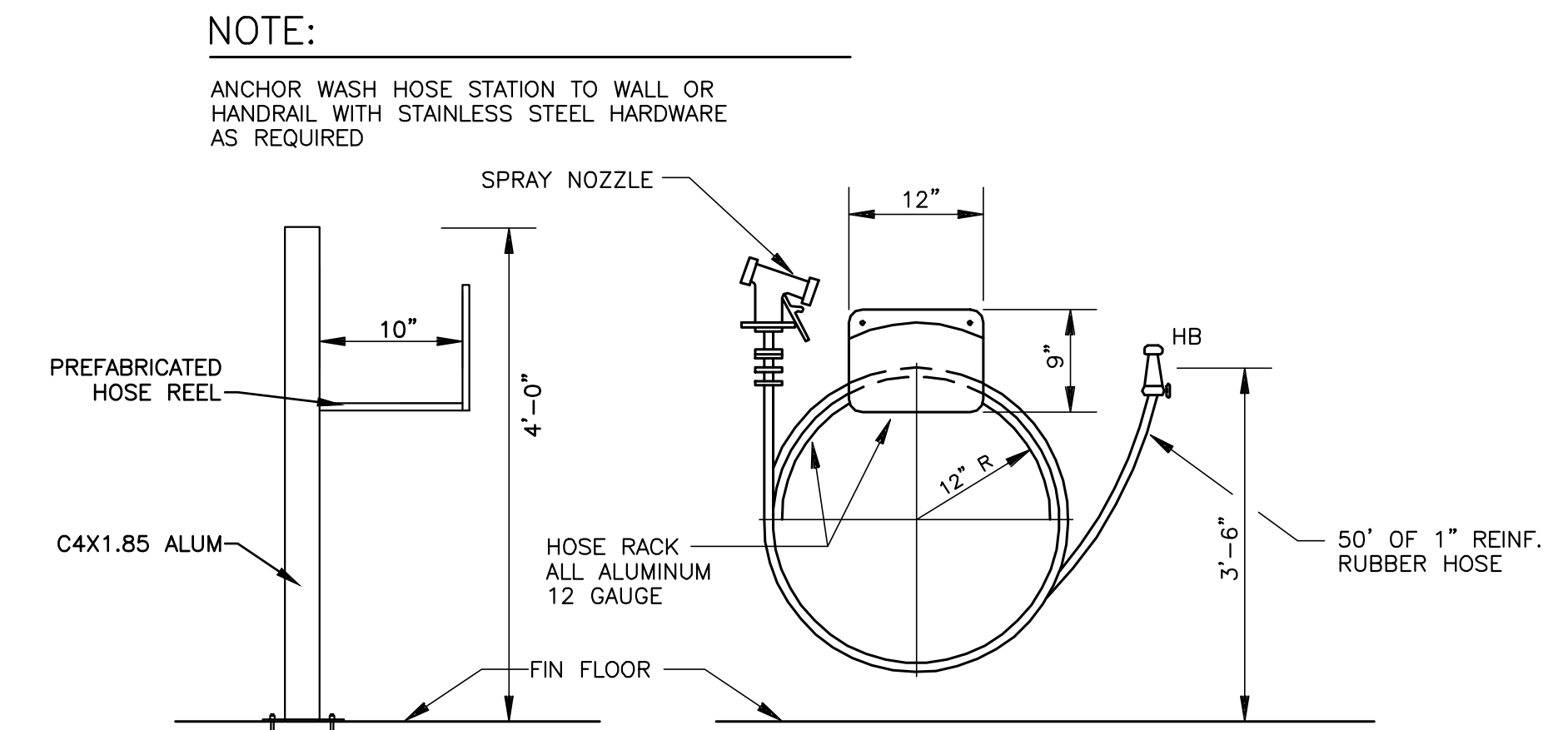
NOT TO SCALE



HANDRAIL MOUNTED HOSE VALVE



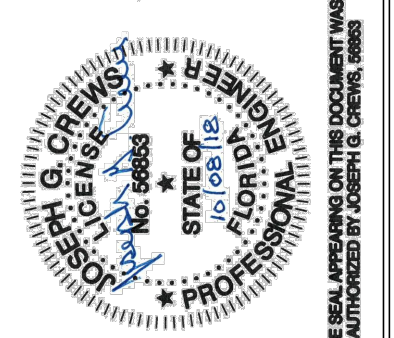
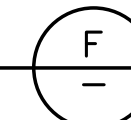
- NOTES:
1. INSULATE W/ 1/2" THICK NBR/PVC BODY INSULATION. (PER-SLIT & PRE-GLUED)



WASH HOSE STATION

DETAIL

NOT TO SCALE



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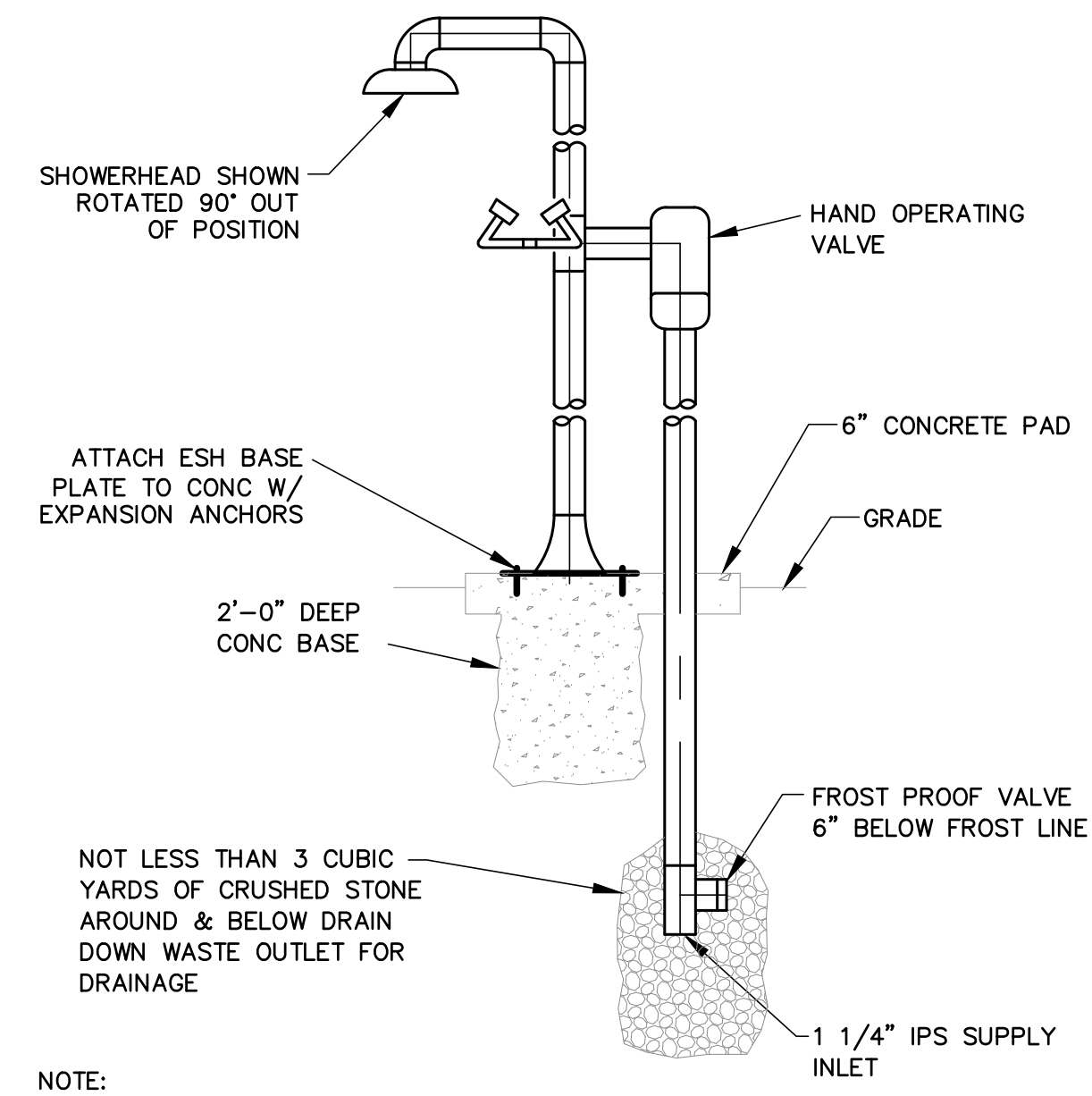
MISCELLANEOUS MECHANICAL DETAILS
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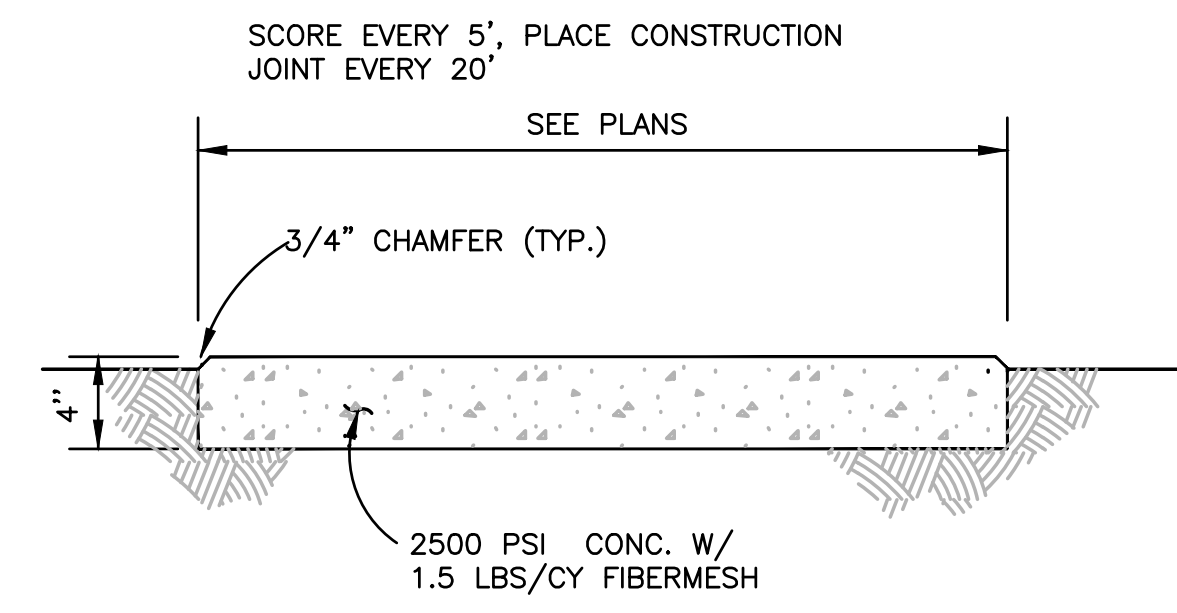
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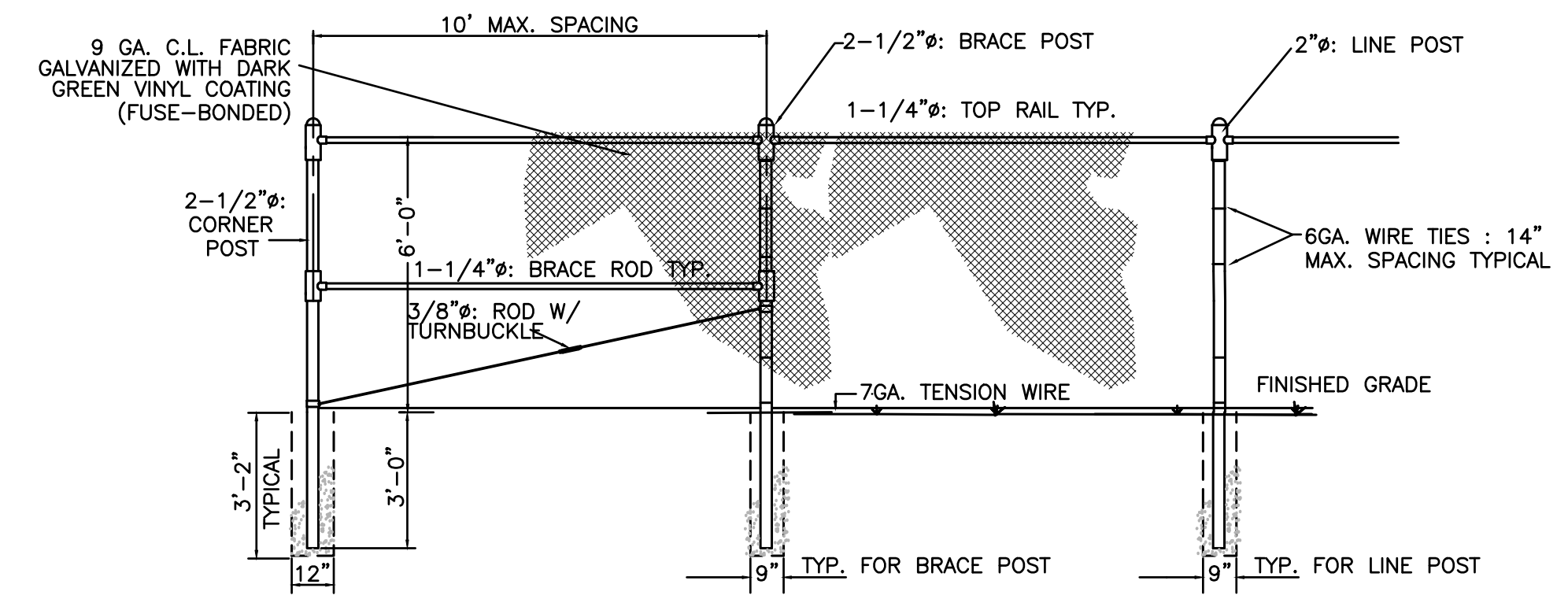


NOTE:
EYEWASH BOWL NOT SHOWN FOR CLARITY.

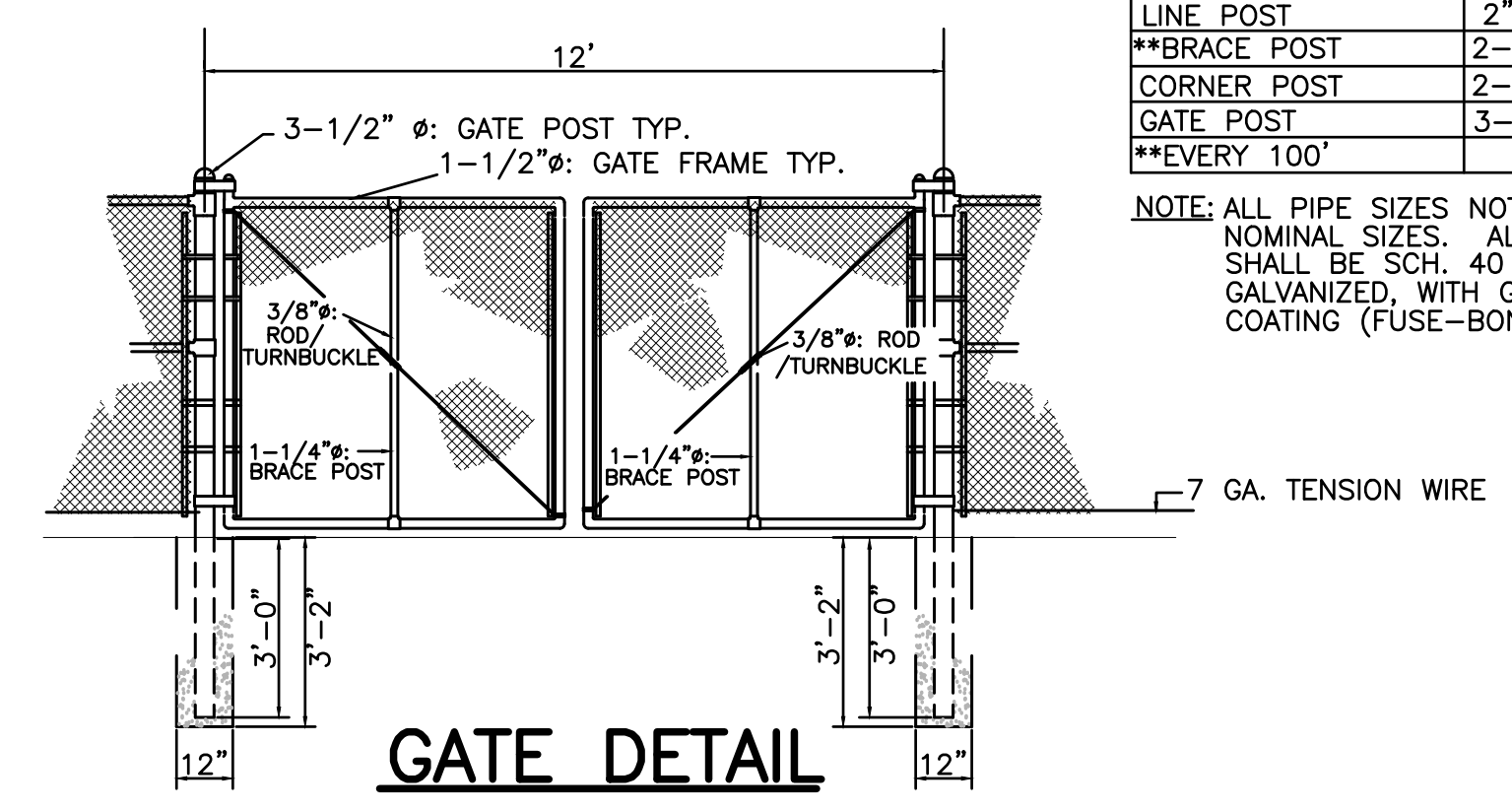
NON-FREEZE EYEWASH/SHOWER ESH-2 A
NOT TO SCALE



SIDEWALK DETAIL B
NOT TO SCALE



6' CHAIN LINK FENCE DETAILS C
M-3.0

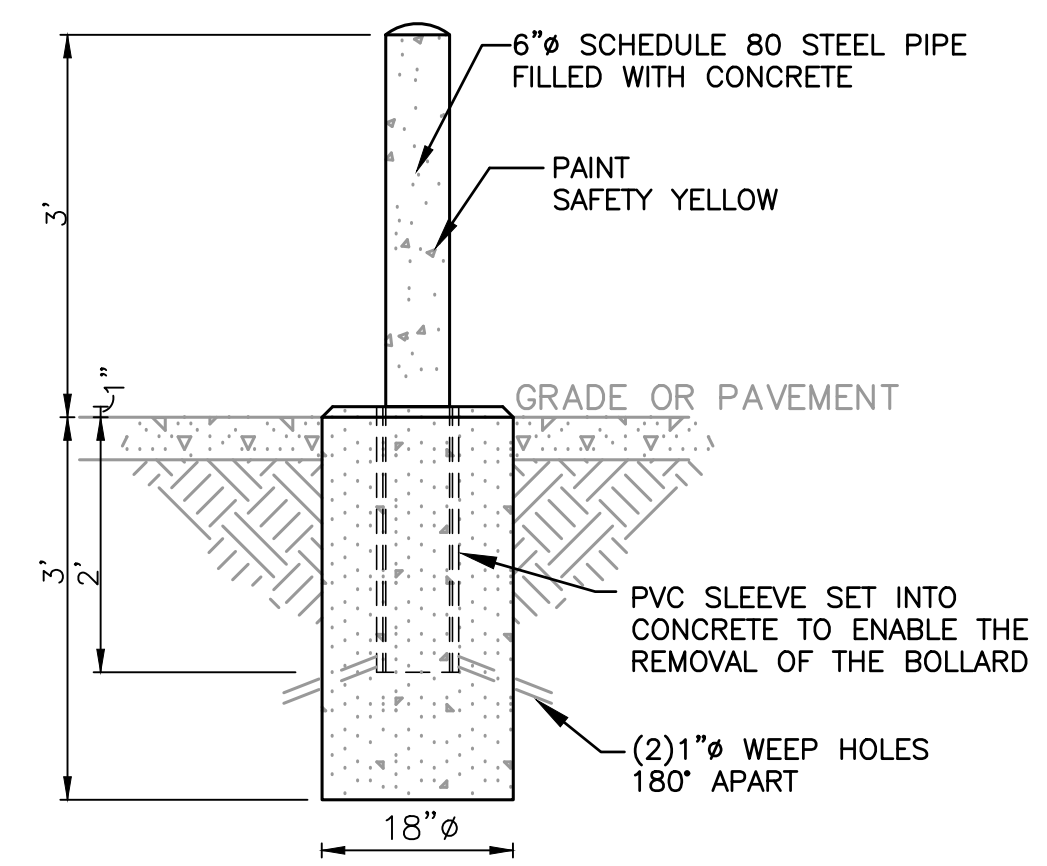


GATE DETAIL

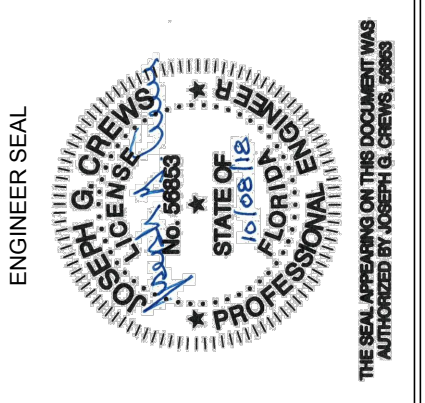
FENCE POST SCHEDULE

TYPE	SIZE
LINE POST	2"Ø
**BRACE POST	2-1/2"Ø
CORNER POST	2-1/2"Ø
GATE POST	3-1/2"Ø
**EVERY 100'	

NOTE: ALL PIPE SIZES NOTED ARE NOMINAL SIZES. ALL PIPE SHALL BE SCH. 40 AND GALVANIZED, WITH GREEN VINYL COATING (FUSE-BONDED).



BOLLARD DETAIL D
NOT TO SCALE



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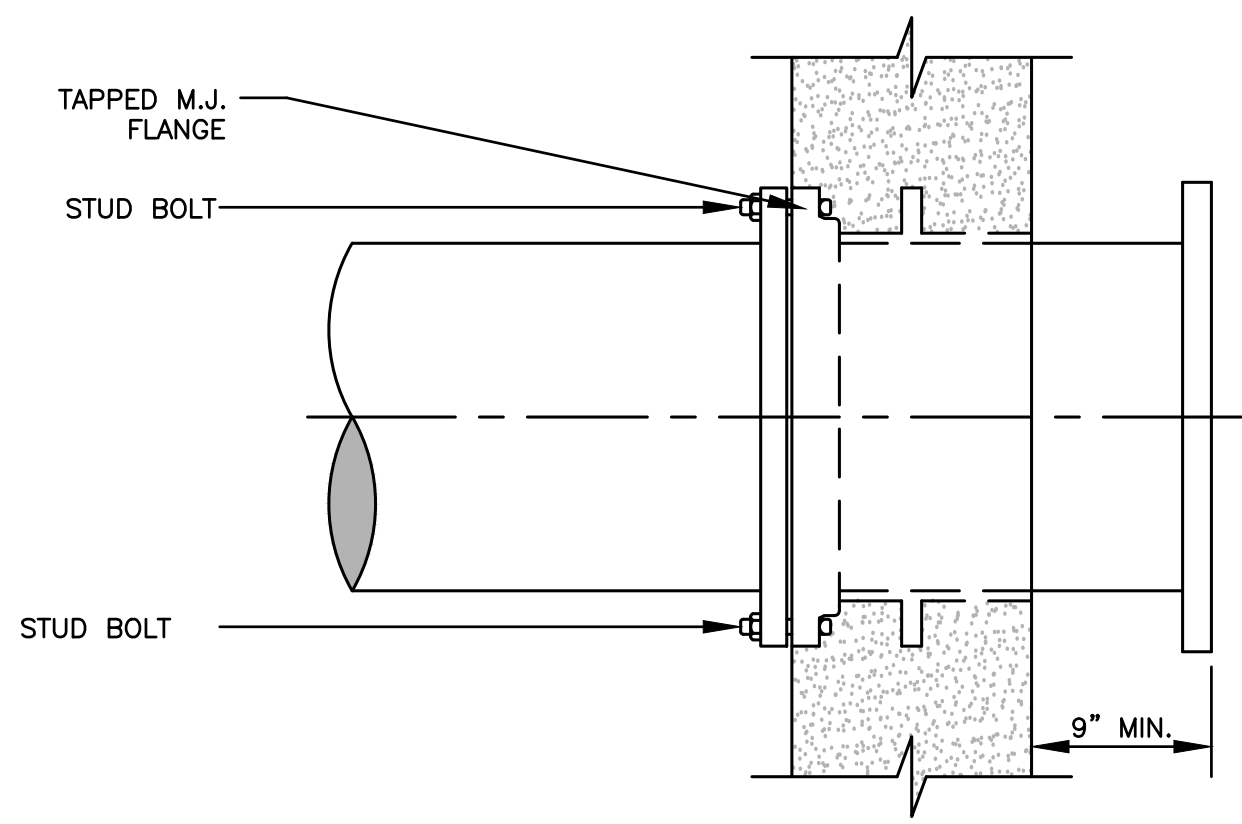
MISCELLANEOUS MECHANICAL DETAILS
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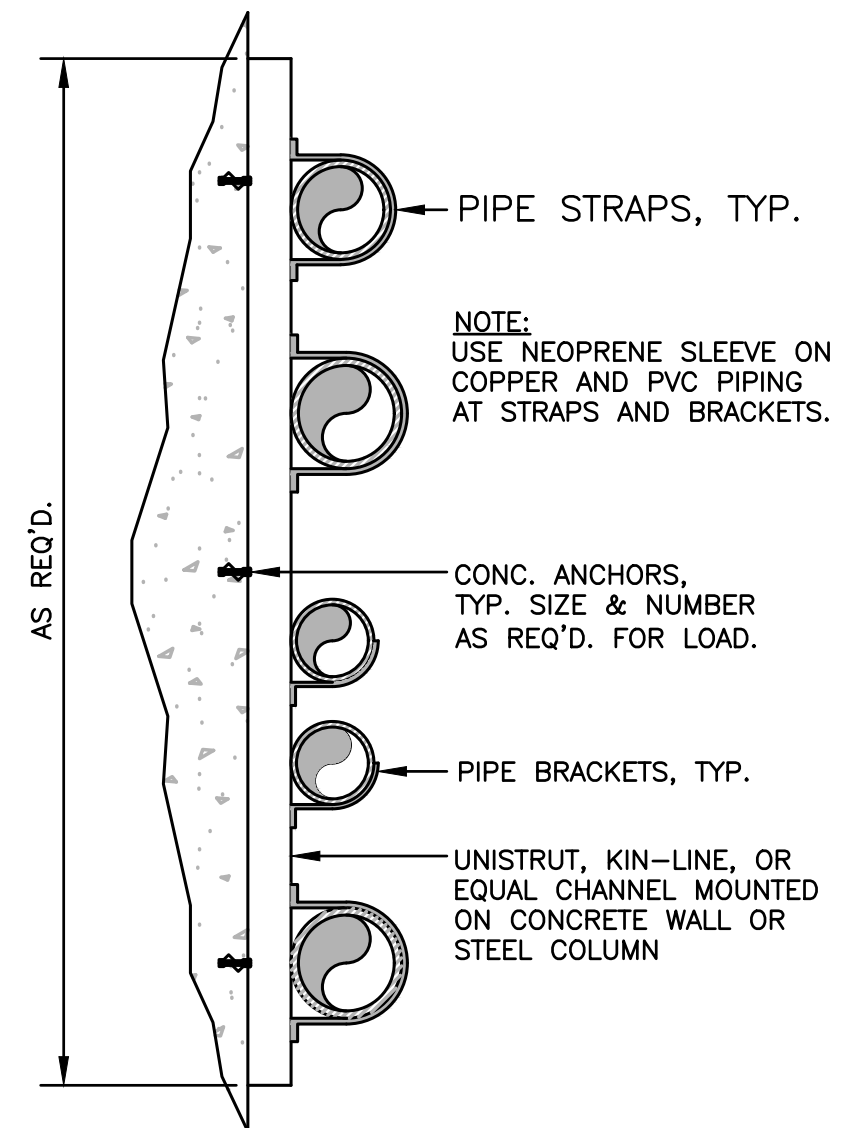
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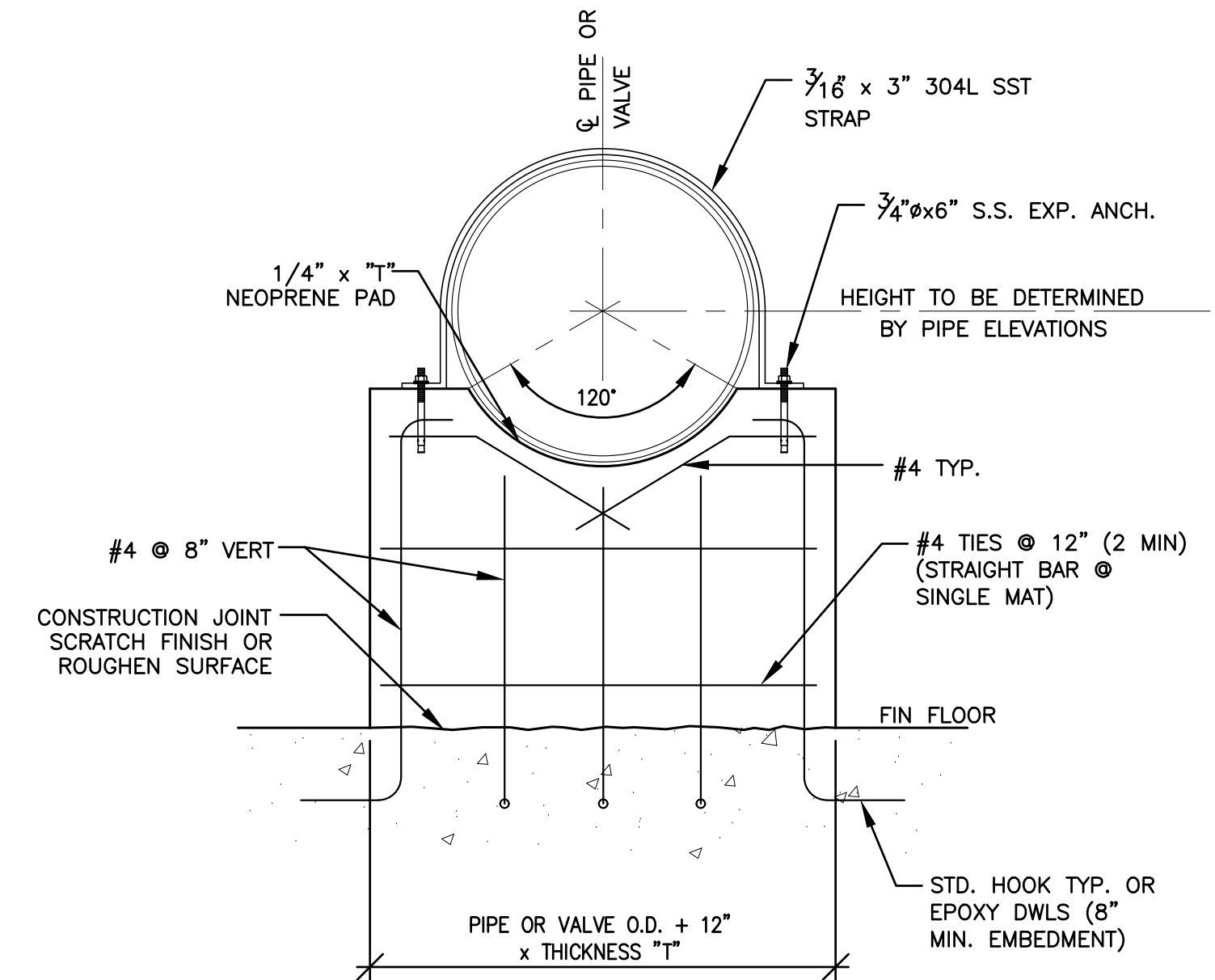


- NOTES:**
1. PAINT ENTIRE SLEEVE WITH COAL TAR EPOXY ACCORDING TO MANUFACTURER'S PREPARATION AND APPLICATION RECOMMENDATIONS.
 2. INCLUDE GASKETS BETWEEN WALL PIPE FLANGE AND CARRIER PIPE FLANGE WHERE NECESSARY FOR WATERTIGHT SEAL.
 3. SEAL WELD AROUND BOTH SIDES OF SEEP RING.

TYPE "C" WALL PIPE DETAIL (A)
 NOT TO SCALE

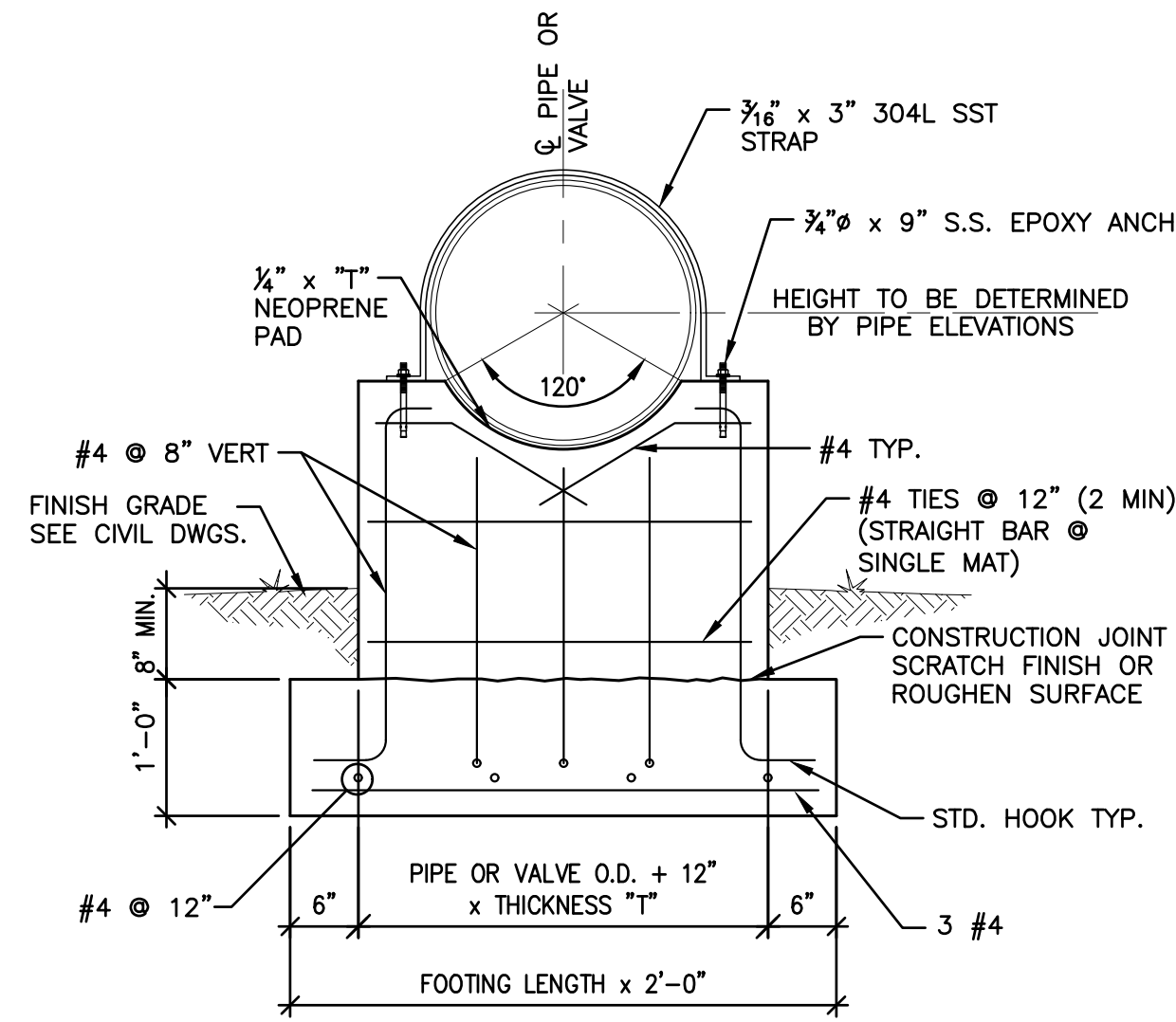


STACKED PIPE WALL SYSTEM DETAIL (B)
 NOT TO SCALE



- NOTES:**
1. PIPE SUPPORT THICKNESS TO BE AS FOLLOWS:
 PIPE $\phi < 24"$ T = 9"
 PIPE $\phi > 24"$ T = 12"
 2. PROVIDE ONE MAT OF REINF. FOR 9" THICK SUPPORT & 2 MATS FOR 12" THICK SUPPORTS.
 3. PIPE SUPPORTS AS SHOWN IS TYPICAL UNLESS SHOWN OTHERWISE ON THE DRAWINGS.

TYPICAL PIPE / VALVE SUPPORT
DETAIL (C)
 SCALE: NONE

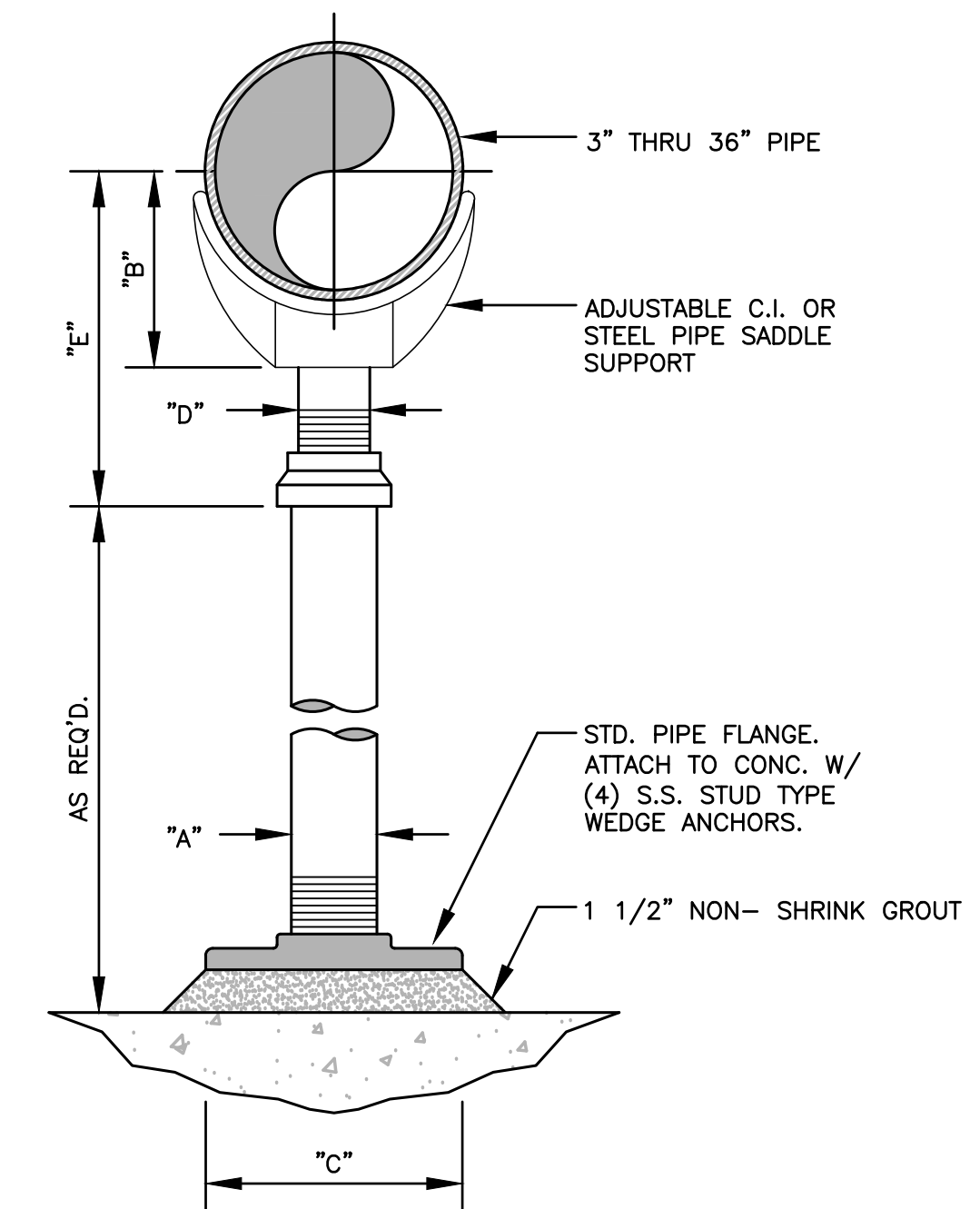


- NOTES:**
1. PIPE SUPPORT THICKNESS TO BE AS FOLLOWS:
 PIPE $\phi < 24"$ T = 9"
 PIPE $\phi > 24"$ T = 12"
 2. PROVIDE ONE MAT OF REINF FOR 9" THICK SUPPORT & 2 MATS (E.F.) FOR 12" THICK SUPPORTS.
 3. PIPE SUPPORTS AS SHOWN IS TYPICAL UNLESS SHOWN OTHERWISE ON THE DRAWINGS.

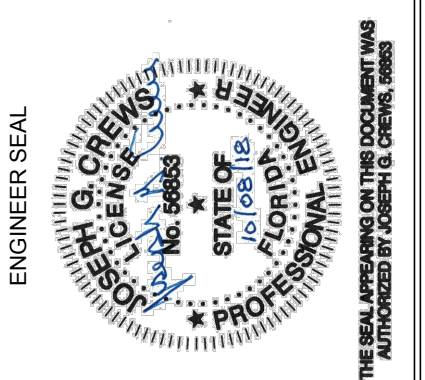
TYPICAL EXTERIOR PIPE / VALVE SUPPORT ON GRADE
DETAIL (D)
 SCALE: NONE

PIPE SIZE	"A"	"B"	"C"	"D"	"E" MIN.	"E" MAX.
3"	2"	4 1/4"	8"	1 1/2"	8 1/2"	13 1/4"
4"	2"	4 1/2"	8"	1 1/2"	9 3/4"	14 1/2"
6"	3"	5 1/2"	9"	2 1/2"	10 1/2"	15 1/4"
8"	3"	6 7/8"	9"	2 1/2"	11 3/4"	16 1/2"
10"	3"	8 1/2"	9"	2 1/2"	13 1/2"	18 1/4"
12"	3"	9 15/16"	9"	2 1/2"	15"	19 3/4"
14"	4"	10 15/16"	11"	3"	16 1/4"	20 3/4"
16"	4"	12 3/8"	11"	3"	17 3/4"	22 1/4"
18"	6"	13 7/8"	13 1/2"	3 1/2"	19 1/2"	24"
20"	6"	15 3/8"	13 1/2"	3 1/2"	21"	25 1/2"
24"	6"	17 15/16"	13 1/2"	4"	23 3/4"	28 1/4"
30"	6"	21 5/16"	13 1/2"	4"	27"	31 1/2"
32"	6"	22 1/2"	13 1/2"	4"	28 1/4"	32 3/4"
36"	6"	24 1/2"	13 1/2"	4"	30 1/4"	34 3/4"

- NOTES:**
1. PROVIDE HALF ROUND RIGID INSULATION & INSULATION PROTECTION SHIELD.
 2. PROVIDE NEOPRENE WAFFLE ISOLATION PAD UNDER SUPPORT FOOT WHEN PIPING IS ISOLATED OR SUPPORT IS ADJACENT TO MECHANICAL EQUIPMENT.
 3. FOR BASE, HEIGHT, AND FLANGE DIMENSIONS, SEE TABLE.
 4. PIPE SUPPORT TO BE PAINTED SAME AS PIPING.



3" THRU 36" PIPE SUPPORT DETAIL (E)
 NO SCALE



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REVISION	BY:	APPROVED BY:	JK
TCG	JK	JK	JK

PIPE SUPPORT DETAILS
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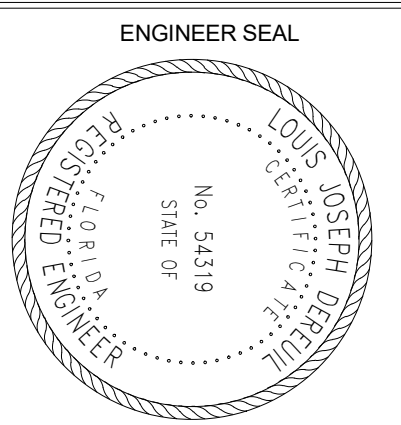
100 GENERAL NOTES

- 101 THESE DRAWINGS ADDRESS ONLY THE STRUCTURAL DESIGN OF THE STRUCTURE. THE DIMENSIONAL LAYOUT OF THE STRUCTURE HAS BEEN DICTATED TO JOE DEREUIL ASSOCIATES IN ORDER TO PRODUCE STRUCTURAL DESIGN DOCUMENTS. NO REPRESENTATION IS MADE REGARDING CODE COMPLIANCE OF NON-STRUCTURAL ASPECTS OF THE STRUCTURE.
- 102 ALL CONSTRUCTION SHALL CONFORM TO THE FLORIDA BUILDING CODE, LATEST EDITION.
- 103 WIND LOADS - ALL STRUCTURES HAVE BEEN DESIGNED TO CONFORM TO THE WIND PROVISIONS OF ASCE 7-16. DESIGN DATA IS AS FOLLOWS:
 - A. BASIC WIND SPEED = 160 MPH
 - C. BLDG CATEGORY = ESSENTIAL USE FACILITY, CATEGORY III
 - D. WIND EXPOSURE CATEGORY = C
 - E. INTERNAL PRESSURE COEFFICIENT = (N/A)
 - F. COMPONENT & CLADDING WIND PRESSURE (UNTIMATED):
 - 32-PSF FOR FREESTANDING WALLS & SOLID SIGNS
 - 7-1-PSF FOR CHIMNEYS, TANKS & SIMILAR STRUCTURES
- 104 TANKAGE DESIGN: DESIGN OF TANKAGE IS GOVERNED BY HYDROSTATIC & EARTH PRESSURES. WIND DESIGN DOES NOT GOVERN, EXCEPT FOR THE BATTLE WALLS IN THE DISINFECTION BASIN. DURING AN EMPTY TANK AND HURRICANE WIND EVENT SCENARIO, AND EVEN THEN THE MINIMUM REINFORCING REQUIREMENTS FOR SHRINKAGE GOVERN THE DESIGN. ACI 360 AND 318 WERE UTILIZED FOR TANKAGE DESIGN.
- 105 FILTERS EQUIPMENT SLAB DESIGN: FILTER EQUIPMENT LOADS WERE INCREASED BY FACTOR OF SAFETY OF 1.25 FOR DESIGN PURPOSES. ALSO, SEE NOTES BELOW FOR WALKWAY/STAIR DESIGN LOADING INFO. SOIL BEARING PRESSURES BELOW FILTER SUPPORT SLAB ARE ASSUMED TO BE LESS THAN 1500-PSF.
- 106 DESIGN GRAVITY LOADS ARE AS FOLLOWS:
 - A. SUPERIMPOSED UNIFORM LIVE LOADS AT PUMPSTATION TOP SLAB: 100 PSF (UNREDUCIBLE)
 - B. ELEVATED NON-FERROUS (ALUMINUM) WALKWAYS, STAIRS, ETC.: 100-PSF, EXCEPT SEE SPEC 05700 FOR OTHER SPECIAL LOADING
 - C. HANDRAILS (SEE SPECS)
 - D. EFFLUENT PUMPSTATION PUMPS & ASSEMBLY WHICH ARE SUPPORTED BY THE TOP LID OF THE TANK WERE EACH ASSUMED TO WEIGH NO MORE THAN 7000-LBS. ALSO, 3.3 FT-KIP MOMENT IN VERTICAL PLANE WAS DESIGNED FOR.
- 107 TANKAGE (MORSE CASE) LOADING CONDITIONS
 - A. TOTALLY OPEN EXCAVATION, FULL WATER TIGHTNESS TEST TO 4-INCHES FROM TOP OF WALL (OPEN TOP)
 - B. BACKFILL COMPLETE, EMPTY TANK (OPEN TOP)
 - C. ABOVE CONDITIONS WITH ONE OF TWO HYDROSTATIC TRANS FULL OR EMPTY
 - D. ABOVE CONDITIONS WITH TOP ON (AT PUMPSTATION)
 - E. EMPTY TANK, HURRICANE WIND EVENT (FOR BATTLE WALLS IN DISINFECTION BASIN)
- 108 DRAWINGS SHOW TYPICAL AND CERTAIN SPECIFIC CONDITIONS ONLY. FOR DETAILS NOT SPECIFICALLY SHOWN, PROVIDE DETAILS SIMILAR TO THOSE SHOWN.
- 109 VERIFY ALL EXISTING CONDITIONS, DIMENSIONS AND ELEVATIONS BEFORE STARTING WORK. NOTIFY STRUCTURAL ENGINEER OF ANY DISCREPANCY.
- 110 THE DESIGN, ADEQUACY, AND SAFETY OF ERECTION BRACING, SHORING, TEMPORARY SUPPORTS, ETC., ARE THE SOLE RESPONSIBILITY OF THE CONTRACTOR. REFER TO PROJECT SPECIFICATIONS FOR DELEGATED DESIGNER RESPONSIBILITIES.
- 111 COORDINATE STRUCTURAL CONTRACT DOCUMENTS WITH MECHANICAL, ELECTRICAL, PLUMBING AND CIVIL. NOTIFY STRUCTURAL ENGINEER OF ANY CONFLICT AND/OR OMISSION. CONTRACTOR SHALL MAKE NO DEVIATION FROM DESIGN DRAWINGS WITHOUT WRITTEN APPROVAL OF THE ENGINEER. FOR ADDITIONAL OPENINGS NOT SHOWN ON THE STRUCTURAL DRAWINGS, SEE MECHANICAL, ELECTRICAL, AND PLUMBING DRAWINGS.
- 112 REVIEW OF SUBMITTALS AND/OR SHOP DRAWINGS BY THE STRUCTURAL ENGINEER DOES NOT BELIEVE THE CONTRACTOR OF THE RESPONSIBILITY TO REVIEW AND CHECK SHOP DRAWINGS BEFORE SUBMITTAL TO THE STRUCTURAL ENGINEER. THE CONTRACTOR REMAINS SOLELY RESPONSIBLE FOR ERRORS AND OMISSIONS ASSOCIATED WITH THE PREPARATION OF SHOP DRAWINGS AS THEY PERTAIN TO MEMBER SIZES, DETAILS, AND DIMENSIONS SPECIFIED IN THE CONTRACT DOCUMENTS.
- 113 CONTRACTOR IS ALSO RESPONSIBLE FOR MEANS, METHODS, TECHNIQUES, SEQUENCES, AND PROCEDURES OF CONSTRUCTION.

200 FOUNDATIONS AND SLAB-ON-GRADE

- 201 THE DESIGN OF FOUNDATIONS, RETAINING WALLS AND SLAB ON GRADE IS BASED ON THE CRITERIA ESTABLISHED IN THE GEOTECHNICAL REPORT BY [] A PROJECT SPECIFIC INVESTIGATION WAS NOT COMMISSIONED BY THE OWNER NOR CONSTANTINE ENGINEERING [].
- 202 TANKAGE FOUNDATIONS HAVE BEEN DESIGNED FOR AN ASSUMED ALLOWABLE SOIL BEARING PRESSURE OF 2000 PSF. THIS MUST BE VERIFIED BY A QUALIFIED GEOTECHNICAL ENGINEER. CONTRACTOR TO COMMISSION SERVICES OF GEOTECHNICAL ENGINEER AFTERED AWARD TO CONFIRM THE ASSUMED ALLOWABLE BEARING PRESSURE. CONTRACTOR TO FOLLOW RECOMMENDATIONS OF GEOTECHNICAL ENGINEER TO ACHIEVE REQUIRED ALLOWABLE SOIL BEARING PRESSURE AT NO ADDITIONAL COST TO OWNER.
- 203 A QUALIFIED GEOTECHNICAL ENGINEER SHALL VERIFY CONDITION AND/OR ADEQUACY OF ALL SUBGRADES, FILLS AND BACKFILLS BEFORE PLACEMENT OF FOUNDATIONS, FOOTINGS, SLABS, WALLS, FILLS, BACKFILLS, ETC. SHOULD THE CONTRACTOR FIND UNSUITABLE SOILS, HE SHALL STOP WORK AND IMMEDIATELY CONTACT THE ENGINEER. ALL FOOTINGS SHALL REST EITHER ON UNDISTURBED SOIL OR A MANUALLY OPERATED VIBRATORY SLED OR TAMPER SHOULD BE USED TO DENSIFY ANY SOILS IN THE BOTTOM OF THE TRENCHES LOOSELY DURING THE EXCAVATION OPERATION.
- 204 SIDES OF FOUNDATIONS SHALL BE FORMED.
- 205 CONTRACTOR IS RESPONSIBLE FOR ADEQUATELY PROTECTING ALL EXCAVATION SLOPES.
- 206 DEWATER TO AT LEAST TWO FEET BELOW BOTTOM OF LOWEST FOUNDATION IF GROUNDWATER IS ENCOUNTERED.
- 207 LAP ALL WELDED WIRE FABRIC (MESH) 8".
- 300 REINFORCED CONCRETE
 - 301 ALL CONCRETE WORK SHALL CONFORM TO ACI 301, SPECIFICATIONS FOR STRUCTURAL CONCRETE FOR BUILDINGS, DESIGN IS BASED ON ACI 318, BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE AND ACI 360, ENVIRONMENTAL ENGINEERING CONCRETE STRUCTURES. DETAIL CONCRETE REINFORCEMENT AND ACCESSORIES IN ACCORDANCE WITH ACI 315, DETAILING MANUAL.
 - 302 REFERENCE SPECIFICATION SECTIONS 03301.4 & 03302 FOR MINIMUM 28 DAY COMPRESSIVE STRENGTHS. THE PROPOSED MATERIALS AND MIX DESIGN SHALL BE REVIEWED BY THE ENGINEER.
 - 303 PROVIDE CONTINUOUS REINFORCEMENT WHEREVER POSSIBLE. SPLICE ONLY AS SHOWN OR APPROVED. STAGGER SPLICE WHERE POSSIBLE. DOWELS SHALL MATCH THE SIZE AND SPACING OF THE SPECIFIED REINFORCEMENT AND SHALL BE LAPPED WITH FULL TENSION SPLICES (CLASS "B") UNLESS NOTED OTHERWISE. TERMINATE BARS WITH STANDARD HOOKS.
 - 304 REINFORCING STEEL SHALL HAVE 3-INCHES OF CONCRETE COVER FOR ALL CONDITIONS, LOCATIONS, AND STRUCTURES, UNLESS NOTED OTHERWISE. SLABS ON GRADE WHICH ARE NOT PART OF TANKAGE STRUCTURES MAY HAVE NO LESS THAN 2" OF CONCRETE COVER TO THEIR TOP (WALKING) SURFACE.
 - 305 DO NOT PLACE CONDUITS WITHIN ELEVATED SLABS WITHOUT PRIOR PERMISSION.
 - 306 ALL REINFORCING STEEL PLACEMENTS SHALL BE REVIEWED BY THE SPECIAL INSPECTOR OR HIS AUTHORIZED REPRESENTATIVE. THE CONTRACTOR SHALL PROVIDE 24 HOURS NOTICE PRIOR TO EACH CONCRETE POUR IN ORDER TO PERMIT INSPECTION OF THE PRE-POUR CONDITIONS.
 - 307 PROVIDE FOR AN ALLOWANCE OF 1% BY WEIGHT OF REINFORCING BARS TO BE FABRICATED, AND PLACED DURING PROGRESS OF WORK AS MAY BE DIRECTED BY THE STRUCTURAL ENGINEER, IN ADDITION TO ALL THE STEEL INDICATED ON THE DRAWINGS.
 - 308 FOR OTHER CONCRETE PADS SEE MECHANICAL AND ELECTRICAL DRAWINGS.
- 500 ALUMINUM (NON-FERROUS METALS)
 - 501 STRUCTURAL ALUMINUM SHAPES AND FABRICATIONS FOR ELEVATED WALKWAY FRAMING AND SUPPORT: REFERENCE SPEC. 05700
 - 502 STAIRS, LANDINGS, & PLATFORMS: REFERENCE SPEC. 05700
 - 503 PPE AND TUBE HANDRAILS AND RAILING SYSTEMS: REFERENCE SPEC. 05700
 - 504 ANCHORS FOR ALL NON-FERROUS METAL FABRICATIONS SHALL BE TYPE 316 STAINLESS STEEL, PER SPEC 05700.

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GENERAL NOTES

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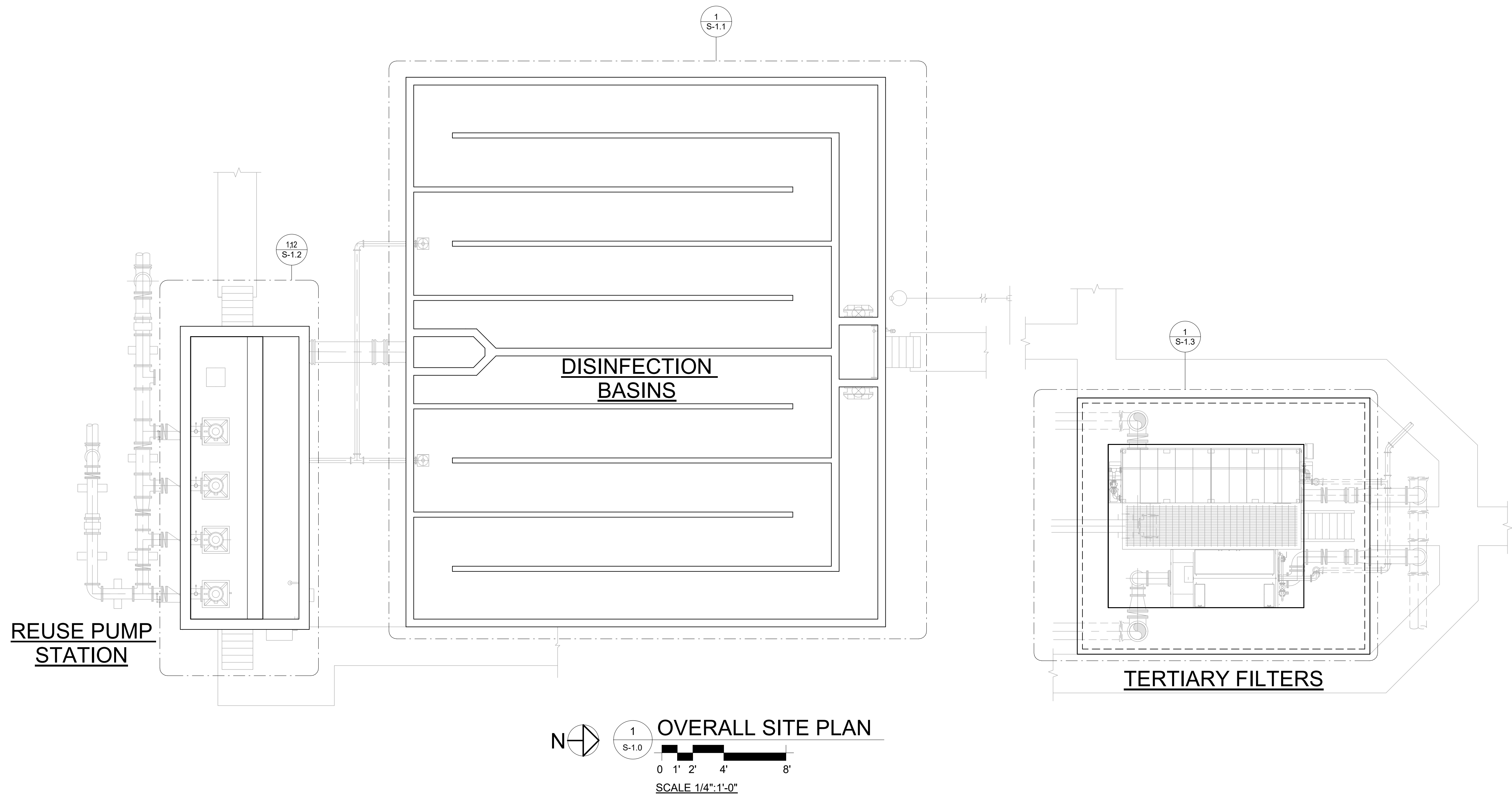
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	JLM	WEC	LJD	LJD	

1988 LEWIS TURNER BLVD.
 FORT WALTON BEACH, FL 32547
 PH. 850-244-5800
 FL. CERTIFICATE OF AUTHORIZATION # 9816

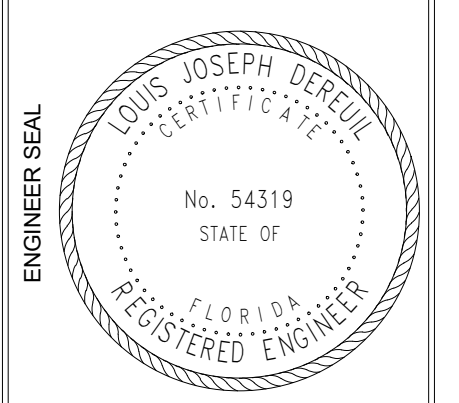


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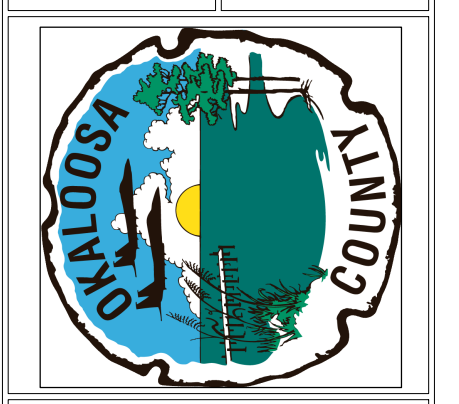


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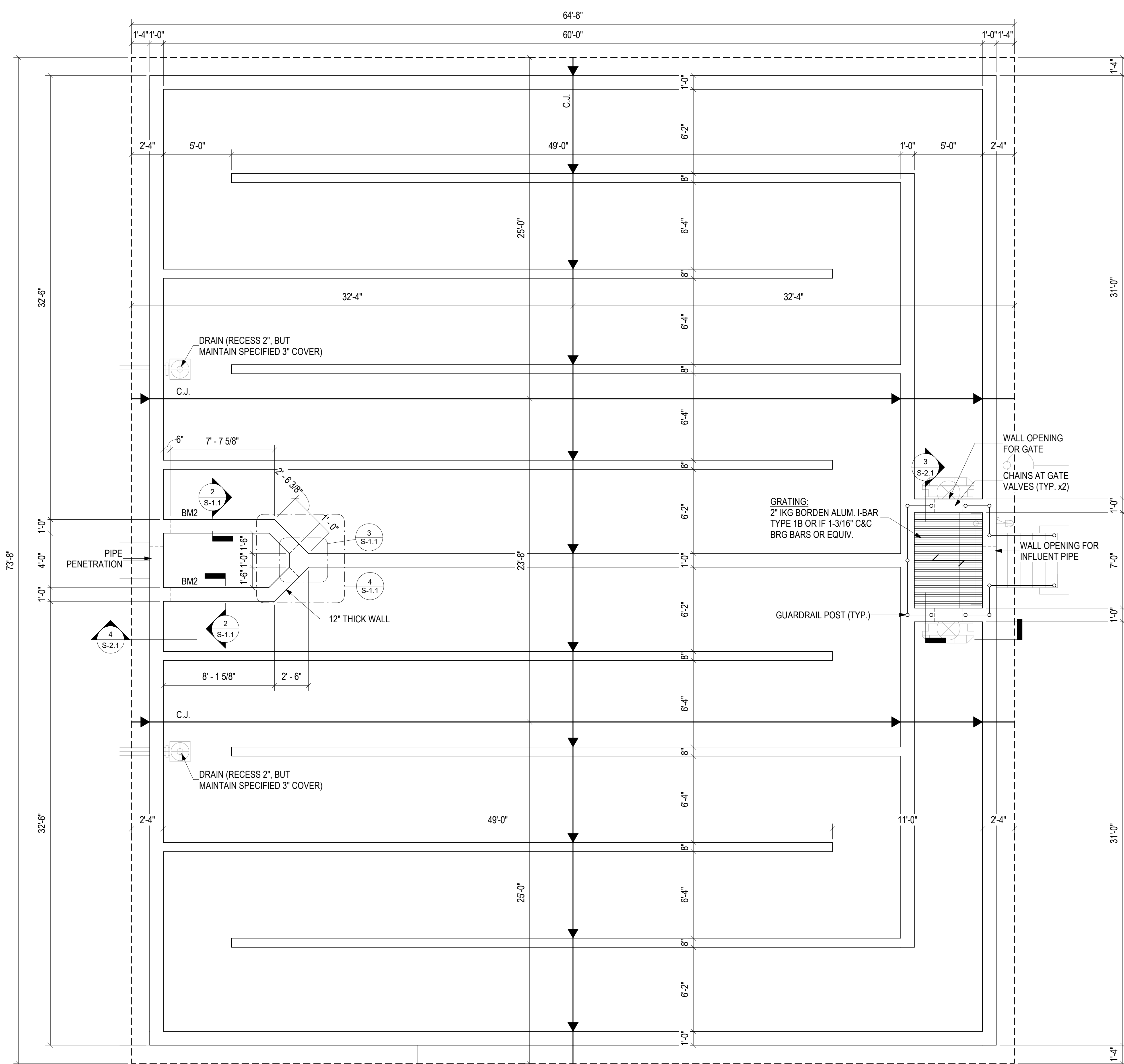
OVERALL PLAN
OCWS APWRF RECLAIM EXPANSION



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 1988 LEWIS TURNER BLVD.
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 FL CERTIFICATE OF AUTHORIZATION # 9816

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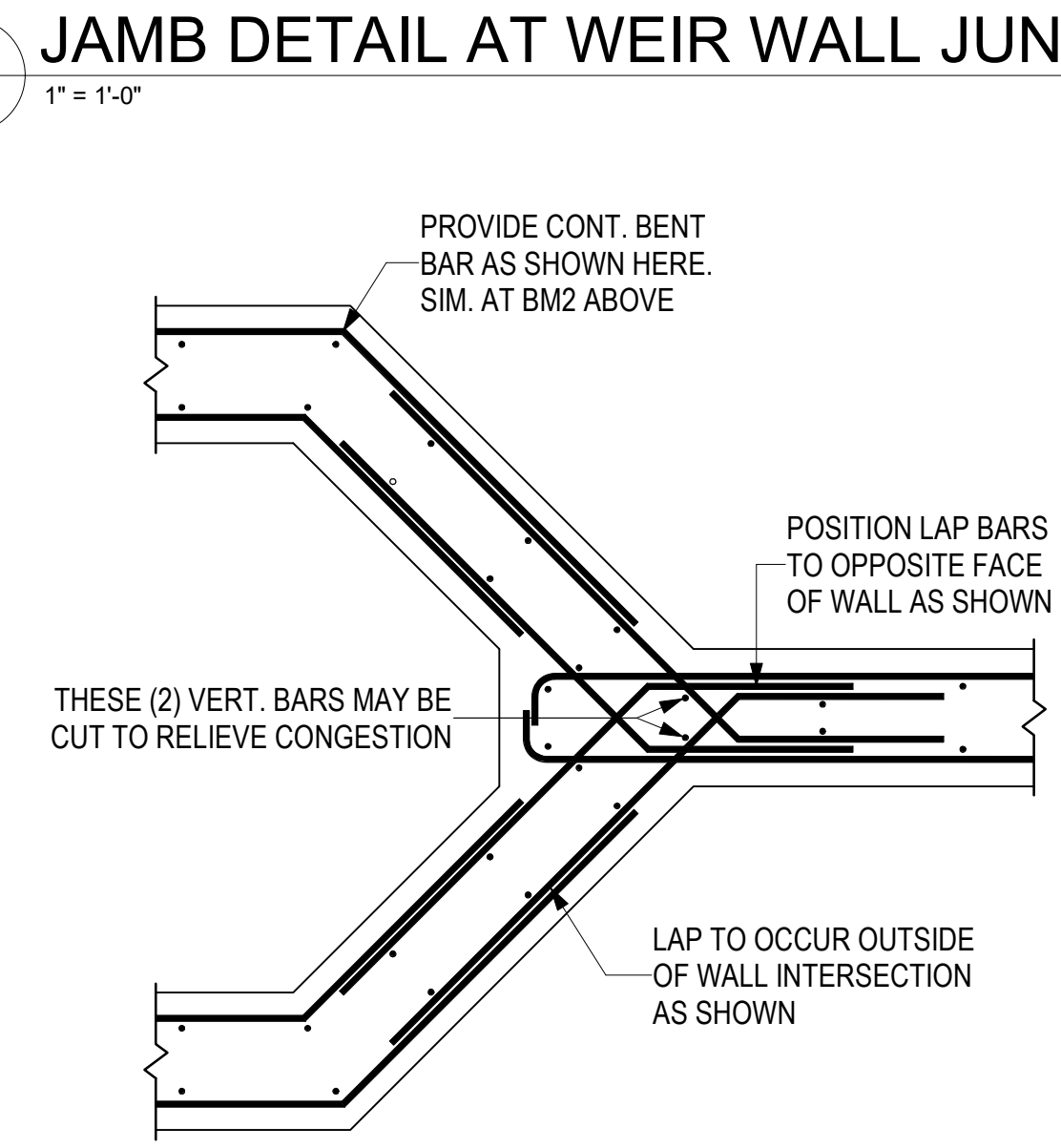
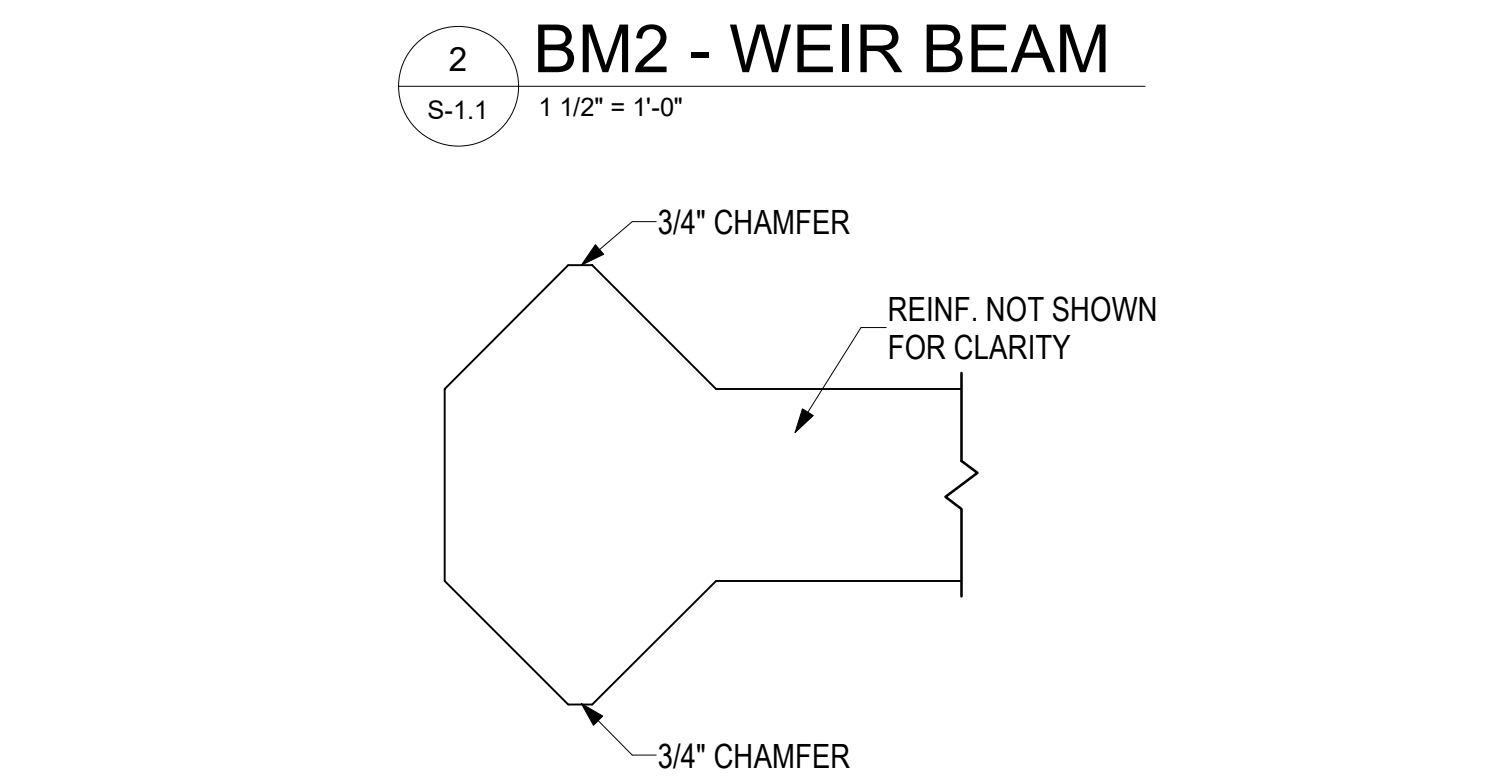
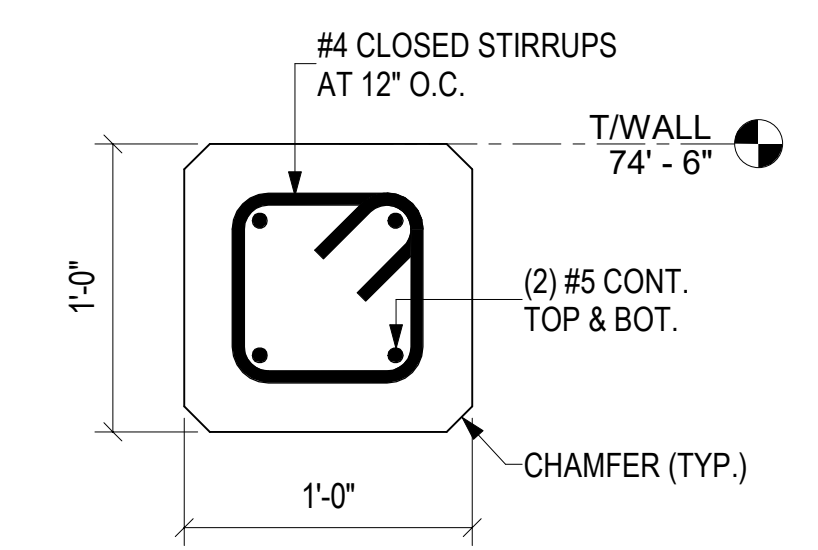
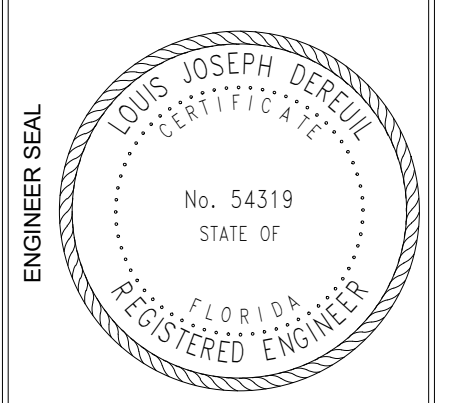
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1 DISINFECTION BASIN
 SCALE 1/4" = 1'-0"

LEGEND
 C.J. = TANKAGE SLAB CONSTRUCTION JOINT, SEE DETAIL 6/S-5.1
 W.C.J. = WALL CONTROL JOINT, SEE DETAILS 8 & 9/S-5.1
 BM2 = SEE DETAIL THIS SHEET

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COATINGS & WATERPROOFING:
 APPLY CEMENTITIOUS & BITUMINOUS COATINGS TO TANKAGE PER SPECIFICATIONS 09981 & 07115 RESPECTIVELY. ALL TANKAGE CONCRETE SHALL CONTAIN CRYSTALLINE WATERPROOFING ADMIX AS PER SPECIFICATION 07164 INCLUDING FOUNDATION SLABS, WALLS, TOP SLABS, & BEAMS.

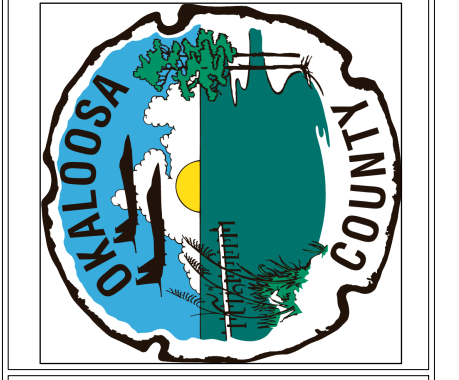
FLOTATION NOTE:
 HIGH GROUND WATER OF 4'-0" BELOW GRADE (OR 2'-0" ABOVE BASIN FLOOR SLAB) CAN SAFELY BE RESISTED, W/O NEED FOR PRESSURE RELIEF VALVES

SLAB REINFORCEMENT & THICKNESS:
 SLAB TO BE 16" THICK & REINF. W/ #6 @ 12" O.C. TOP & BOT., PROVIDE 90 DEG. HOOKS AT EDGES & JOINTS

WALL REINFORCEMENT:
 - ALL 8" WALLS TO HAVE ONE LAYER OF #5 AT 8" O.C. CENTERED IN WALL. DOWELS MATCH VERTS.
 - ALL 12" WALL TO HAVE TWO LAYERS OF #5 AT 8" O.C. E.W. W/ #6 AT 8" O.C. VERT. DOWELS.

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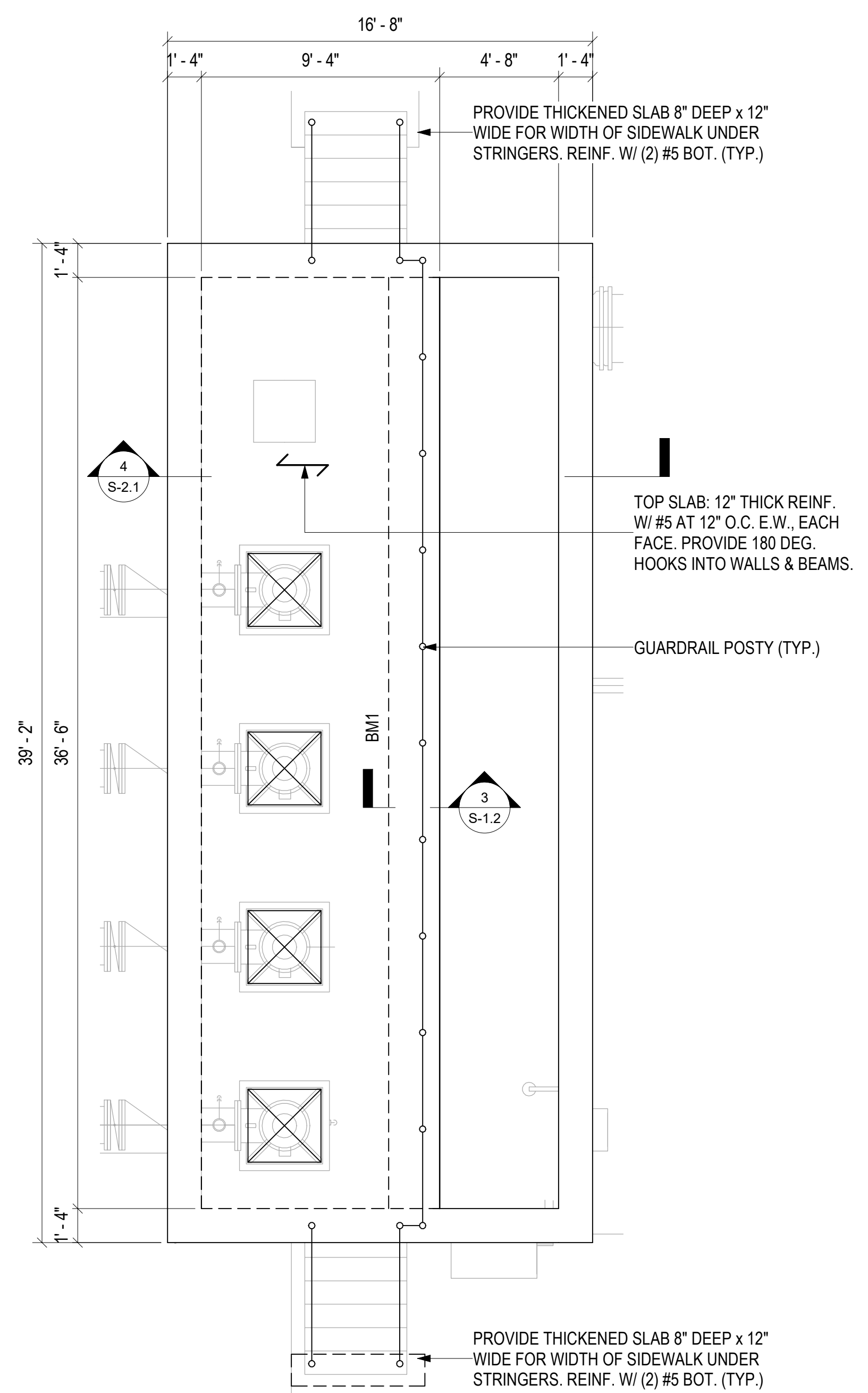
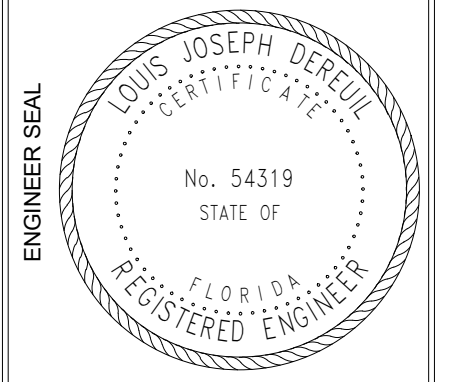
DISINFECTION BASIN PLAN
OCWS APWRF RECLAIM EXPANSION



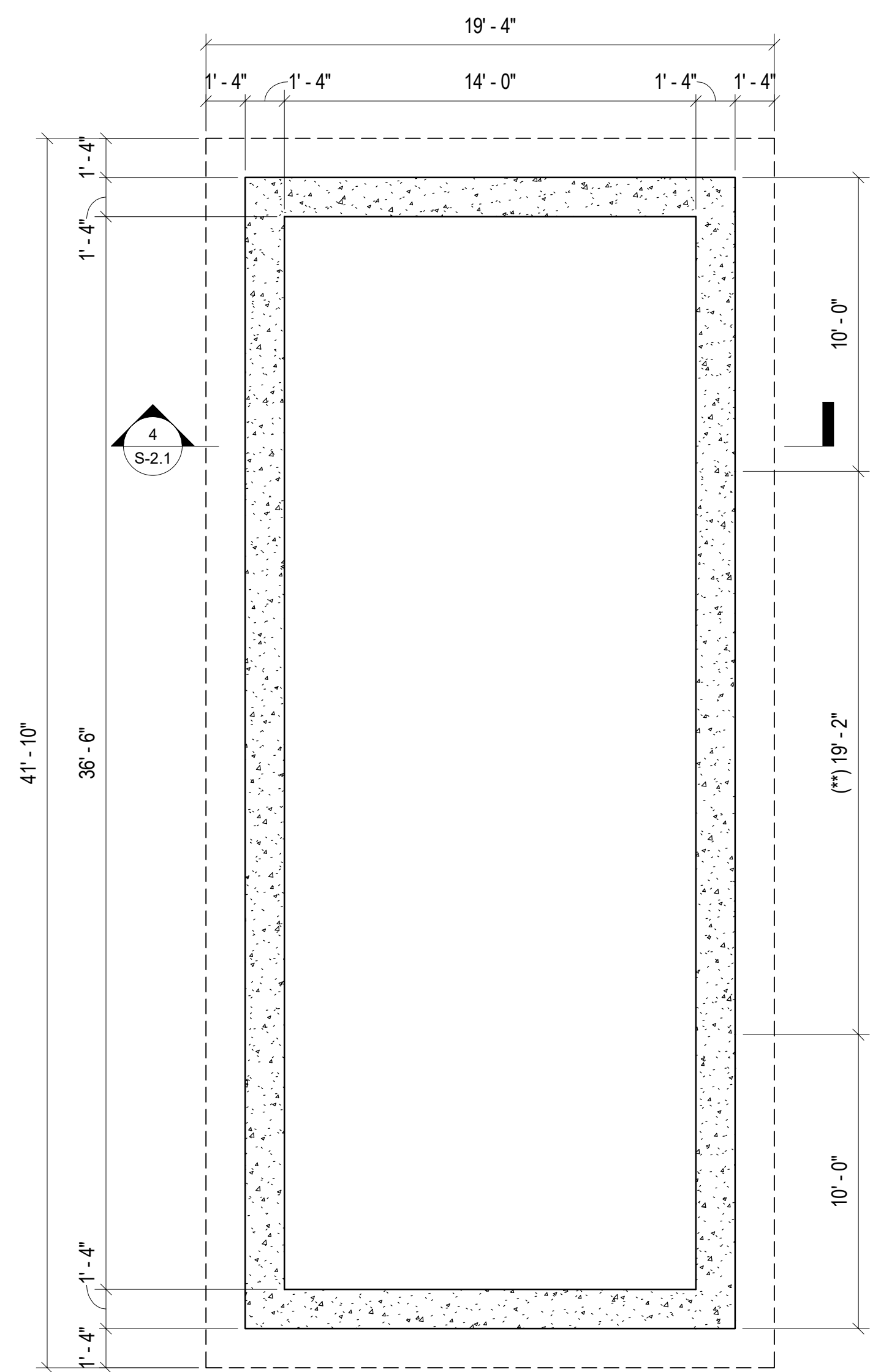
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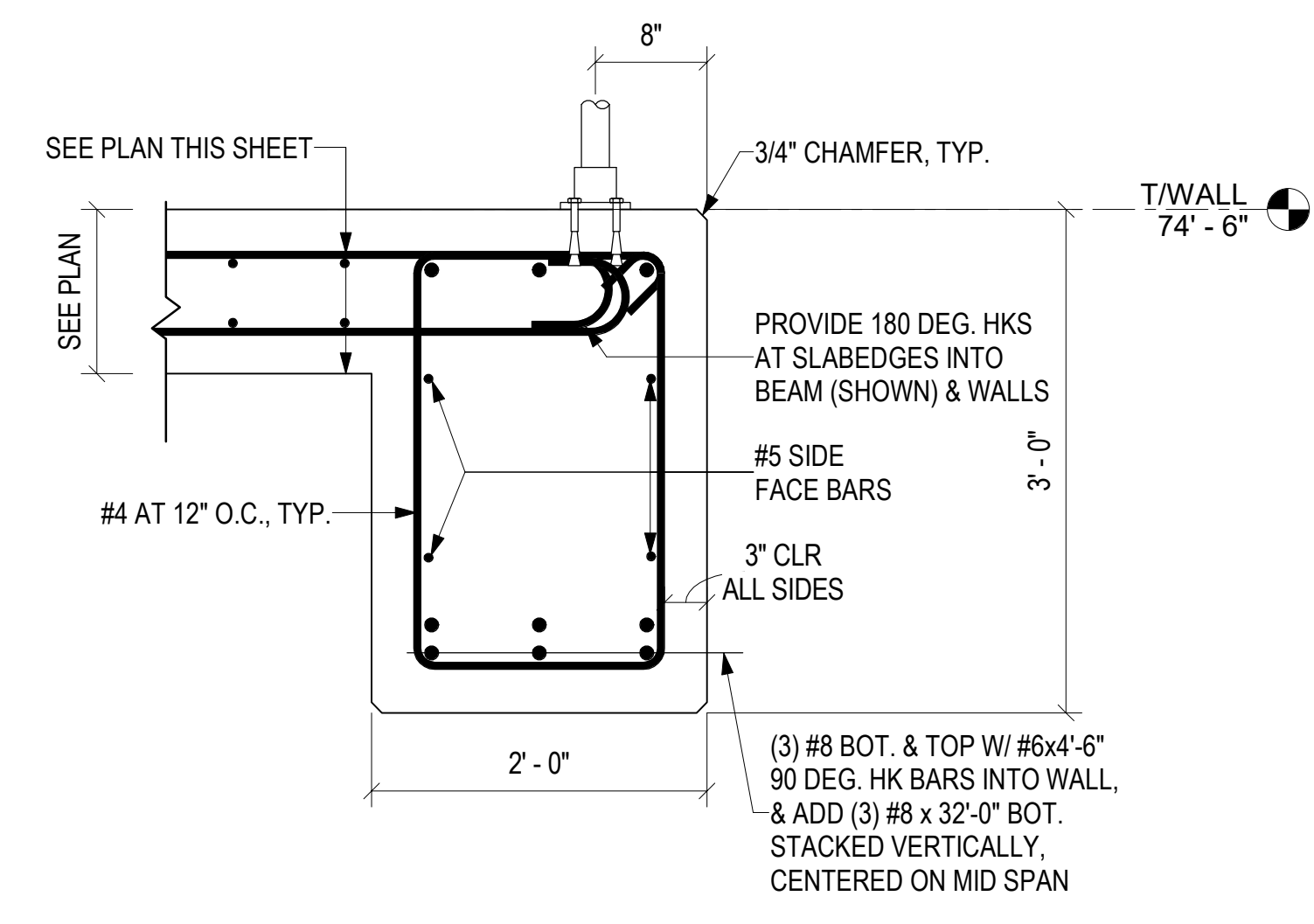
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1 PUMP STATION TOP OF SLAB/WALL PLAN
 SCALE 1/4"=1'-0"
 Includes north arrow and graphic scale (0, 1, 2, 4, 8 feet).



2 PUMP STATION TOP OF FOUNDATION
 SCALE 1/4"=1'-0"
 Includes north arrow and graphic scale (0, 1, 2, 4, 8 feet).



3 BM1 DETAIL
 1" = 1'-0"

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LEGEND
 BM1 = CONC. BEAM, SEE 3/S-1.2

FOUNDATION SLAB INFO:
 PROVIDE 16" THICK SLAB W/ #6 AT 8" O.C. E.W., TOP & BOT. W/ 90 DEG. HOOKS AT SLAB EDGES

WALL REINFORCEMENT:
 -PROVIDE #6 AT 8" O.C. DOWELS TYPICALLY EACH FACE & #5 AT 8" O.C. ADDITIONAL DOWELS EACH FACE. ADDITIONAL DOWELS TO ONLY BE LOCATED AT (**) AREAS, OR THE 19'-2" LENGTH OF EACH OF THE NORTH & SOUTH WALLS.
 -PROVIDE #6 AT 8" O.C. E.W., EACH FACE, IN ALL WALLS.

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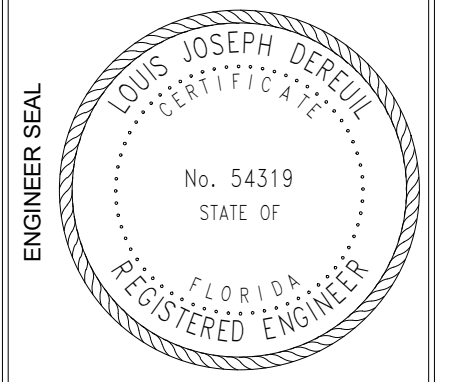
PUMP STATION PLAN
OCWS APWRF RECLAIM EXPANSION



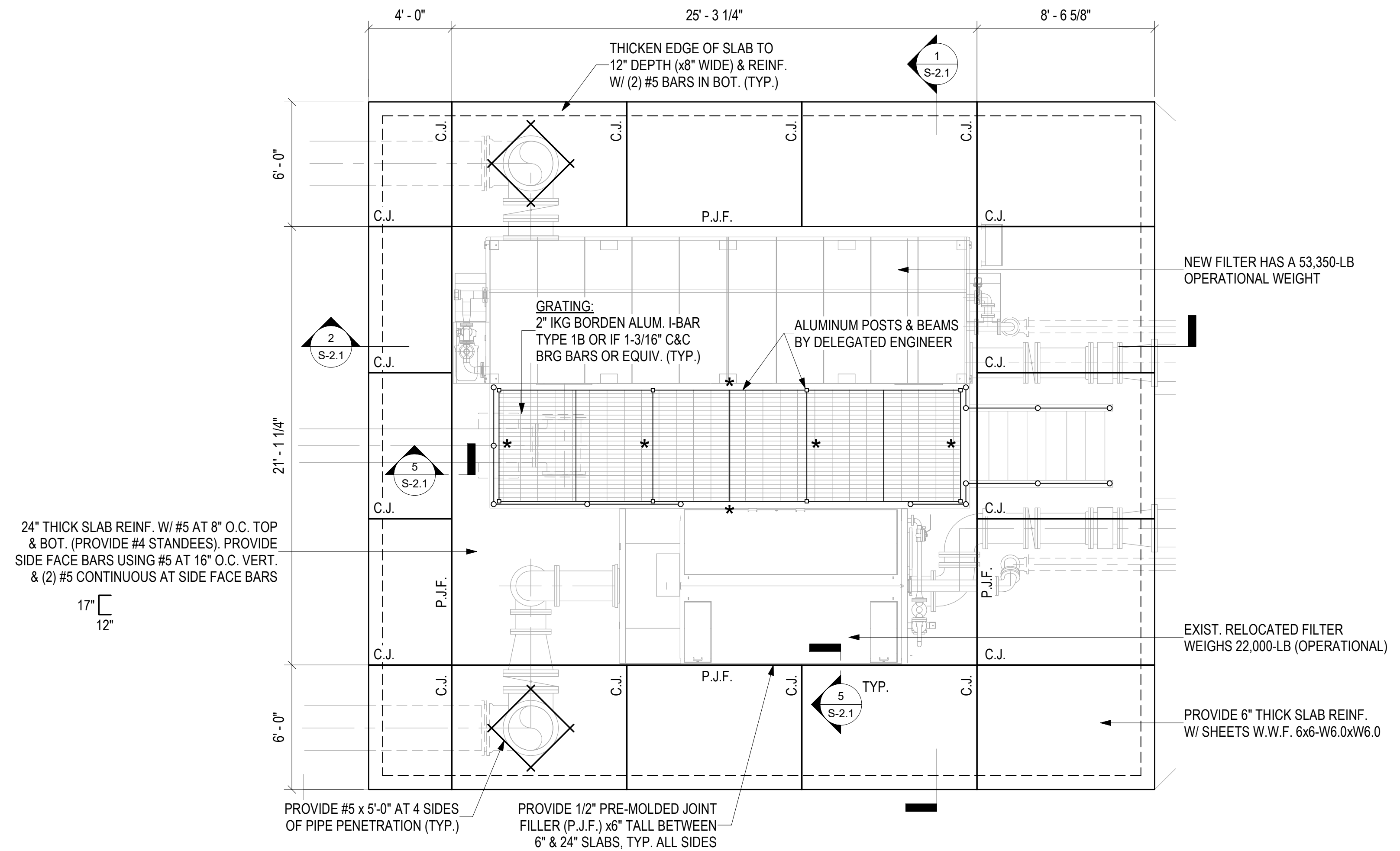
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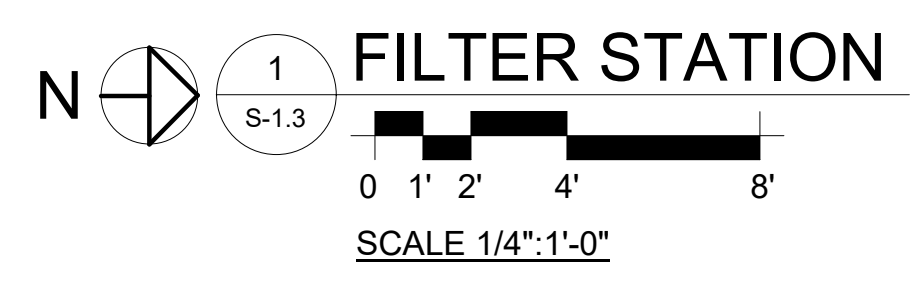


LEGEND
 C.J. = CONSTRUCTION JOINT, SEE SLAB-ON-GRADE DETAIL 4/S-5.1
 * = PROVIDE DIAGONAL BRACING BETWEEN ALUMINUM POSTS
 —○— = ALUMINUM GUARDRAIL & POST LAYOUT AS SHOWN

NOTE:
 OMIT GUARDRAIL ALONG FILTER EQUIPMENT TO ALLOW ACCESS

NOTE:
 REFER TO PROJECT SPECIFICATION 05700 FOR ALUMINUM PLATFORM, STAIRS & GUARDRAIL DESIGN CRITERIA

SEE MECHANICAL FOR STAIR & PLATFORM OVERALL DIMENSIONS



FILTER STATION PLAN

OCWS APWRF RECLAIM EXPANSION

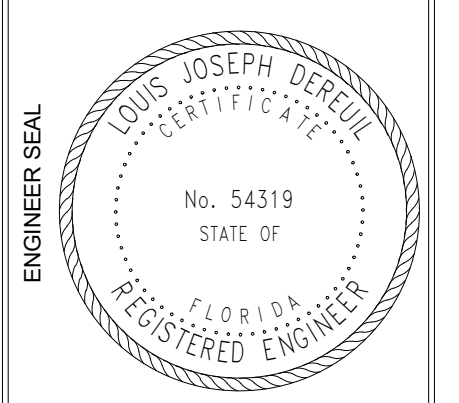


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 FORT WALTON BEACH, FL 32547
 PH: 850-244-5800
 FL CERTIFICATE OF AUTHORIZATION # 9816

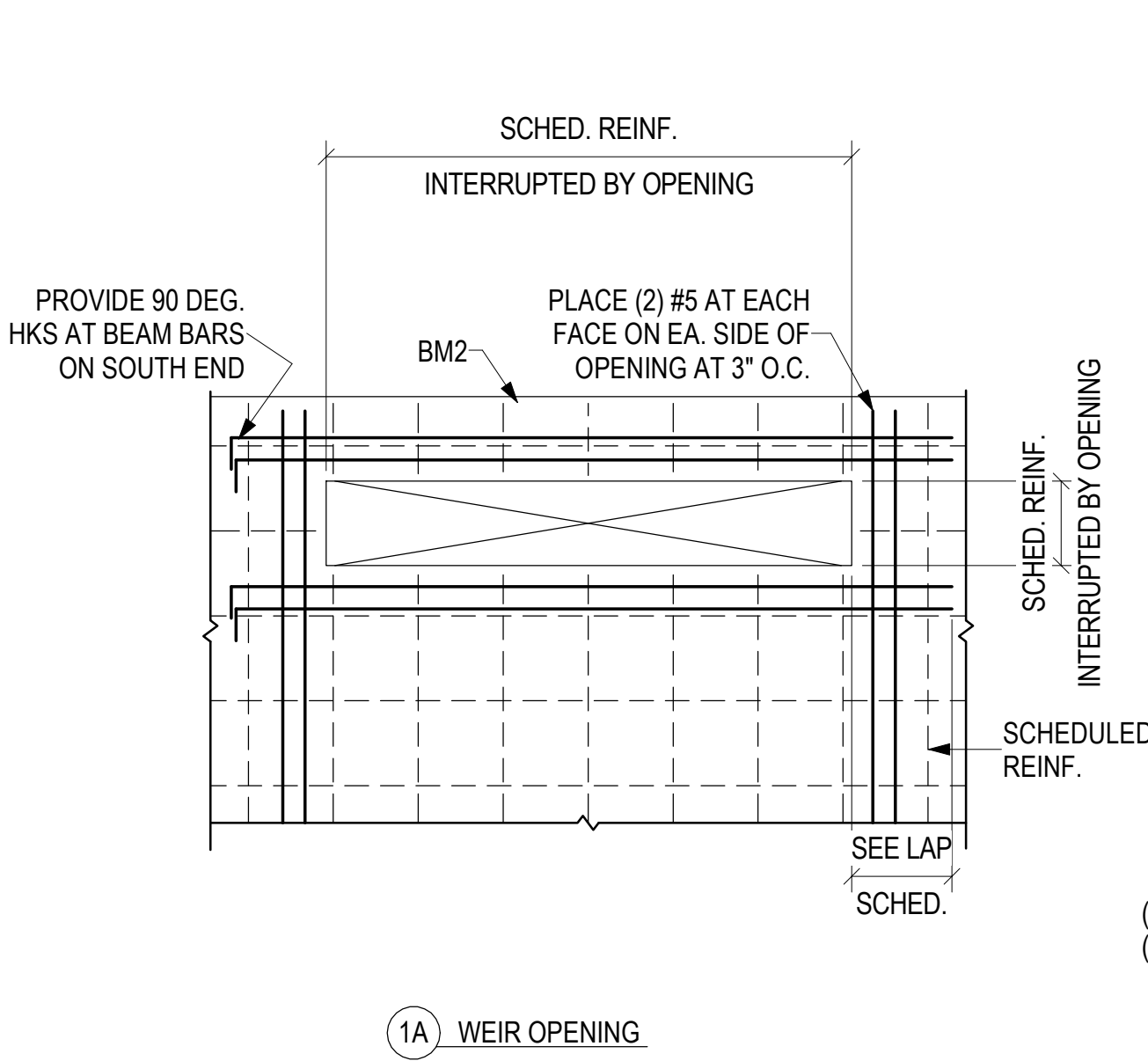
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DWG.	S-1.3

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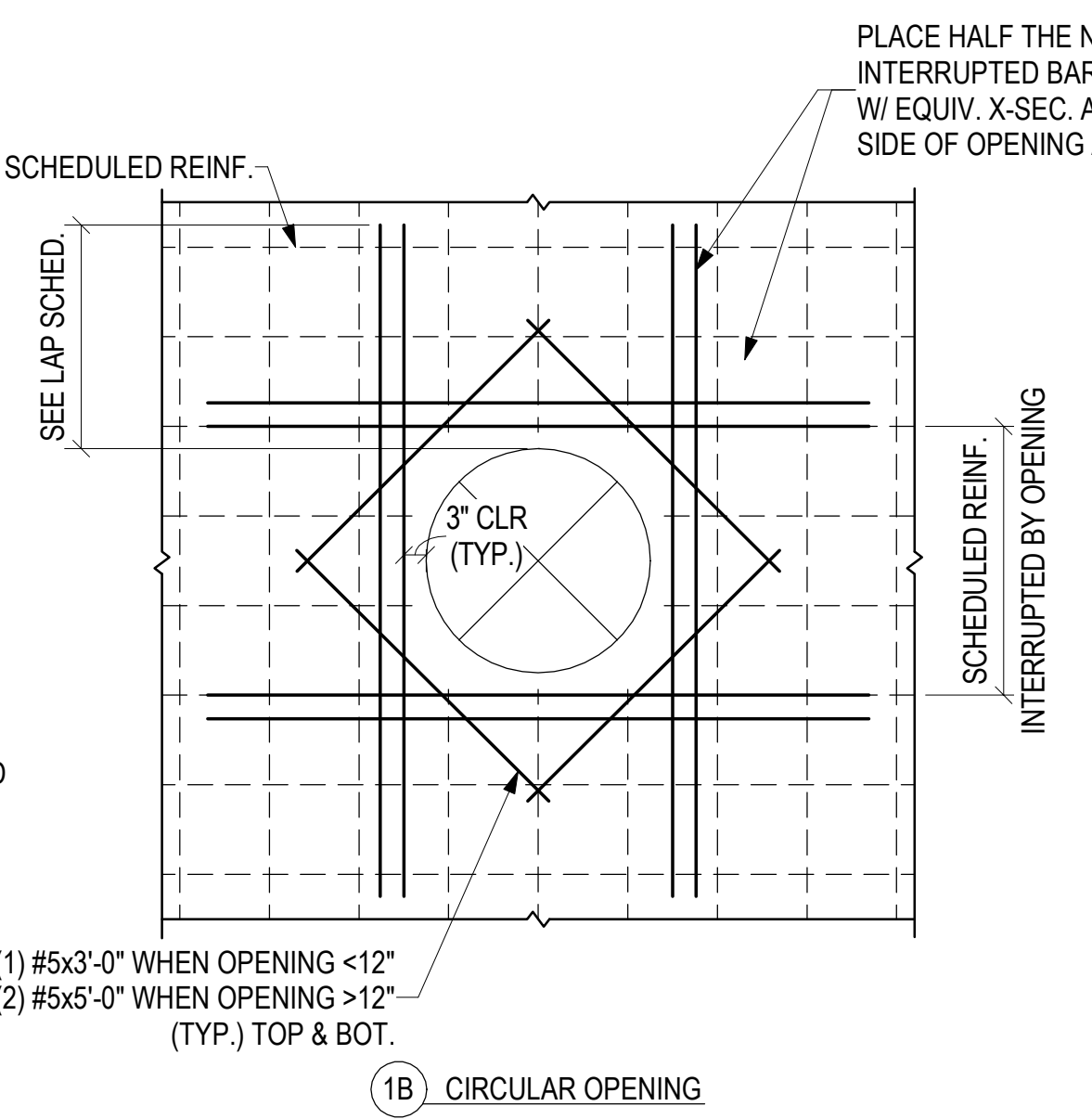
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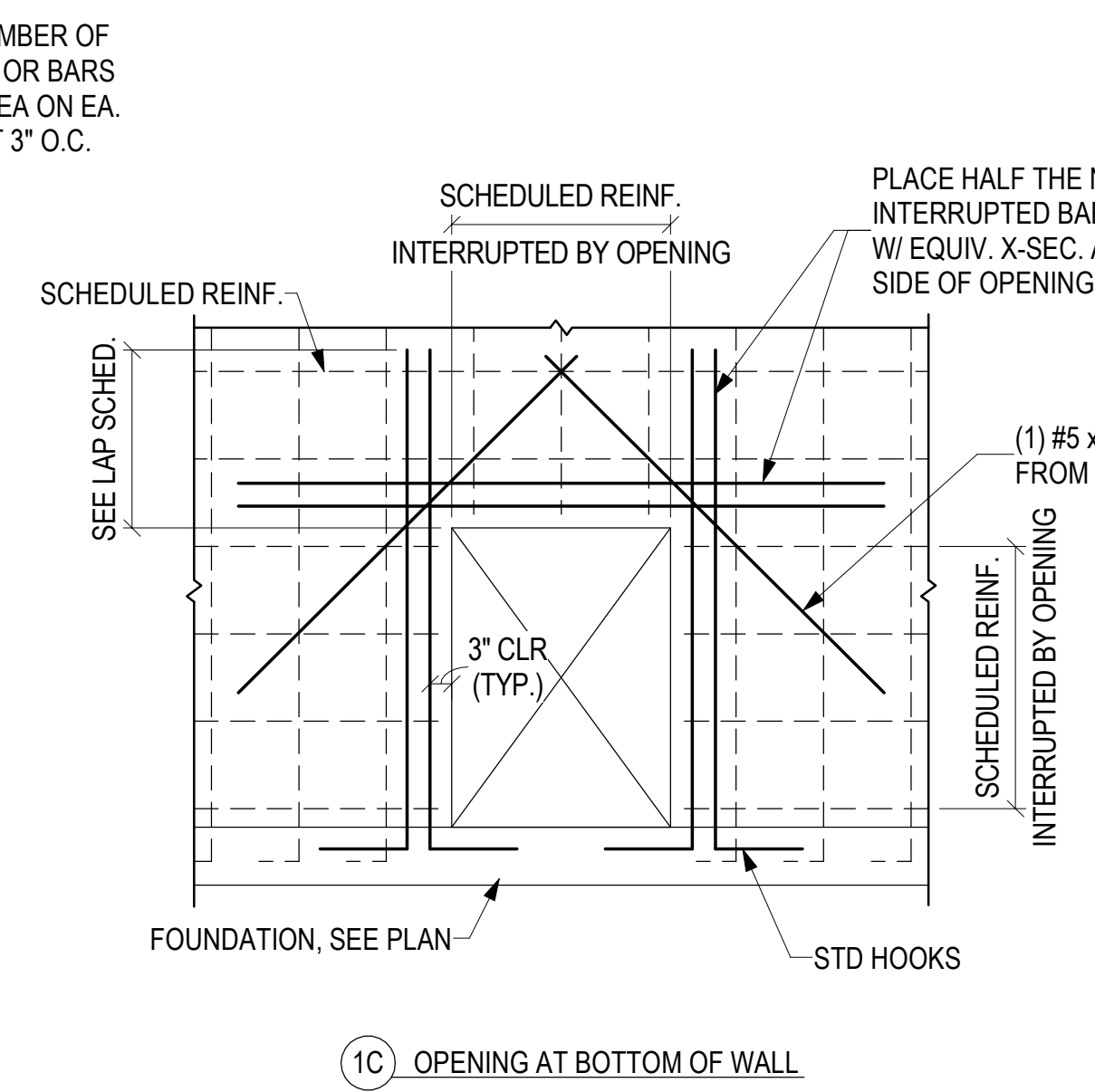
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1A WEIR OPENING

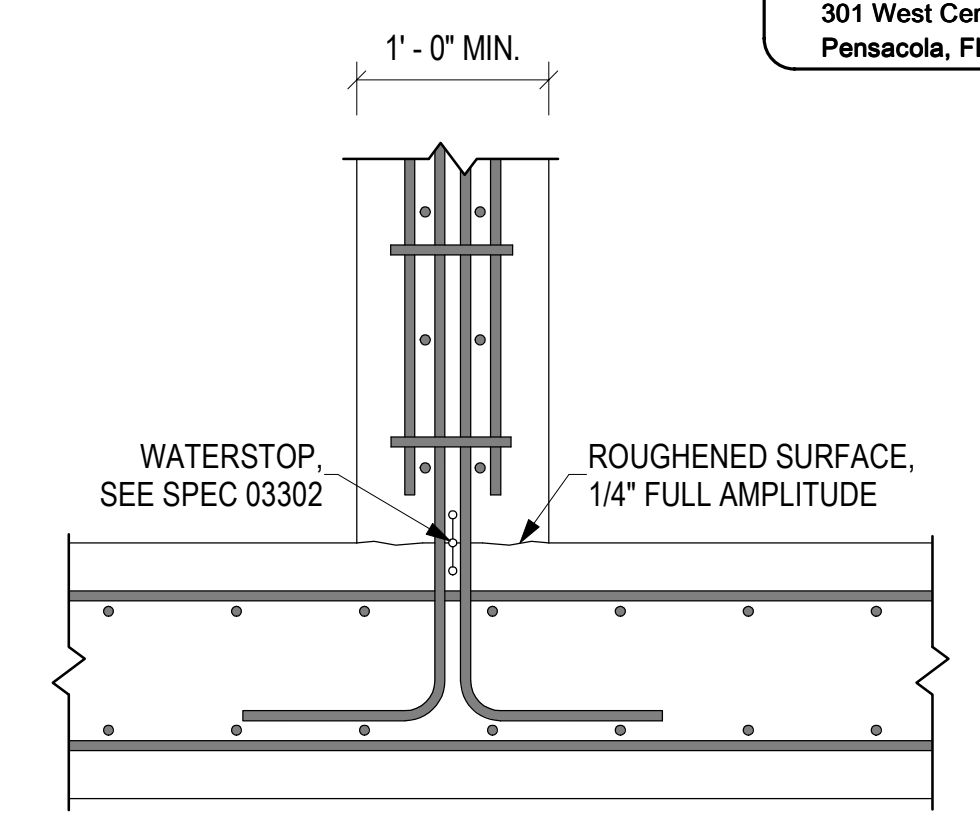


1B CIRCULAR OPENING



1C OPENING AT BOTTOM OF WALL

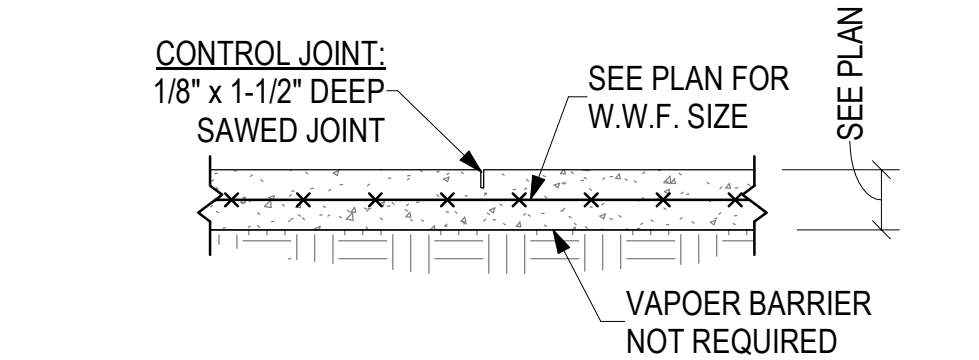
11 TYP. WALL BASE CONSTRUCTION JOINT
1" = 1'-0"



1 TYPICAL OPENING DETAILS
1/2" = 1'-0"

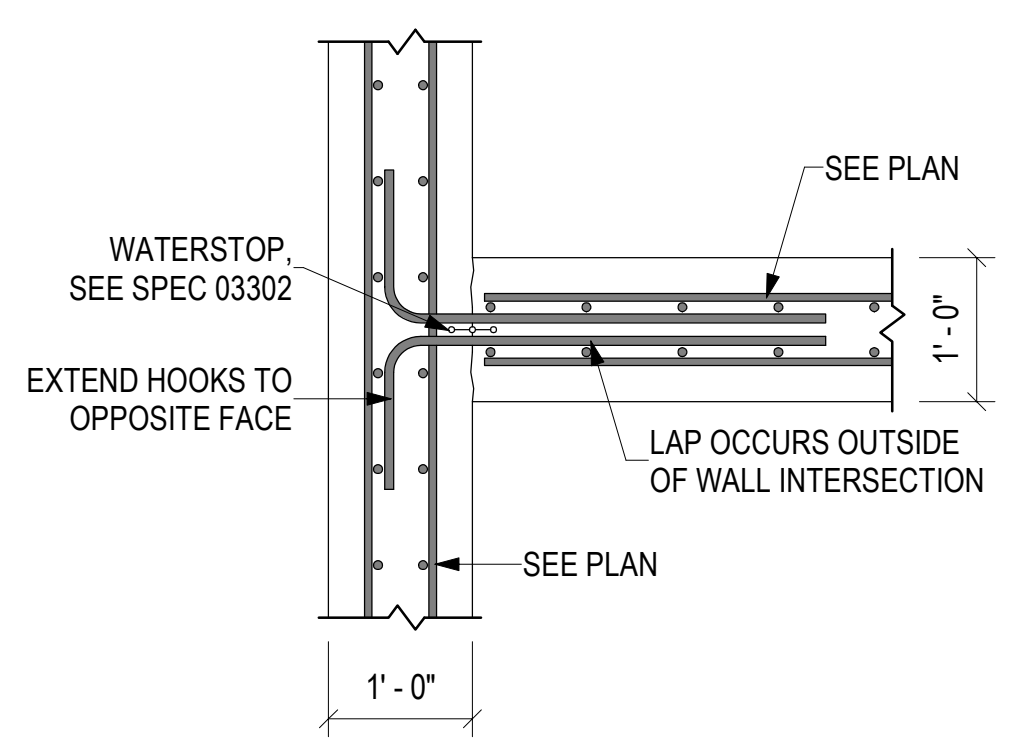
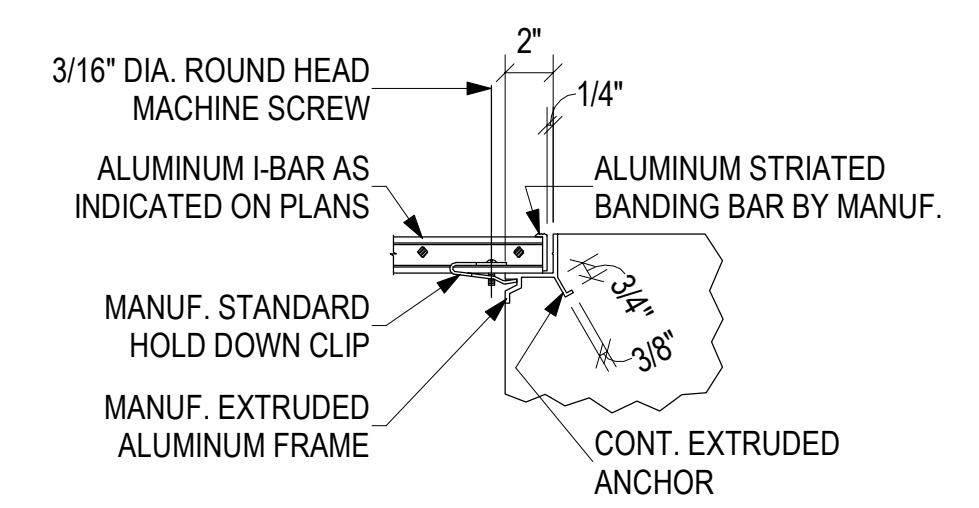
REBAR LAP SCHEDULE	
BAR	LAP LENGTH
#5	2'-6"
#6	3'-0"
#7	3'-6"
#8	4'-0"

10 LAP SCHEDULE
S-5.1

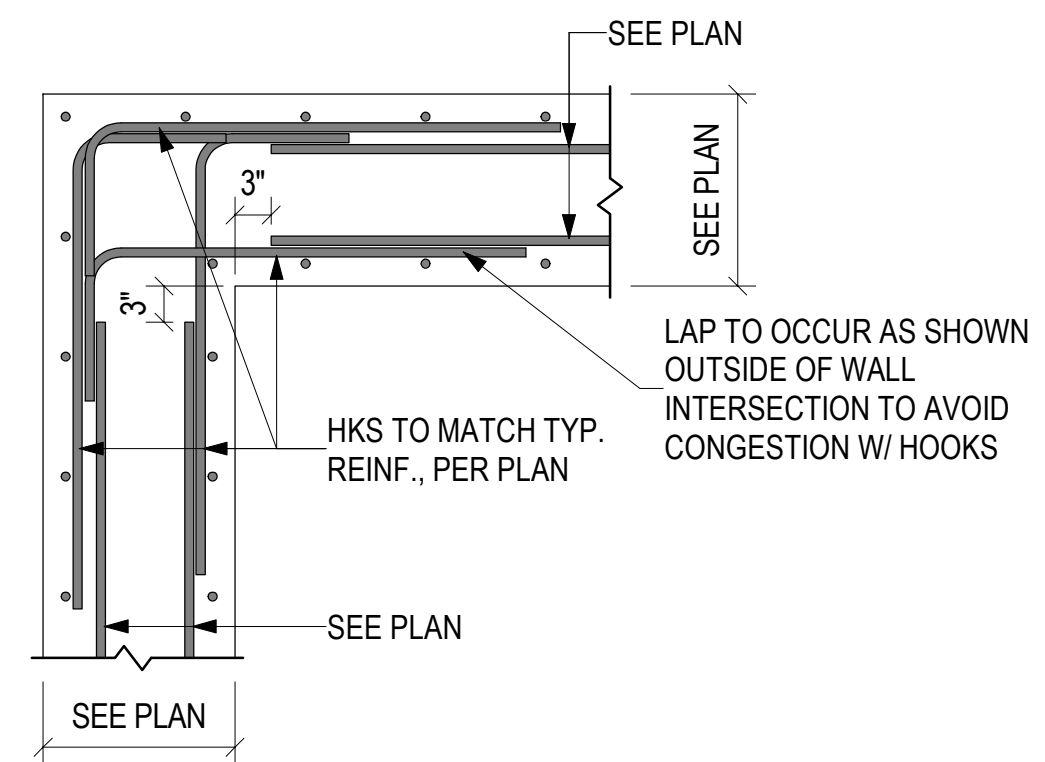


4 SLAB-ON-GRADE DETAIL
3/4" = 1'-0"

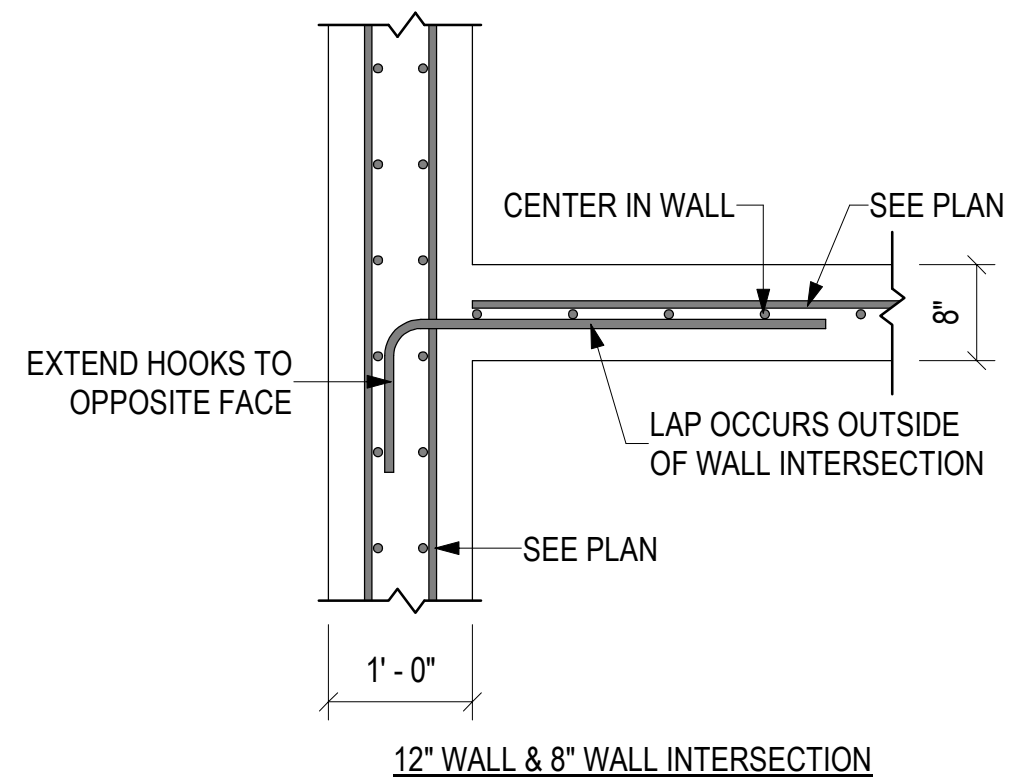
5 GRATING BEARING DETAIL AT CONC. WALL
1 1/2" = 1'-0"



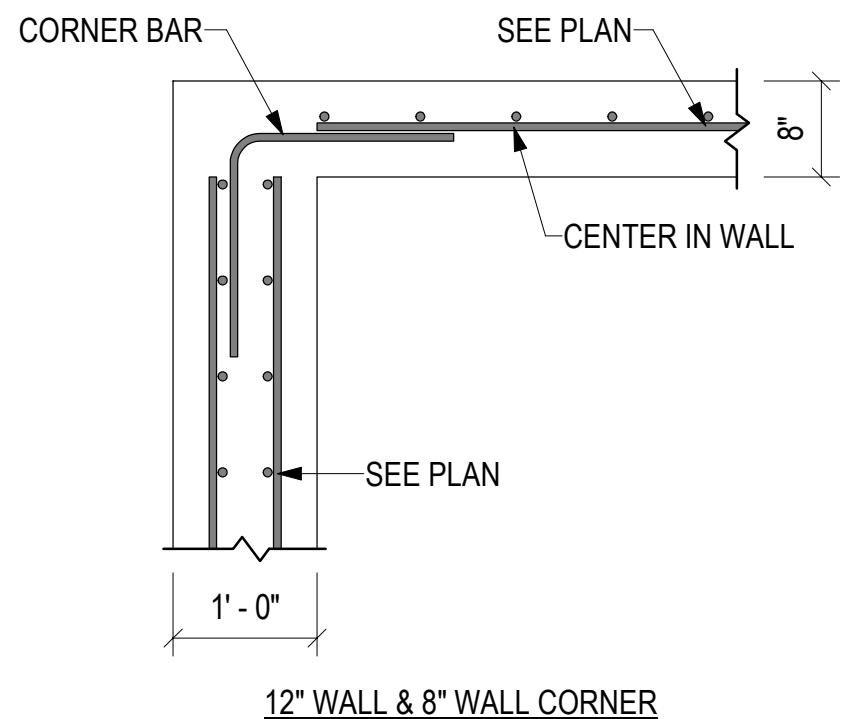
12" WALL & 12" WALL INTERSECTION



12" / 16" WALL & 12" / 16" WALL CORNER



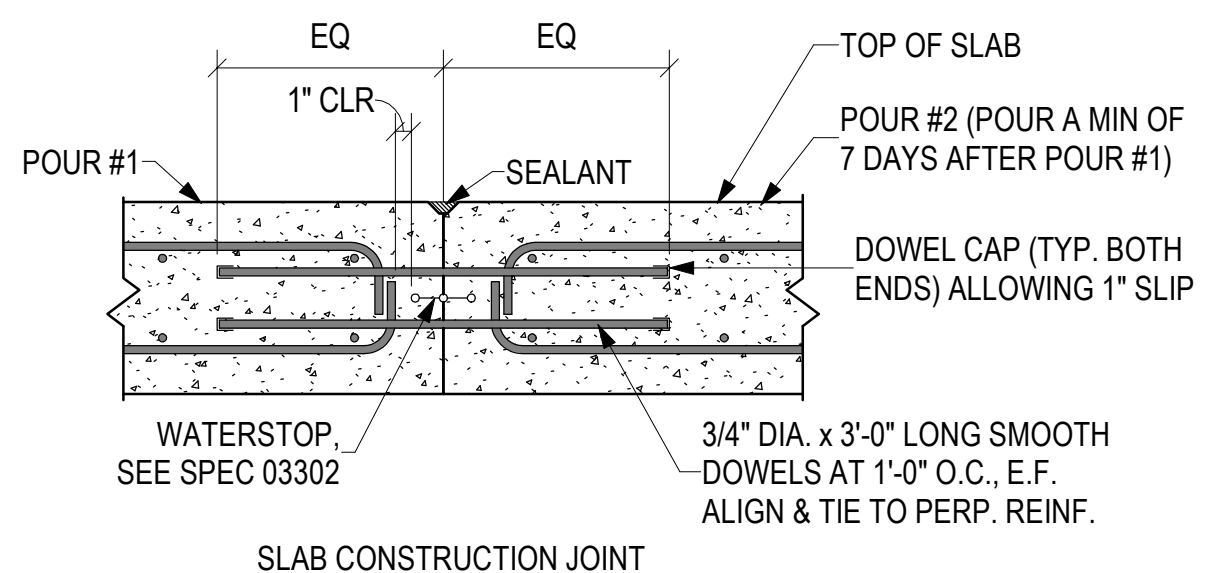
12" WALL & 8" WALL INTERSECTION



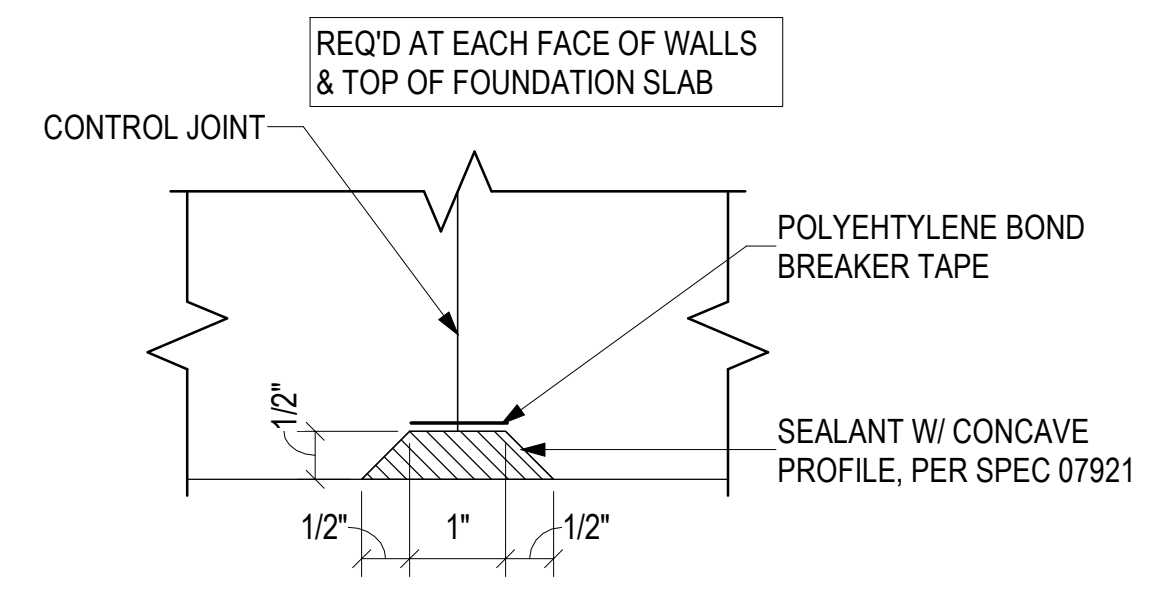
12" WALL & 8" WALL CORNER

2 WALL INTERSECTION REINF. DETAIL
3/4" = 1'-0"

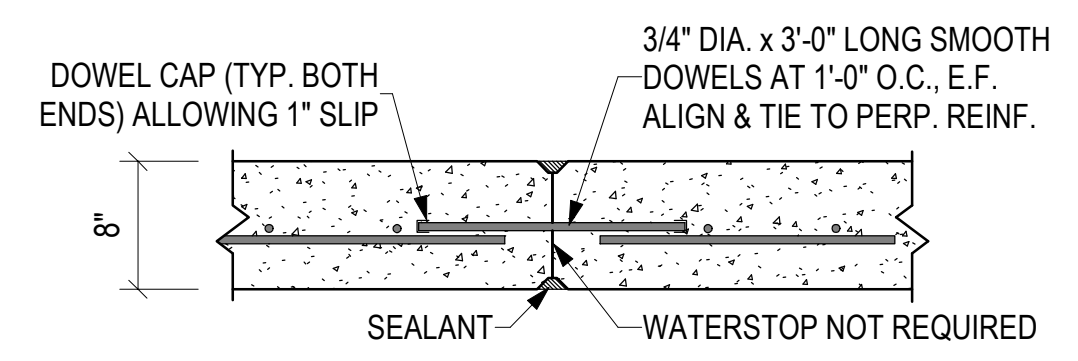
3 WALL CORNER REINF. DETAIL
3/4" = 1'-0"



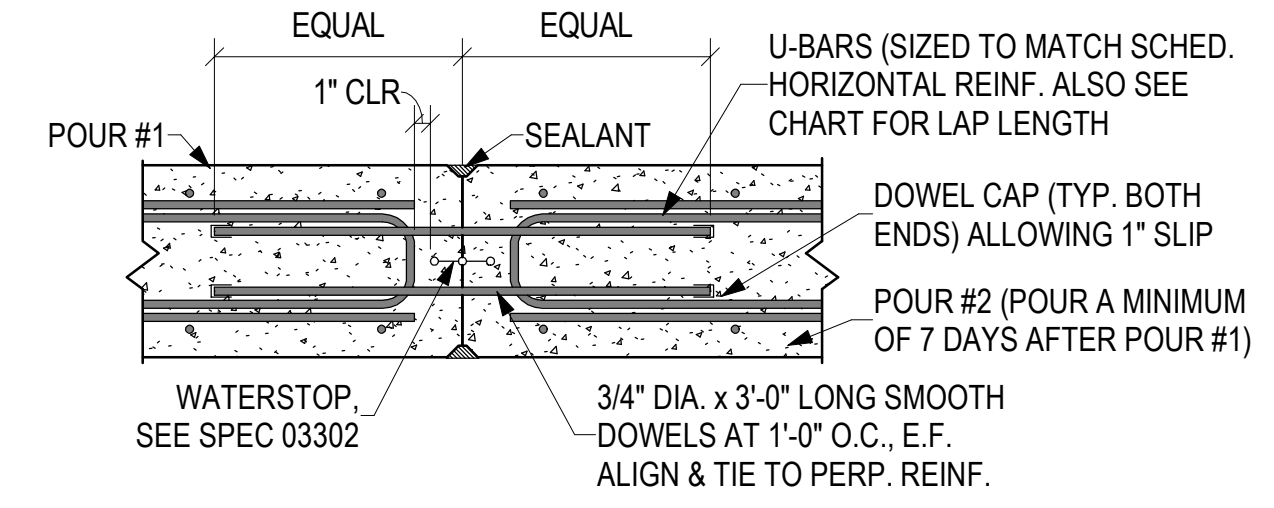
6 TANKAGE SLAB C.J. DETAIL
1" = 1'-0"



7 CONTROL JOINT SEALANT DETAIL
6" = 1'-0"



9 8" WALL CONTROL JOINT DETAIL (NONHYDROSTATIC WALLS)
1" = 1'-0"

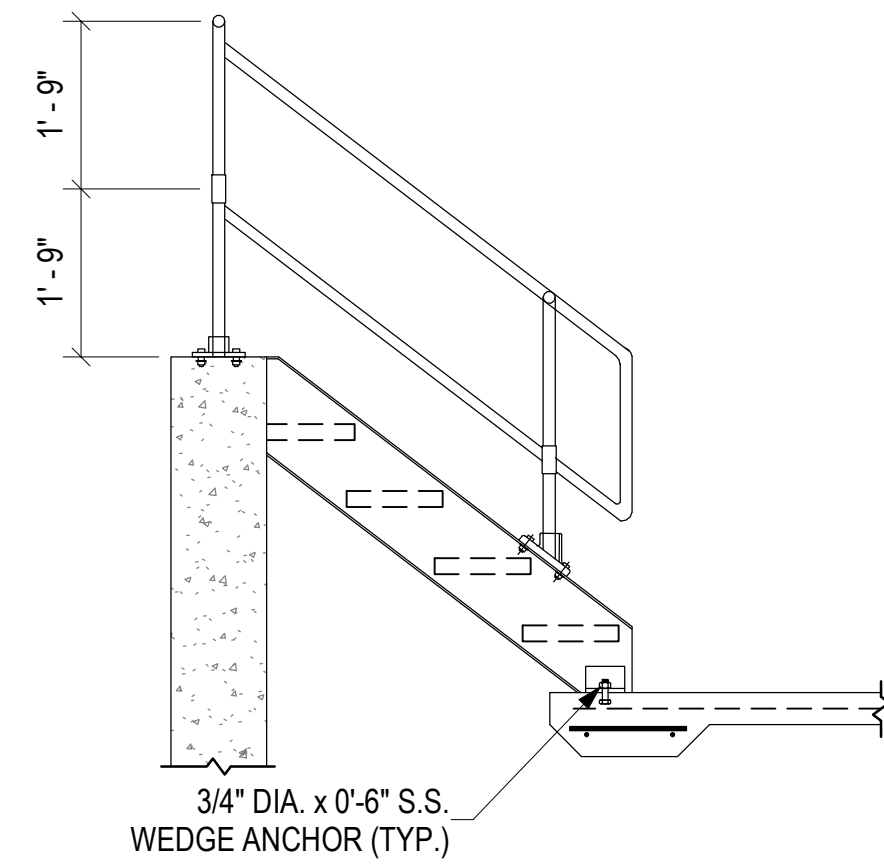


8 12" WALL CONTROL JOINT DETAILS
1" = 1'-0"

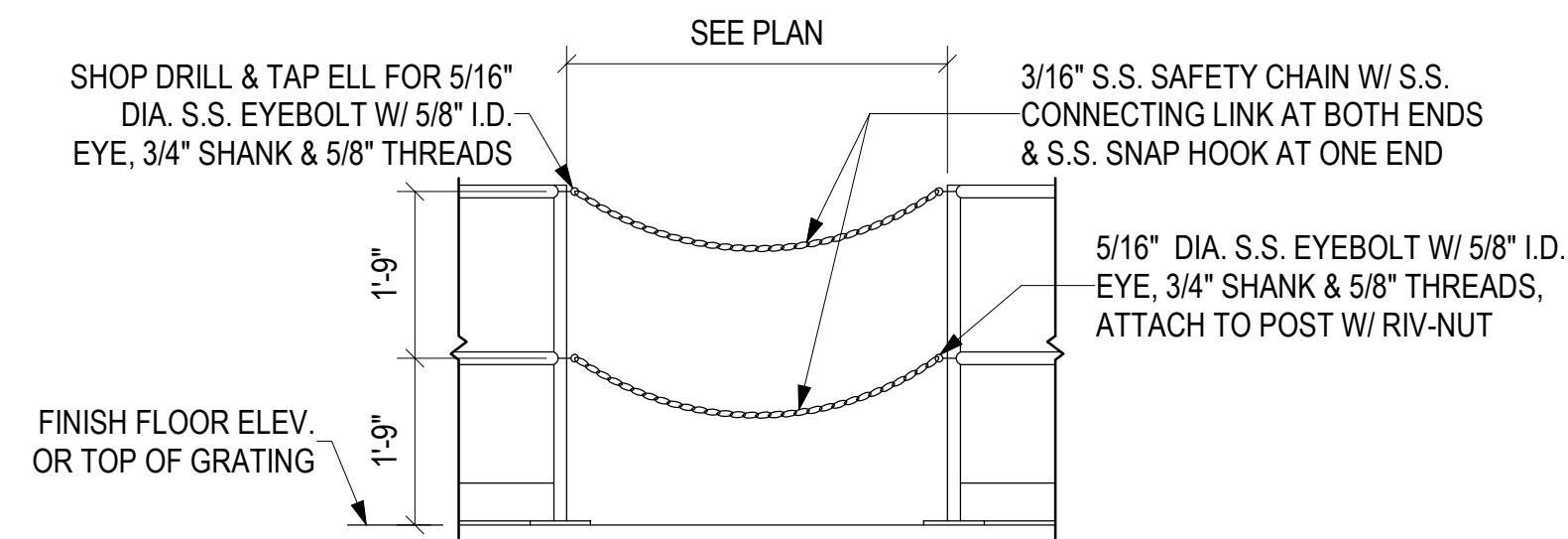
DETAILS
 OCWS APWRP RECLAIM EXPANSION



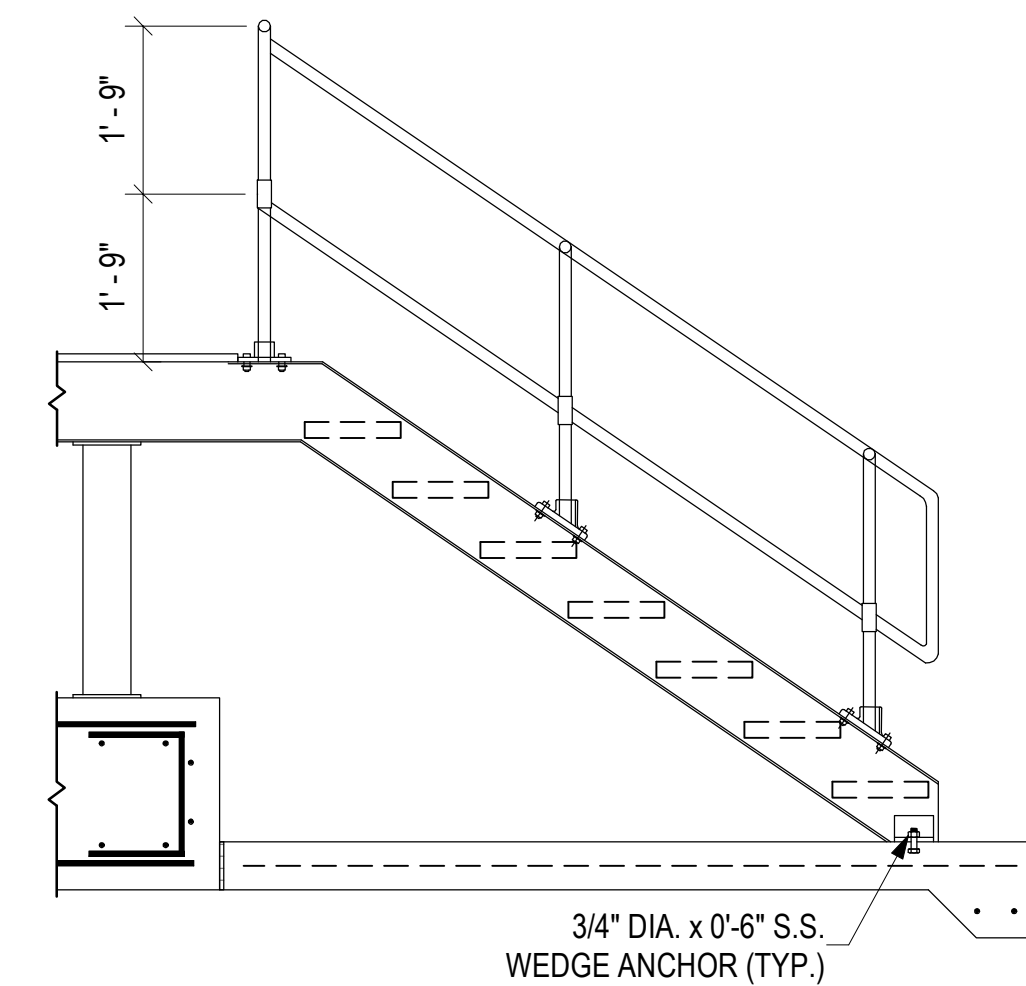
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STAIRS TO CONCRETE WALL



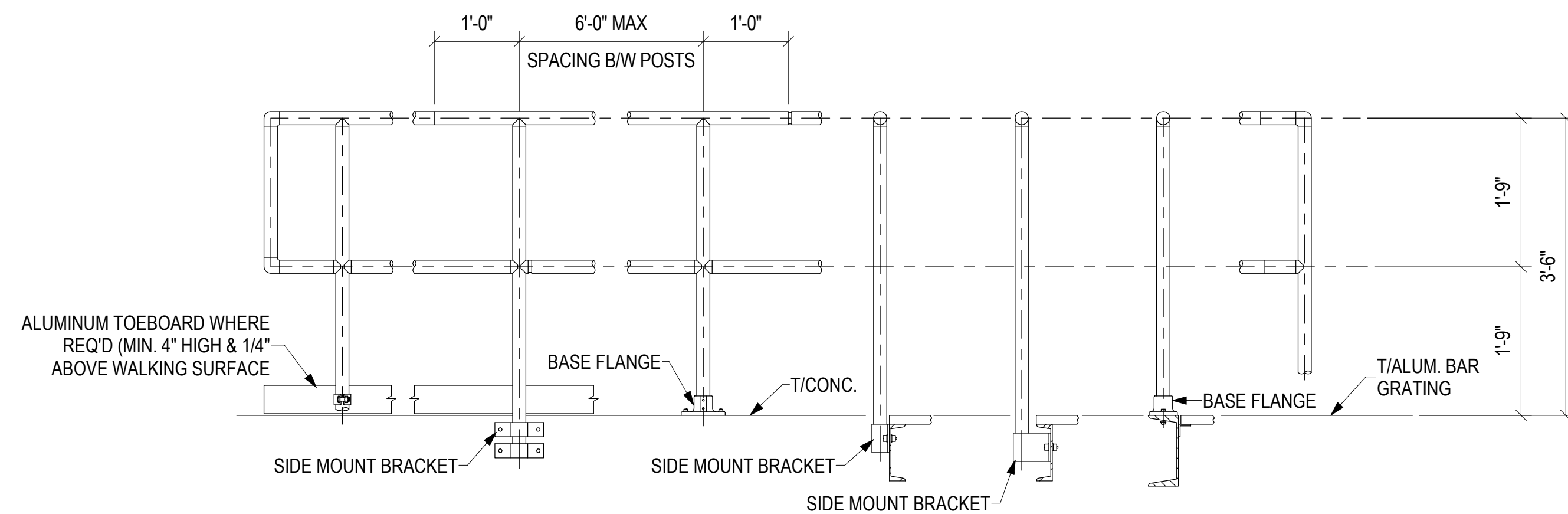
2 CHAINRAIL CONCEPTUAL DETAIL
S-5.2 1/2" = 1'-0"



STAIRS TO PLATFORM

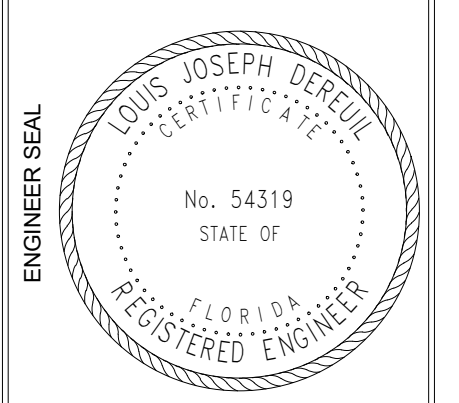
1 TYP. STAIR CONCEPTUAL DETAILS
S-5.2 1/2" = 1'-0"

PROVIDE ALL ALUMINUM FRAMING INCLUDING STAIRS, PLATFORMS, GUARDRAILS, ETC. PER SPEC 05700



3 TYP. HANDRAIL CONCEPTUAL DETAILS
S-5.2 3/4" = 1'-0"

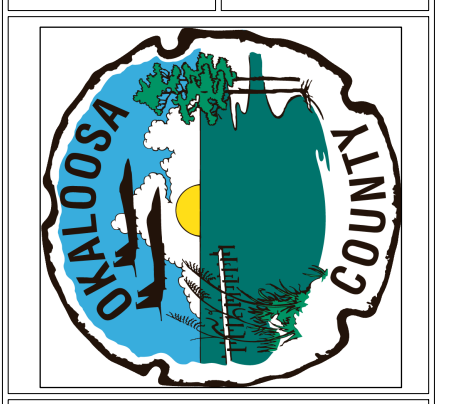
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STRUCTURAL ENGINEERS
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301 West Cervantes St. Tel. 850.429.1951
Pensacola, FL 32501 Fax. 850.429.0158
JDA PROJECT #18213



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			JJM	WEC	LJD	LJD

DETAILS

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ABBREVIATIONS

A OR AMP	AMPERES	UG	UNDERGROUND
AFF	ABOVE FINISH FLOOR	UL	UNDERWRITER'S LABORATORIES
AHU	AIR HANDLING UNIT	UNO	UNLESS NOTED OTHERWISE
AIC	AMPERE INTERRUPTING CAPACITY	V	VOLTS
AM	AMMETER	VFD	VARIABLE FREQUENCY DRIVE
AS	AMMETER SELECTION SWITCH	VM	VOLTMETER
ASYM	ASYMMETRICAL	VMS	VOLTMETER SELECTOR SWITCH
ATS	AUTOMATIC TRANSFER SWITCH	W	WIDTH
AT	AUTOMATIC TRANSFORMER	W/	WITH
BCP	BACKUP CONTROL PANEL	WHDM	WATT HOUR DEMAND METER
C	CONDUIT	WM	WATTMETER
CB	CIRCUIT BREAKER	WP	WEATHER PROOF
CKT	CIRCUIT	XFMR	TRANSFORMER
CLF	CURRENT LIMITING FUSE	Y	WYE CONNECTION
CNTL	CONTROL		
CT	CURRENT TRANSFORMER		
Δ	DELTA CONNECTION		
D	DEPTH		
DP	DISTRIBUTION PANELBOARD		
DS OR DISC	DISCONNECT SWITCH		
DTC	DATA TERMINAL CABINET		
EF	EXHAUST FAN		
EG	EQUIPMENT GROUND		
EMCP	ENERGY MANAGEMENT CONTROL PANEL		
EGC	EQUIPMENT GROUNDING CONDUCTOR		
EMT	ELECTRICAL METALLIC TUBING		
ESTOP	EMERGENCY STOP		
ETR	EXISTING TO REMAIN		
EX OR EXIST.	EXISTING		
EXP	EXPLOSION PROOF		
F	FUSE		
FA	FIRE ALARM		
FCR	FLOAT CONTROL RELAY		
FLR	FLOOR		
FACP	FIRE ALARM CONTROL PANEL		
FMPX	FIRE ALARM MULTIPLEX PANEL		
G OR GND	GROUND		
GEC	GROUNDING ELECTRODE CONDUCTOR		
GF	GROUND FAULT		
GFI	GROUND FAULT INTERRUPTING		
H	HEIGHT		
HP	HORSEPOWER		
HV	HIGH VOLTAGE, 600VAC		
HVAC	HEATING, VENTILATION AND AIR		
IMC	INTERMEDIATE METAL CONDUIT		
JB OR J	JUNCTION BOX		
KVA	KILOVOLT – AMPS		
KW	KILOWATTS		
KWH	KILOWATT–HOUR		
L	LENGTH		
LA	LIGHTING ARRESTOR		
LCP	LIGHTING CONTROL PANEL		
LFMC	LIQUIDTIGHT FLEXIBLE METAL CONDUIT		
LP	LIGHTING PANELBOARD		
LV	LOW VOLTAGE, 240VAC		
MCB OR MB	MAIN CIRCUIT BREAKER		
MCC	MOTOR CONTROL CENTER		
MFR	MANUFACTURER		
MH OR MTG	MOUNTING HEIGHT		
MLO	MAIN LUG ONLY		
MMS	MICROPROCESSOR–BASED METERING SYSTEM		
MT OR MTD	MOUNT OR MOUNTED		
N	NEUTRAL		
NC	NORMALLY CLOSED		
NEC	NATIONAL ELECTRICAL CODE		
NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION		
NF	NON–FUSIBLE		
NFPA	NATIONAL FIRE PROTECTION ASSOCIATES		
NO	NORMALLY OPEN		
NTS	NOT TO SCALE		
P	POLE		
PFC	POWER FACTOR CAPACITOR		
PLC	PROGRAMMABLE LOGIC CONTROLLER		
PMT	PAD MOUNT TRANSFORMER		
PNL	PANEL		
PVC	POLYVINYLCHLORIDE CONDUIT		
RC	REMOTE CONTROL SWITCH		
REC OR RECPT	RECEPTACLE		
RGC	RIGID GALVANIZED COUDUIT		
RMS	ROOT MEAN SQUARE		
RTU	REMOTE TERMINAL UNIT		
SS	STAINLESS STEEL, SOFT START		
SW	SWITCH		
SWBD	SWITCHBOARD		
SYM	SYMMETRICAL		
TBB	TELEPHONE BACKBOARD		
TCP	TEMPERATURE CONTROL PANEL		
TTC	TELEPHONE TERMINAL CABINET		
TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSOR		
TYP	TYPICAL		

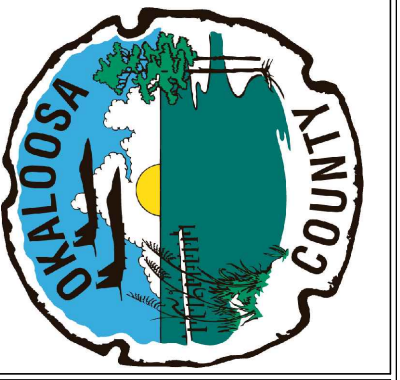
GENERAL NOTES

- ENTIRE INSTALLATION SHALL BE IN ACCORDANCE WITH THE FOLLOWING CODES AND STANDARDS:
 - NFPA 70, NATIONAL ELECTRICAL CODE.
 - NFPA 101 LIFE SAFETY CODE.
 - NFPA 820 STANDARD FOR FIRE PROTECTION IN WASTEWATER TREATMENT AND COLLECTION FACILITIES.
- WET WELLS ARE CLASS 1, DIV. 1, SPACES.
- ALL ELECTRICAL CIRCUITS SHALL INCLUDE A GREEN GROUNDING CONDUCTOR SIZED PER NEC.
- CONDUIT AND DEVICE LOCATIONS ARE SHOWN DIAGRAMMATICALLY ONLY, CONTRACTOR SHALL FIELD LOCATE OR ROUTE AS REQUIRED.
- ALL CONDUIT SHALL BE INSTALLED PARALLEL AND PERPENDICULAR TO BUILDING STRUCTURE.
- ALL PANEL LEGENDS SHALL BE RETYPED TO REFLECT UP TO DATE CONDITIONS. ALL PANEL LEGENDS SHALL INDICATE THE PANEL'S FEEDER CKT. SOURCE PANEL (OR SUBSTATION) AND ITS LOCATION.
- ELECTRICAL EQUIPMENT AND DEVICES SHALL BE PROVIDED WITH PHENOLIC NAMEPLATES. ALL NAMEPLATES SHALL BE MECHANICALLY FASTENED WITH S.S. SCREWS OR RIVETS. THE USE OF ADHESIVE NAMEPLATES SHALL NOT BE ALLOWED.
- CONTRACTOR SHALL MAINTAIN A SET OF PRINTS AND MARK–UP DURING CONSTRUCTION TO REFLECT "AS–BUILT" CONDITIONS. PRINTS SHALL BE DELIVERED TO THE ENGINEER UPON COMPLETION OF THE PROJECT AS A COMPLETE SET OF RECORD DRAWINGS. IN ADDITION, THE CONTRACTOR SHALL PROVIDE ELECTRONIC COPIES OF ALL UPDATES "AS–BUILT" DRAWINGS IN AUTOCAD 2013 FORMAT.
- THE CONTRACTOR SHALL PROVIDE PULL BOXES IN POWER CIRCUIT CONDUIT AS REQUIRED, SO AS TO LIMIT THE NUMBER OF BENDS TO A MAXIMUM OF 360 DEGREES OR FOUR 90 DEGREE TURNS.
- PROVIDE CONDUIT EXPANSION FITTINGS AS CONDUIT CROSSES BUILDING EXPANSION JOINTS.
- ALL EXTERIOR ELECTRICAL ENCLOSURES SHALL BE NEMA 4X STAINLESS STEEL UNLESS OTHERWISE NOTED.
- ALL SUPPORTING AND FASTENING DEVICES SHALL BE STAINLESS STEEL.
- CONTRACTOR MAY COMBINE HOMERUNS TO ALL PANEL BOARDS PER NEC.
- ALL RECEPTACLE BRANCH CIRCUITS OVER 75' IN LENGTH SHALL USE #10 AWG CONDUCTOR (FOR VOLTAGE DROP).
- CONTRACTOR TO PROVIDE ALL REQUIRED POWER AND STARTERS FOR PROCESS EQUIPMENT (COORDINATE WITH PROCESS EQUIPMENT SUPPLIER).
- ALL SERVICE ENTRANCE CONDUITS SHALL BE SCH. 80 PVC BURIED 4' BELOW GRADE WITH MARKER TAPE 6" ABOVE TOP OF CONDUIT.
- CONTRACTOR SHALL PAY ALL FEES ASSESSED BY ELECTRICAL UTILITY CO.
- CONTRACTOR SHALL COORDINATE INSTALLATION OF ELECTRICAL SERVICE WITH UTILITY COMPANY.
- CONTRACTOR SHALL PROVIDE 2 SPARE FUSES FOR EACH FUSE INSTALLED INCLUDING ALL EQUIPMENT AND CONTROLS.
- CONTROL AND POWER CONDUITS SHALL BE SEPARATED BY 12" MIN. AND SHALL BE IN SEPARATE JUNCTION BOXES AND DUCT BANKS. MAINTAIN 12" SEPARATION BETWEEN DUCT BANKS.
- CONTRACTOR SHALL MAINTAIN OPERATION OF THE ELECTRICAL SERVICE DURING THE UPGRADE.
- CONTRACTOR SHALL PROVIDE A GROUNDING SYSTEM AS DETAILED IN PLANS. THE INSTALLED GROUNDING SYSTEM SHALL HAVE A RESISTANCE OF LESS THAN 5 OHMS TO GROUND.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR READING ALL PROJECT SPECIFICATIONS AND WILL BE RESPONSIBLE FOR MEETING ALL REQUIREMENTS OUTLINED IN THE SPECIFICATIONS.
- ALL CONDUITS ENTERING CLASS 1 DIV. 1 SPACES SHALL BE STAINLESS STEEL OR RIGID ALUMINUM.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING A COORDINATED ELECTRICAL SYSTEM IN ACCORDANCE WITH NEC ARTICLE 240.12 AND ARTICLE 700.27.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING DETAILED ELECTRICAL EQUIPMENT LAYOUT DRAWINGS TO THE ENGINEER FOR APPROVAL PRIOR TO INSTALLATION.



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ABBREVIATIONS & GENERAL NOTES
OCWS APWRF RECLAIM EXPANSION



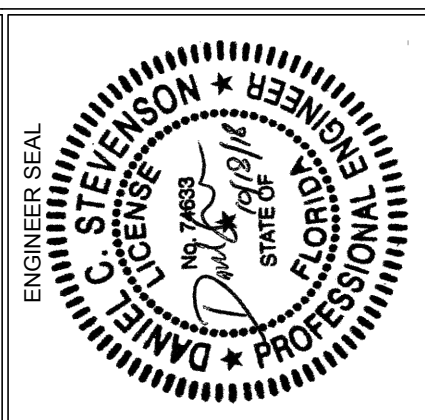
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 DATE: OCTOBER 19, 2018

SYMBOL	DESCRIPTION
	CONTACT, NORMALLY OPEN
	CONTACT, NORMALLY CLOSED
	OPERATING COIL * DESIGNATION: C - CONTACTOR R - CONTROL RELAY M - MAGNETIC MOTOR STARTER - NON REVERSING MF - MAGNETIC MOTOR STARTER - FORWARD MR - MAGNETIC MOTOR STARTER - REVERSE MO - MAGNETIC MOTOR STARTER - OPEN MC - MAGNETIC MOTOR STARTER - CLOSE MH - MAGNETIC MOTOR STARTER - HIGH SPEED ML - MAGNETIC MOTOR STARTER - LOW SPEED SOV - SOLENOID OPERATED VALVE TD - TIME DELAY RELAY T - PROGRAMMABLE TIMER
	METER, ELAPSED TIME
	INDICATING LIGHT - FULL VOLTAGE TRANSFORMER OR LED * DESIGNATION: A - AMBER R - RED B - BLUE W - WHITE G - GREEN Y - YELLOW
	INDICATING LIGHT, PUSH -TO-TEST * DESIGNATION: A - AMBER R - RED B - BLUE W - WHITE G - GREEN Y - YELLOW
	SWITCH, PUSHBUTTON, NORMALLY OPEN CIRCUIT
	SWITCH, PUSHBUTTON, NORMALLY CLOSED CIRCUIT
	SWITCH, PUSHBUTTON, TAG LINE, NORMALLY CLOSED CIRCUIT WITH MAINTAINED CONTACT
	SWITCH, PUSHBUTTON, TWO CIRCUIT, NORMALLY OPEN AND NORMALLY CLOSED
	SWITCH, EMERGENCY SHUTDOWN, MUSHROOM-HEAD PUSHBUTTON, NORMALLY CLOSED CIRCUIT WITH MAINTAINED CONTACT
	SWITCH, MASTER OR CONTROL X - INDICATES CONTACT CLOSED
	MOMENTARY-CONTACT SWITCH
	SWITCH PRESSURE/VACUUM OPERATED. NORMALLY OPEN. CLOSING ON RISING PRESSURE
	SWITCH PRESSURE/VACUUM OPERATED. NORMALLY CLOSED OPENING ON RISING PRESSURE
	SWITCH, FLOW ACTUATED, NORMALLY OPEN, CLOSING ON INCREASE IN FLOW
	SWITCH, FLOW ACTUATED, NORMALLY CLOSED OPENING ON INCREASE IN FLOW
	SWITCH, TEMPERATURE ACTUATED, NORMALLY CLOSED OPENING ON RISING TEMPERATURE
	SWITCH, TEMPERATURE ACTUATED, NORMALLY OPEN CLOSING ON RISING TEMPERATURE
	CONTACT, TIME DELAY, NORMALLY OPEN WITH TIME DELAY CLOSING
	CONTACT, TIME DELAY, NORMALLY OPEN WITH TIME DELAY OPENING
	CONTACT, TIME DELAY, NORMALLY CLOSED WITH TIME DELAY CLOSING
	SWITCH, LIMIT
	SWITCH, TORQUE
	SWITCH, LIQUID LEVEL ACTUATED, CLOSING ON RISING LEVEL
	SWITCH, LIQUID LEVEL ACTUATED, OPENING ON RISING LEVEL

SYMBOL	DESCRIPTION
	FUSE (AMPERE RATING SHOWN)
	FUSED DISCONNECT SWITCH, 3 POLE * DESIGNATION: LS - LOAD BREAK SWITCH DS - DISCONNECT SWITCH
	POWER CIRCUIT BREAKER, MEDIUM-VOLTAGE, DRAWOUT TYPE (AMPERE RATING SHOWN)
	CIRCUIT BREAKER, DRAWOUT TYPE, 600VAC OR LESS, 3P (TRIP AND FRAME AMPERE RATING SHOWN)
	CIRCUIT BREAKER, THERMOMAGNETIC, 600 VAC OR LESS, 3P (AMPERE RATING SHOWN)
	CIRCUIT BREAKER, THERMOMAGNETIC, 600 VAC OR LESS, 3P ADJUSTIBLE TRIP (TRIP & FRAME AMPERE RATING SHOWN)
	MOTOR CIRCUIT PROTECTOR, 600V AC OR LESS, 3P UON (CONTINUOUS AMPERE RATING SHOWN)
	CONTACTOR (NUMBER OF POLES AND AMPERE RATING SHOWN)
	MAGNETIC MOTOR STARTER * NEMA SIZE ** DESIGNATION: FVNR - FULL VOLTAGE, NON-REVERSING FVR - FULL VOLTAGE, REVERSING RVNR - REDUCED VOLTAGE, NON-REVERSING RVR - REDUCED VOLTAGE, REVERSING
	MANUAL MOTOR STARTER
	VARIABLE FREQUENCY DRIVE / INVERTER
	POWER TRANSFORMER (KVA RATING, VOLTAGES AND WINDINGS CONNECTIONS SHOWN)
	SERIES REACTOR (LINE OR LOAD RATING SHOWN)
	VOLTAGE TRANSFORMER (QUANTITY AND VOLTAGE RATIO SHOWN)
	CURRENT TRANSFORMER (QUANTITY AND CURRENT RATIO SHOWN)
	MULTI-RATIO CURRENT TRANSFORMER (QUANTITY, MAXIMUM CURRENT RATIO AND SETTING SHOWN)
	ZERO SEQUENCE CURRENT TRANSFORMER (CURRENT RATIO SHOWN)
	CAPACITOR
	GROUND CONNECTION
	SURGE ARRESTER (QUANTITY SHOWN)
	TRANSFER SWITCH (NUMBER OF POLES AND AMPERE RATING SHOWN)
	BATTERY (RATING SHOWN)
	MOTOR, INDUCTION
	MOTOR, INDUCTION (PLAN VIEW)

SYMBOL	DESCRIPTION
	750KW 480V 3-PHASE GENERATOR (KW RATINGS, VOLTAGE AND PHASE SHOWN)
	THERMISTOR
	DIODE, SEMICONDUCTOR
	RESISTANCE TEMPERATURE DETECTOR
	RESISTOR
	SPACE HEATER
	500VA 480/120V CONTROL POWER TRANSFORMER, (VA RATING VOLTAGES)
	AMMETER SWITCH
	VOLTMETER SWITCH
	CONTROL SWITCH
	METER * DESIGNATION: AM - AMMETER VM - VOLTMETER PFM - POWER FACTOR WM - WATTMETER FMM - FREQUENCY METER WHM - WATTHOUR METER PM - POWER MONITORING DEVICE
	PROTECTIVE RELAY OR DEVICE * DESIGNATION: 11 - MULTIFUNCTION PROTECTIVE RELAY 25 - SYNCHRONIZING OR SYNCHRONISM-CHECK RELAY 26 - APPARATUS THERMAL DEVICE 27 - UNDERVOLTAGE RELAY 32 - DIRECTIONAL POWER RELAY 37 - UNDERCURRENT OR UNDERPOWER RELAY 40 - FIELD RELAY 46 - REVERSE-PHASE OR PHASE-BALANCE CURRENT RELAY 49 - MACHINE OR TRANSFORMER THERMAL RELAY 50 - INSTANTANEOUS OVERCURRENT RELAY 50GS - INSTANTANEOUS GROUND FAULT RELAY 51 - AC TIME OVERCURRENT RELAY 51GS - AC TIME GROUND FAULT RELAY 51V - AC TIME OVERCURRENT RELAY (VOLTAGE RESTRAINT) 55 - POWER FACTOR RELAY 59 - OVERVOLTAGE RELAY 60 - VOLTAGE OR CURRENT BALANCE RELAY 63 - PRESSURE SWITCH 64 - GROUND DETECTOR RELAY 67 - AC DIRECTIONAL OVERCURRENT RELAY 81 - FREQUENCY RELAY 86 - LOCKOUT RELAY 87 - DIFFERENTIAL PROTECTIVE RELAY 87G - GENERATOR DIFFERENTIAL GROUND FAULT RELAY



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ELECTRICAL SYMBOLS

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Constantine Engineering

1988 LEWIS TURNER BLVD.
FORT WALTON BEACH, FL 32547
PH. 850-244-5800
FL CERTIFICATE OF AUTHORIZATION # 9816

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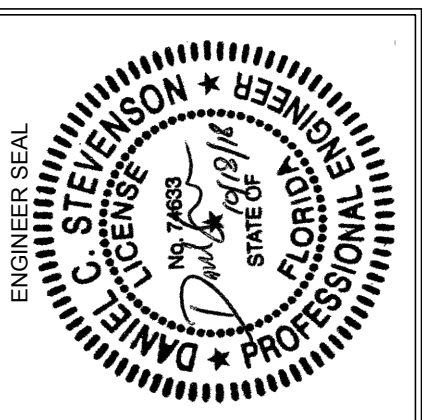
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WIRING	
	JUNCTION BOX
	PULL BOX
	HANDHOLE
	CONDUIT CONDUCTOR WIRE TAG. P--DENOTES POWER, L--DENOTES 120V CIRCUITS, I--DENOTES INSTRUMENTATION TO PLC, AND C--DENOTES CONTROL CIRCUIT FROM MCC.
COMMUNICATION	
	DATA COMMUNICATION OUTLET
	CABLE OUTLET
	DATA COMMUNICATION FLOOR OUTLET
	TELEPHONE FLOOR RECEPTACLE
	WALL MOUNTED TELEPHONE
	WALL MOUNTED DATA
	CEILING MOUNTED SPEAKER
LIGHTING	
	EXIT SIGN WALL MOUNTED LIGHT
	ELECTRIC RESISTANCE HEATER
	FLUORESCENT EMERGENCY LIGHT FIXTURE
	SINGLE POLE SWITCH
	THREE-WAY SWITCH
	TIMER OPERATED SWITCH
	FUSED SWITCH
	SWITCH WITH PILOT LIGHT
	CEILING MOUNTED PULL SWITCH
	DOUBLE POLE SWITCH
	FOUR-WAY SWITCH
	KEY OPERATED SWITCH
	LAMP HOLDER POLE SWITCH

LIGHTING (CONT)	
	LOW VOLTAGE MASTER SWITCH
	WEATHER PROOF SWITCH
	INCANDESCENT CEILING MOUNTED LIGHT
	RECESSED FLUORESCENT 2X4 LIGHT FIXTURE
	RECESSED FLUORESCENT 1X4 LIGHT FIXTURE
	RECESSED FLUORESCENT 1X8 LIGHT FIXTURE
	SURFACE MOUNTED FLUORESCENT 2X4 LIGHT FIXTURE
	SURFACE MOUNTED FLUORESCENT 1X4 LIGHT FIXTURE
	SURFACE MOUNTED FLUORESCENT 1X8 LIGHT FIXTURE
	STREET LIGHT WITH BRACKET
	EXTERIOR BUILDING LIGHT
	EMERGENCY BATTERY POWERED LIGHTS
	2' X 2' LIGHT FIXTURE
	INDUSTRIAL OR STRIP FIXTURE
	HIGHMAST LIGHTING ASSEMBLY
	AREA LIGHTING ASSEMBLY

POWER	
	CLOCK HANGER RECEPTACLE
	DUPLEX RECEPTACLE
	DUPLEX ON EMERGENCY POWER RECEPTACLE
	DUPLEX WITH GFI RECEPTACLE
	QUADRAPLEX RECEPTACLE
	SINGLE RECEPTACLE
	SINGLE RECEPTACLE WITH SWITCH
	SPECIAL PURPOSE RECEPTACLE
	DUPLEX RECEPTACLE WITH SWITCH
	FLUSH MOUNTED PANELBOARD CABINET
	SURFACE MOUNTED PANELBOARD CABINET
	TRANSFORMER

POWER (CONT)	
	EARTH GROUND
	FUSED DISCONNECT SWITCH
	UNFUSED DISCONNECT SWITCH
	METER
	DISTRIBUTION PANEL
	LIGHTING PANEL
	POWER PANEL



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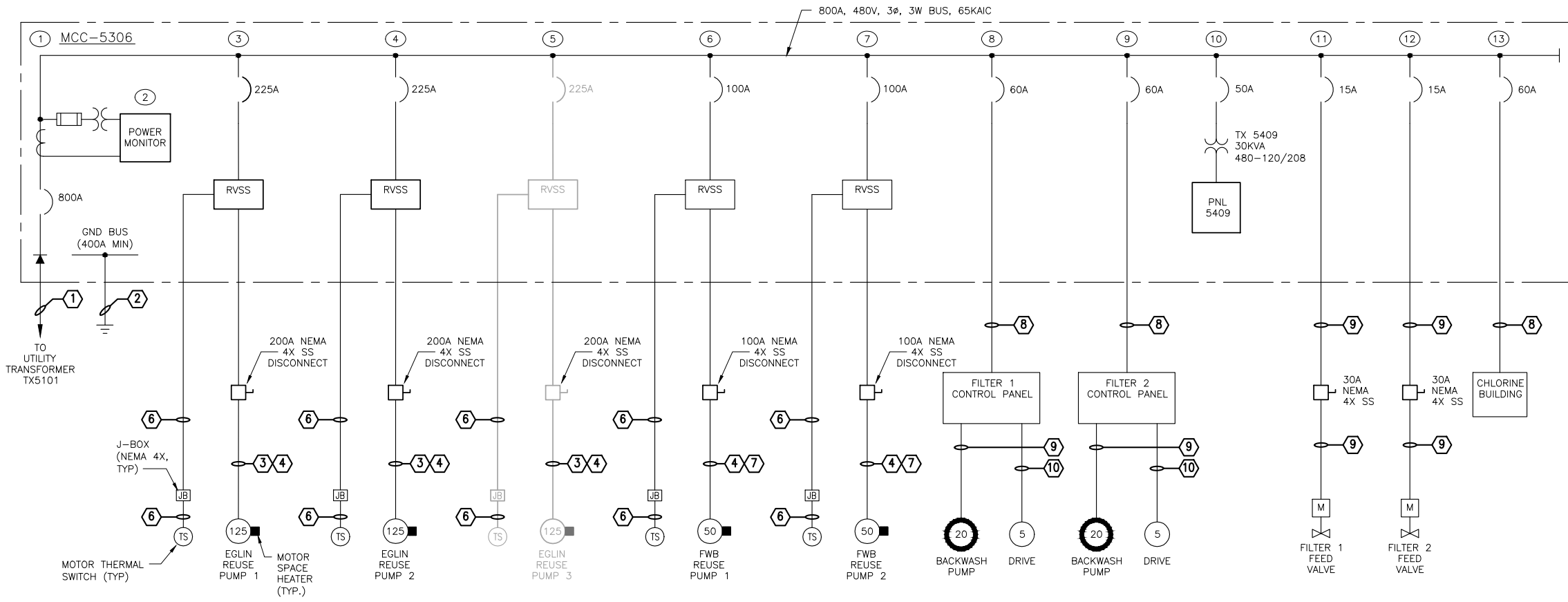


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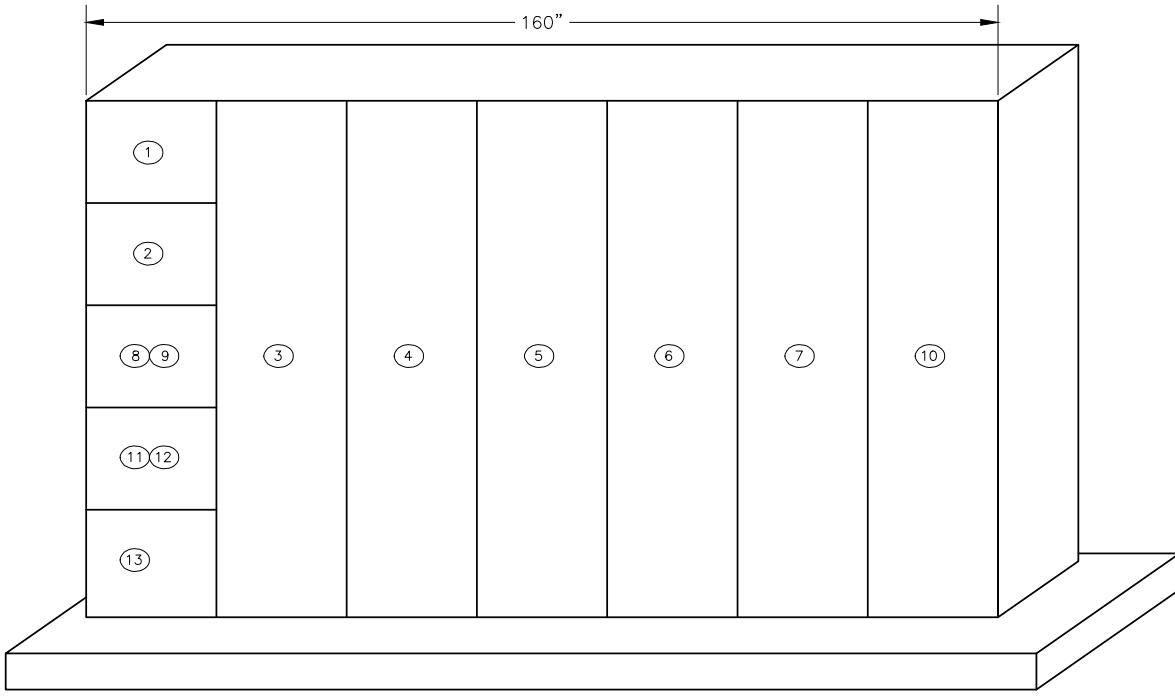
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SINGLE LINE POWER DIAGRAM
MCC-5306
 NEMA 1 ENCLOSURE REFER TO FRONT ELEVATION FOR FUTURE SPACE



PROPOSED ELEVATION
MCC-5306

GENERAL NOTES:

1. CONDUITS AND CONDUCTORS CAN BE COMBINED PER THE N.E.C.
2. PROVIDE CONDUITS BUT OMIT CONDUCTORS FOR ALL FUTURE EQUIPMENT. STUB UP AND CAP ALL FUTURE CONDUITS.



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MCC-5306 SINGLE LINE
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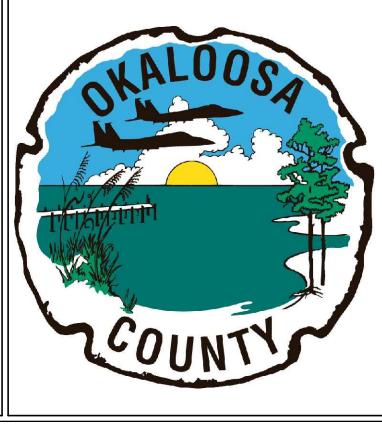
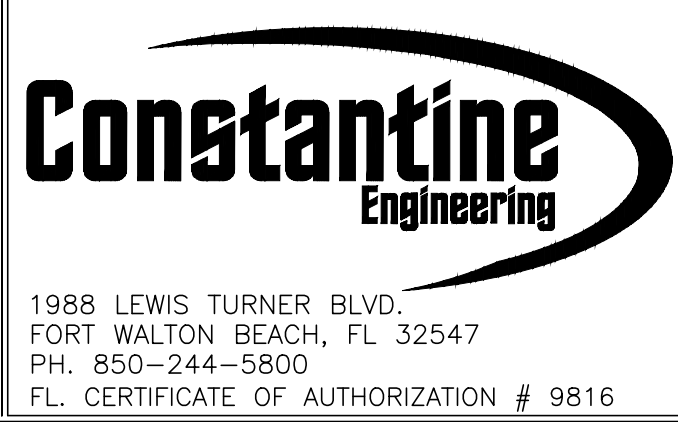
①	(2) 4" C, 3#600MCM, 1#600MCM NEUTRAL
②	#2/0G TO GROUND GRID
③	3" C, 3#4/0, 1#6G VFD CABLE
④	3/4" C, 3#12
⑤	1" C, 2#12, 8#14, 1#12G
⑥	3/4" C, 2#14, 1#14G
⑦	1-1/2" C, 3#2, 1#8G
⑧	1" C, 3#6, 1#10G
⑨	1" C, 3#10, 1#10G
⑩	3/4" C, 3#12, 1#12G
⑪	1" C, 14#14
⑫	1" C, (2) 2#18 TSP
⑬	2" C, 6 STRAND MULTIMODE FIBER
⑭	MFG CABLE, CONDUIT AS REQUIRED
⑮	1" C, 8#14, (2) 2#18 TSP
⑯	1" C, 8#14
⑰	1" C, 3#8, 1#8N, 1#10G
⑱	1-1/2" C, (6) 2#18 TSP

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PANEL: 5409

3		PH		4		WIRE		VOLTAGE		L.L.: 208		L-N: 120		MAIN:		100A MLO			
LOCATION:	ELECTRICAL ROOM	CTK#	BKR.	POLE	DESCRIPTION	VOLT-AMP	PHASE	PHASE	PHASE	VOLT-AMP	PHASE	PHASE	PHASE	VOLT-AMP	DESCRIPTION: MCC	POLE	BKR.	CTK#	
		1	20	1	FILTER 1 FLOW METER	120	A	B	C	0	0	0	0	0	SPARE	1	20	2	
		3	20	1	FILTER 2 FLOW METER	120		120		0	0	0	0	0	SPARE	1	20	4	
		5	20	1	FILTER LIGHTS	100				0	0	0	0	0	SPARE	1	20	6	
		7	20	1	20" REUSE FLOW METER	120	120			0	0	0	0	0	SPARE	1	20	8	
		9	20	1	16" REUSE FLOW METER	120		120		0	0	0	0	0	SPARE	1	20	10	
		11	20	1	REUSE WETWELL LEVEL CONTROLLER	120				0	0	0	0	0	SPARE	1	20	12	
		13	20	1	REUSE CL ANALYZER	120	120			0	0	0	0	0	SPARE	1	20	14	
		15	20	1	REUSE PH ANALYZER	120		120		0	0	0	0	0	SPARE	1	20	16	
		17	20	1	REUSE INST. SAMPLE PUMP	600				0	0	0	0	0	SPARE	1	20	18	
		19	20	1	CL CONT. BASIN TURBIDITY ANALYZER	120	120			0	0	0	0	0	SPARE	1	20	20	
		21	20	1	CL CONT. BASIN INST. SAMPLE PUMP	600		600		0	0	0	0	0	SPARE	1	20	22	
		23	20	1	REUSE PUMP LIGHTS	200				0	0	0	0	0	SPARE	1	20	24	
		25	20	1	CL CONT. BASIN LIGHT	50	50			0	0	0	0	0	SPARE	1	20	26	
		27	20	1	SPARE	0		0		0	0	0	0	0	SPARE	1	20	28	
		29	20	1	SPARE	0				0	0	0	0	0	SPARE	1	20	30	
		31	20	1	SPARE	0	0			0	0	0	0	0	SPARE	1	20	32	
		33	20	1	SPARE	0		0		0	0	0	0	0	SPARE	1	20	34	
		35	20	1	SPARE	0				0	0	0	0	0	SPARE	1	20	36	
		37	20	1	SPARE	0	0			0	0	0	0	0	SPARE	1	20	38	
		39	20	1	SPARE	0		0		0	0	0	0	0	SPARE	1	20	40	
		41	20	1	SPARE	0				0	0	0	0	0	SPARE	1	20	42	
TOTAL LOAD(VA)/PHASE THIS PANEL:						530	960	1200											
TOTAL CONNECTED LOAD(VA) THIS PANEL:						2510		TOTAL CONNECTED LOAD (AMPS):		7									
TOTAL DEMAND LOAD (VA) THIS PANEL:						2510		TOTAL DEMAND LOADS (AMPS):		7									

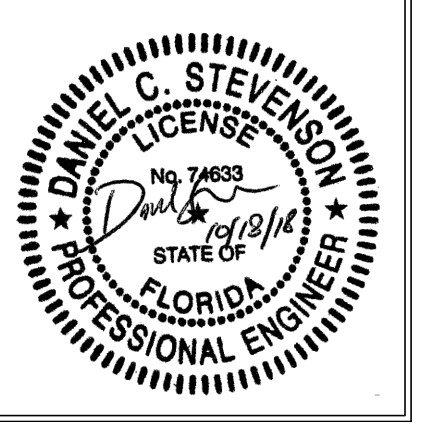
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SCHEDULES

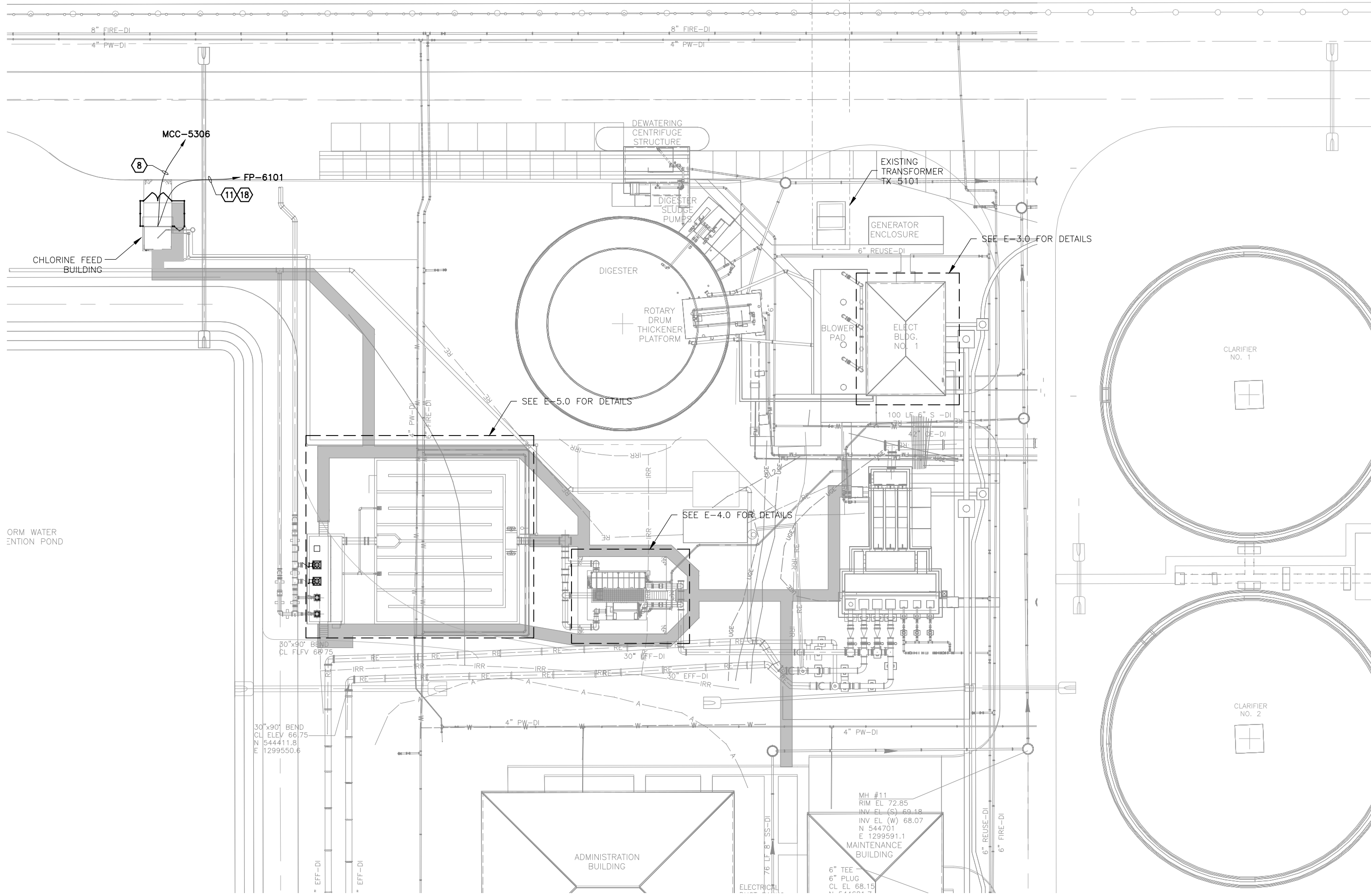
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NO.	DATE	REVISION	BY	APVD			
DESIGNED BY:	TCG	DRAWN BY:	TCG	CHECKED BY:	DS	APPROVED BY:	DS

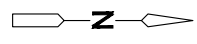


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ORIGINAL DRAWING
OCTOBER 2018
100501.00
E-1.1

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ELECTRICAL BUILDING NO. 1 – PROPOSED CONTROL PLAN
 SCALE: NONE



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APPROVED BY:	DS

OVERALL ELECTRICAL SITE PLAN
OCWS APWRF RECLAIM EXPANSION



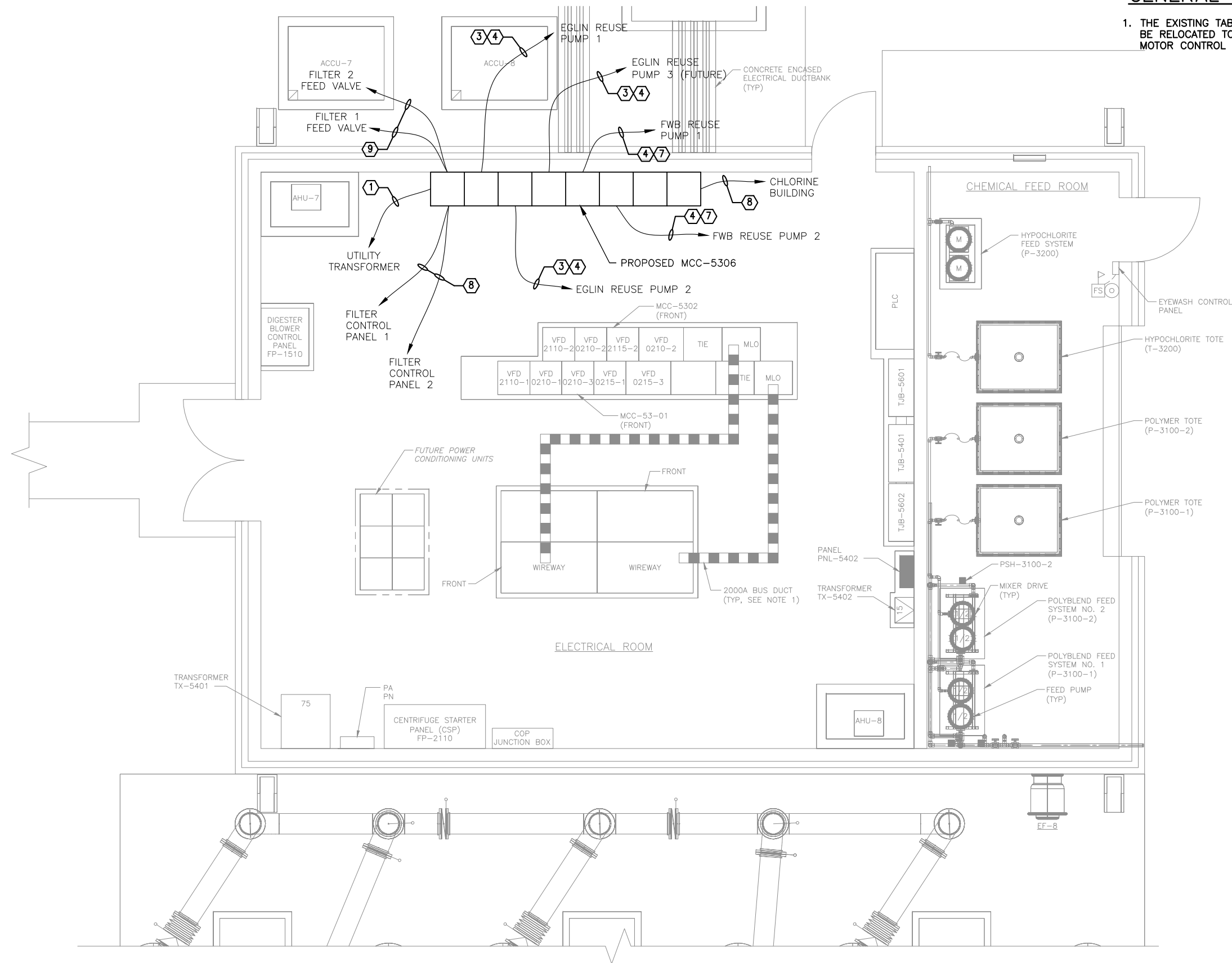
Constantine Engineering
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DATE	OCTOBER 2018
PROJ.	100501.00
DWG.	

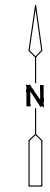
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GENERAL NOTES:

1. THE EXISTING TABLES AND BOOKSHELVES SHALL BE RELOCATED TO PROVIDE ROOM FOR THE NEW MOTOR CONTROL CENTER.



ELECTRICAL BUILDING NO. 1 - PROPOSED POWER PLAN
 SCALE: NONE



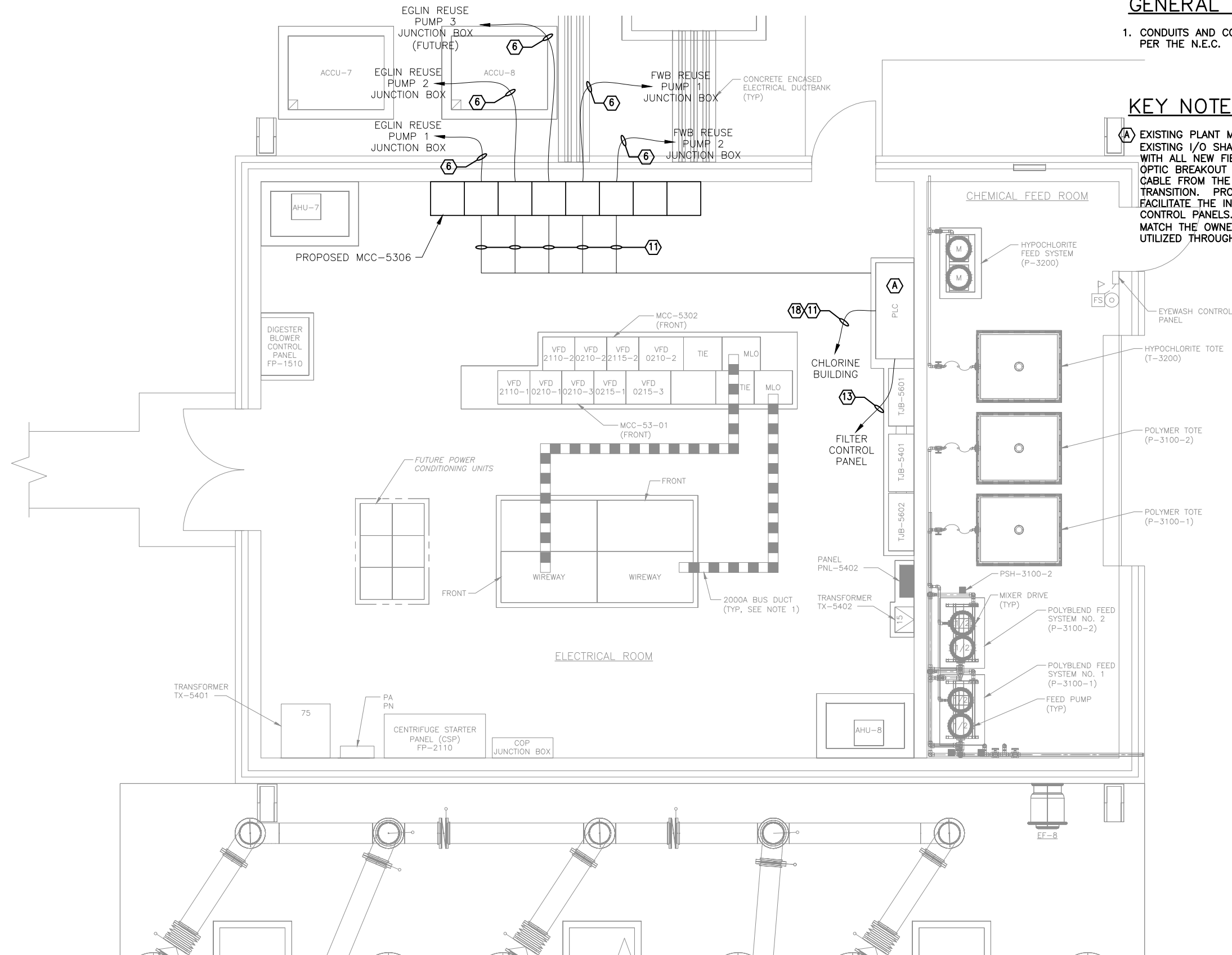
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		TCG	TCG	TCG	DS	DS

**ELECTRICAL BUILDING NO. 1
 PROPOSED POWER PLAN
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DWG.	E-3.0

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GENERAL NOTES:

1. CONDUITS AND CONDUCTORS CAN BE COMBINED PER THE N.E.C.

KEY NOTES:

- A EXISTING PLANT MAIN PLC CABINET, FP-6101. EXISTING I/O SHALL BE UTILIZED TO INTERFACE WITH ALL NEW FIELD DEVICES. PROVIDE A FIBER OPTIC BREAKOUT BOX TO ALLOW THE FIBER OPTIC CABLE FROM THE FILTER CONTROL PANELS TO TRANSITION. PROVIDE A NETWORK SWITCH TO FACILITATE THE INTERCONNECTION OF THE FILTER CONTROL PANELS. THE NETWORK SWITCH SHALL MATCH THE OWNER'S CURRENT STANDARD SWITCH UTILIZED THROUGHOUT THE FACILITY.



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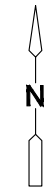
**ELECTRICAL BUILDING NO. 1
PROPOSED CONTROL PLAN**

OCWS APWRF RECLAIM EXPANSION

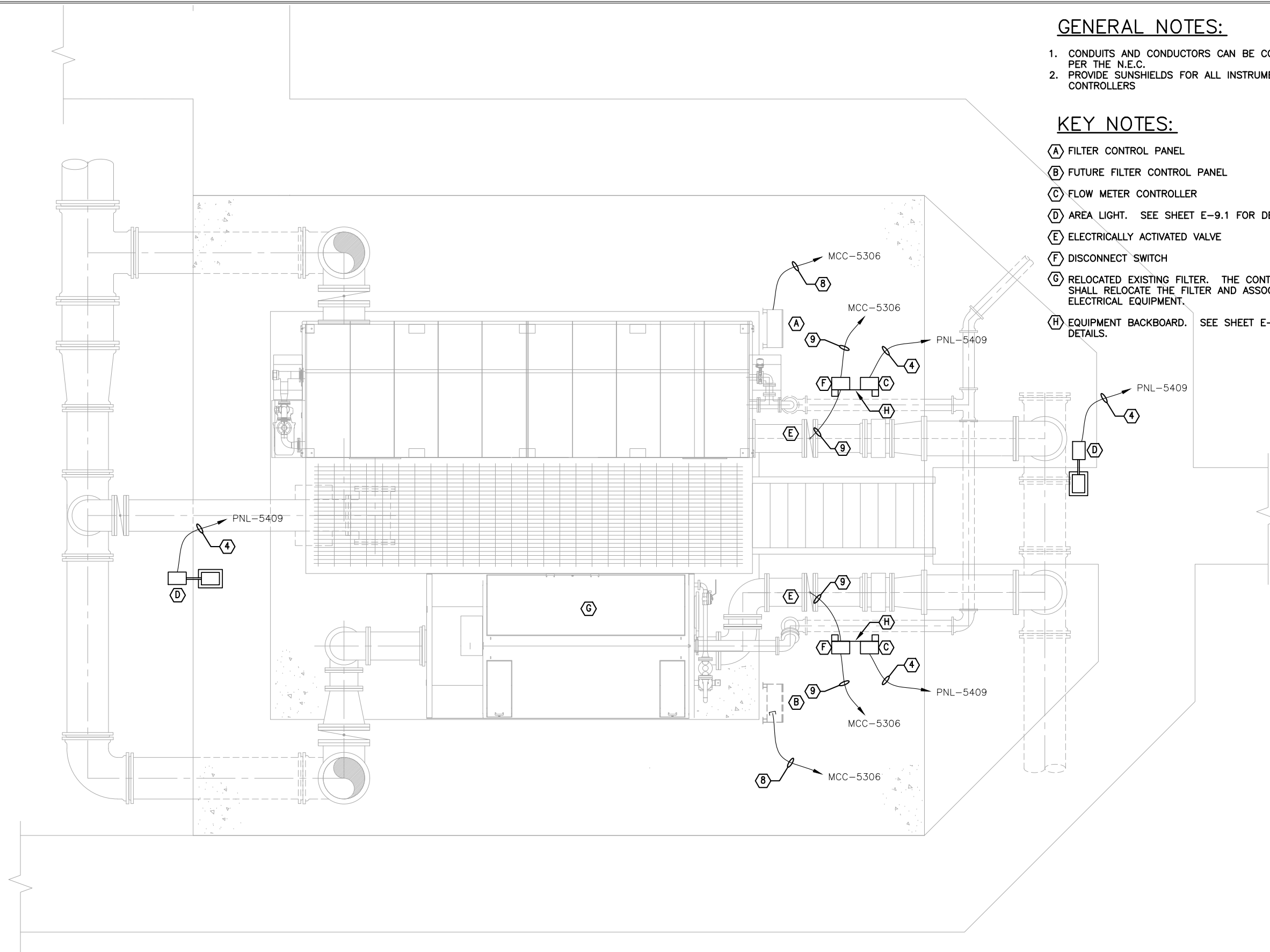


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DWG.	E-3.1

ELECTRICAL BUILDING NO. 1 – PROPOSED CONTROL PLAN
SCALE: NONE



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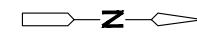
GENERAL NOTES:

1. CONDUITS AND CONDUCTORS CAN BE COMBINED PER THE N.E.C.
2. PROVIDE SUNSHIELDS FOR ALL INSTRUMENT CONTROLLERS

KEY NOTES:

- (A) FILTER CONTROL PANEL
- (B) FUTURE FILTER CONTROL PANEL
- (C) FLOW METER CONTROLLER
- (D) AREA LIGHT. SEE SHEET E-9.1 FOR DETAILS.
- (E) ELECTRICALLY ACTIVATED VALVE
- (F) DISCONNECT SWITCH
- (G) RELOCATED EXISTING FILTER. THE CONTRACTOR SHALL RELOCATE THE FILTER AND ASSOCIATED ELECTRICAL EQUIPMENT.
- (H) EQUIPMENT BACKBOARD. SEE SHEET E-9.1 FOR DETAILS.

TERTIARY FILTERS ELECTRICAL POWER PLAN
 SCALE: NONE



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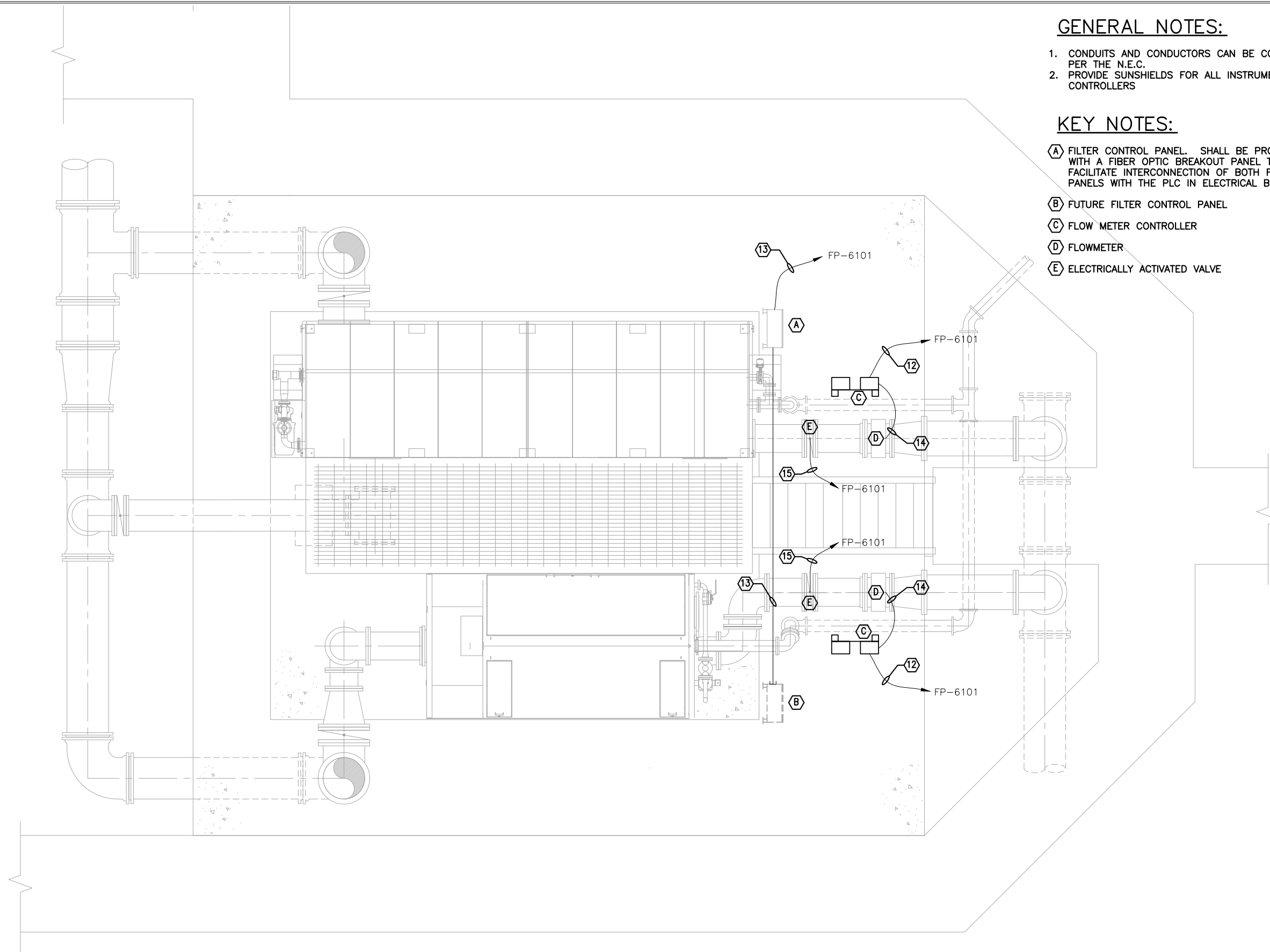
TERTIARY FILTERS ELECTRICAL
 POWER PLAN
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DWG.	E-4.0

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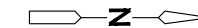
GENERAL NOTES:

1. CONDUITS AND CONDUCTORS CAN BE COMBINED PER THE N.E.C.
2. PROVIDE SUNSHIELDS FOR ALL INSTRUMENT CONTROLLERS

KEY NOTES:

- (A) FILTER CONTROL PANEL. SHALL BE PROVIDED WITH A FIBER OPTIC BREAKOUT PANEL TO FACILITATE INTERCONNECTION OF BOTH FILTER PANELS WITH THE PLC IN ELECTRICAL BUILDING 3.
- (B) FUTURE FILTER CONTROL PANEL
- (C) FLOW METER CONTROLLER
- (D) FLOWMETER
- (E) ELECTRICALLY ACTIVATED VALVE

TERTIARY FILTERS ELECTRICAL CONTROL PLAN
SCALE: NONE



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TERTIARY FILTERS ELECTRICAL CONTROL PLAN

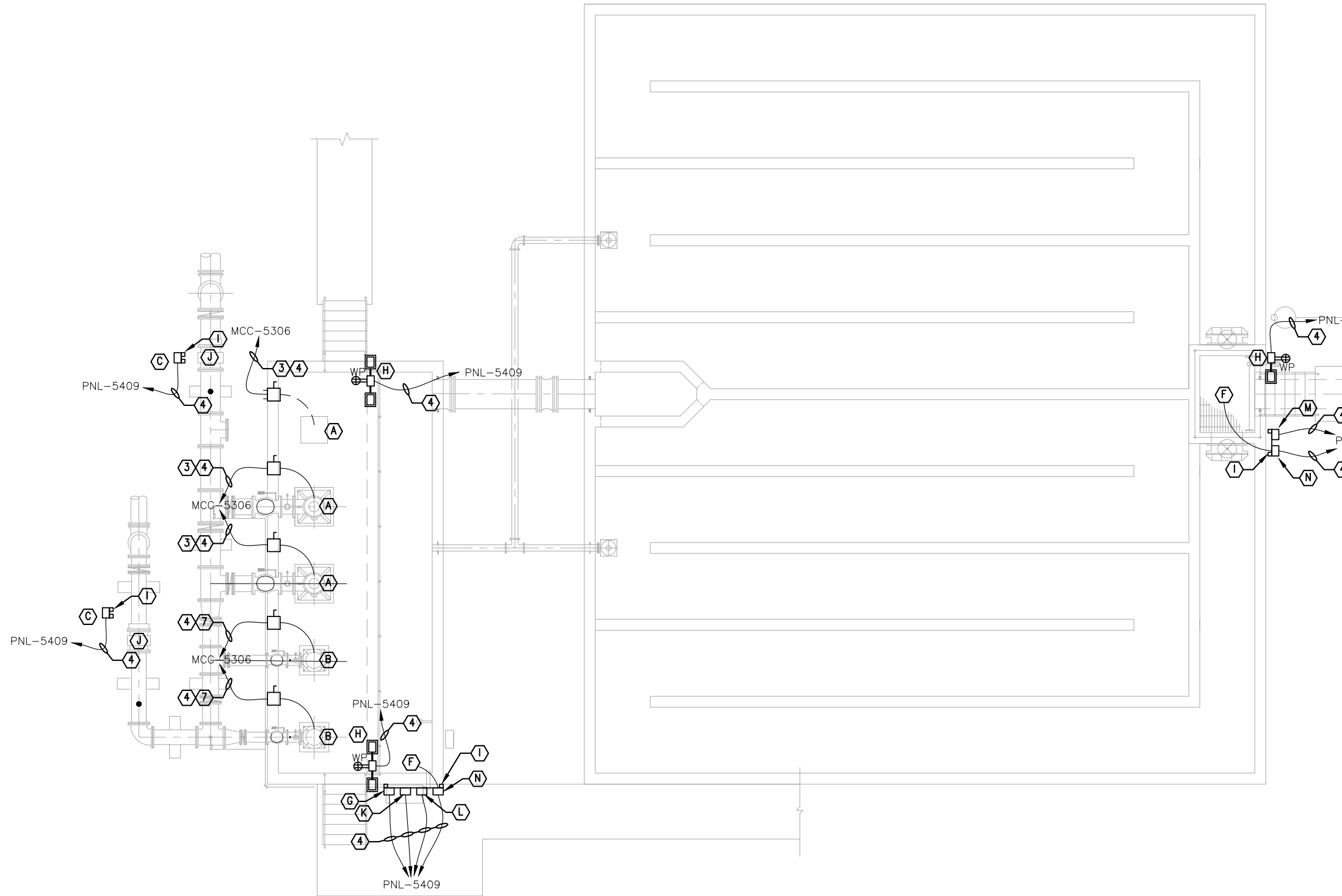
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DWG.	E-4.1

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GENERAL NOTES:

1. CONDUITS AND CONDUCTORS CAN BE COMBINED PER THE N.E.C.
2. PROVIDE SUNSHIELDS FOR ALL INSTRUMENT CONTROLLERS

KEY NOTES:

- (A) EGLIN REUSE PUMP
- (B) FWB REUSE PUMP
- (C) FLOW METER CONTROLLER
- (D) UNUSED
- (E) UNUSED
- (F) SAMPLE PUMP
- (G) LEVEL INDICATING CONTROLLER
- (H) AREA LIGHT. SEE SHEET E-9.1 FOR DETAILS.
- (I) EQUIPMENT BACKBOARD. SEE SHEET E-9.1 FOR DETAILS.
- (J) FLOW METER
- (K) CHLORINE ANALYZER
- (L) PH ANALYZER
- (M) TURBIDITY ANALYZER
- (N) SAMPLE PUMP DISCONNECT



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DISINFECTION BASIN ELECTRICAL POWER PLAN

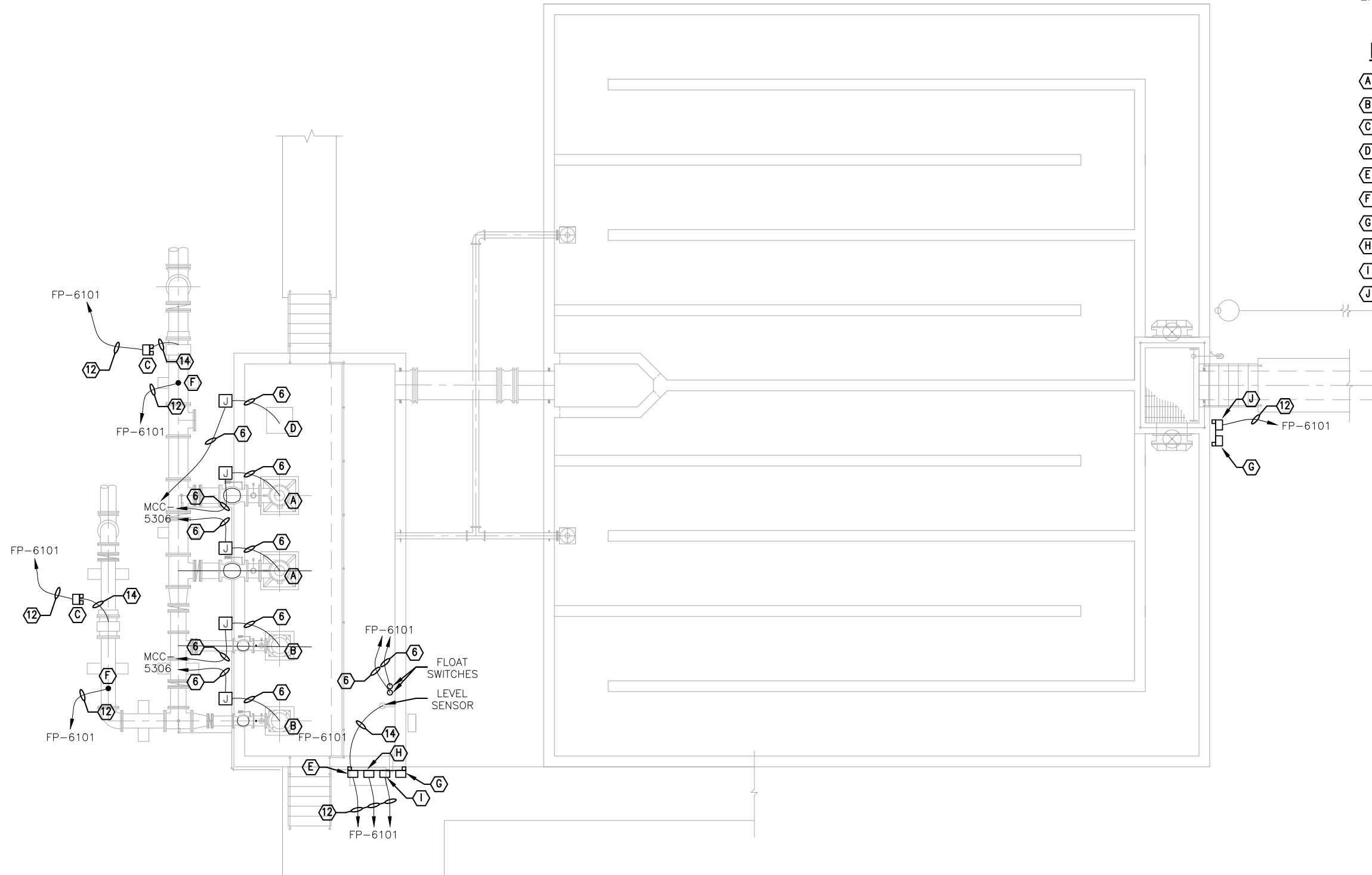
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DISINFECTION BASIN ELECTRICAL POWER PLAN
 SCALE: NONE

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DISINFECTION BASIN ELECTRICAL CONTROL PLAN

SCALE: NONE

GENERAL NOTES:

1. CONDUITS AND CONDUCTORS CAN BE COMBINED PER THE N.E.C.
2. PROVIDE SUNSHIELDS FOR ALL INSTRUMENT CONTROLLERS

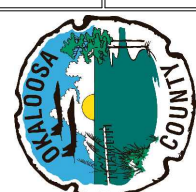
KEY NOTES:

- (A) EGLIN REUSE PUMP
- (B) FWB REUSE PUMP
- (C) FLOW METER CONTROLLER
- (D) FUTURE EGLIN REUSE PUMP
- (E) LEVEL INDICATING CONTROLLER
- (F) PRESSURE TRANSMITTER
- (G) SAMPLE PUMP DISCONNECT
- (H) CHLORINE ANALYZER
- (I) PH ANALYZER
- (J) TURBIDITY ANALYZER



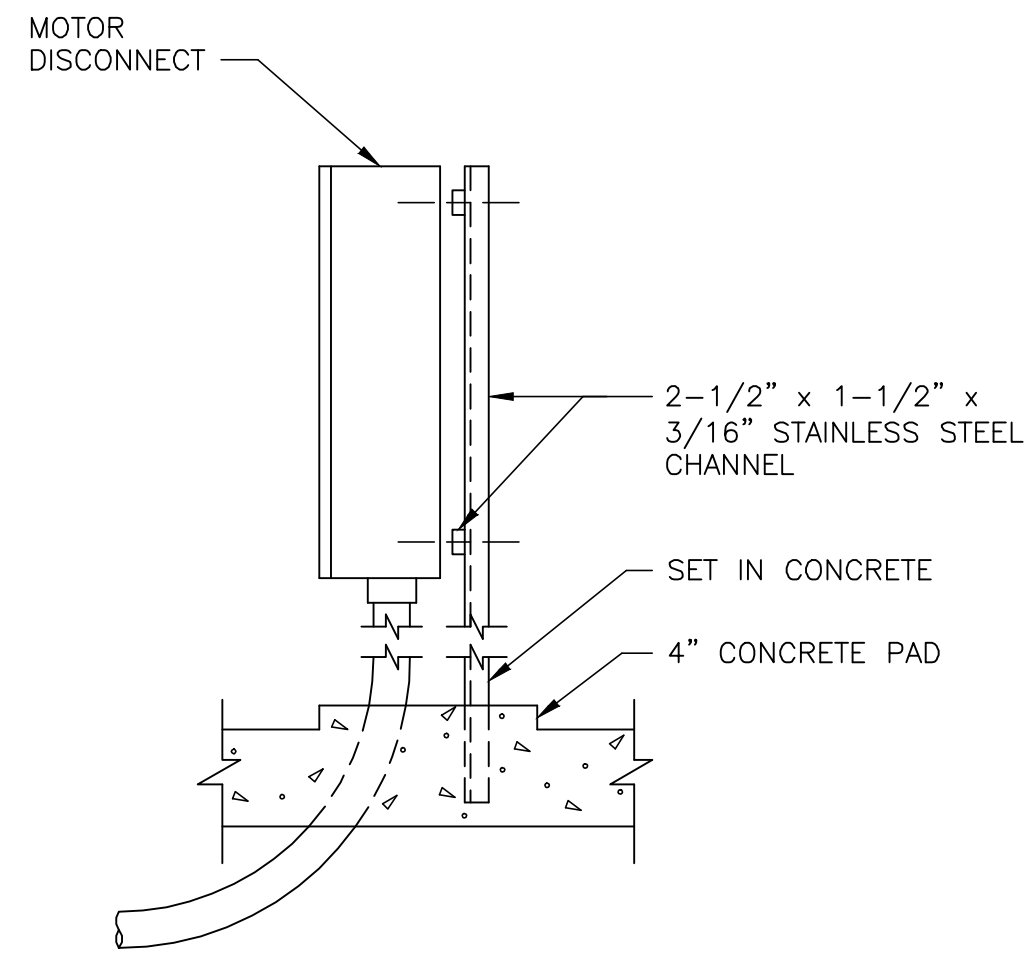
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DISINFECTION BASIN ELECTRICAL CONTROL PLAN
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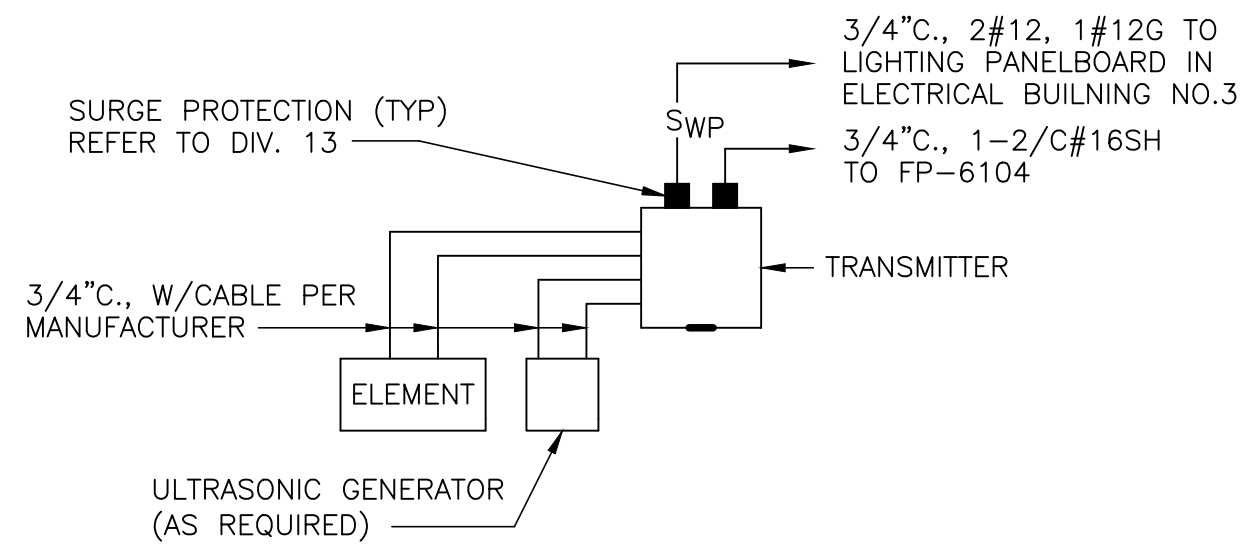


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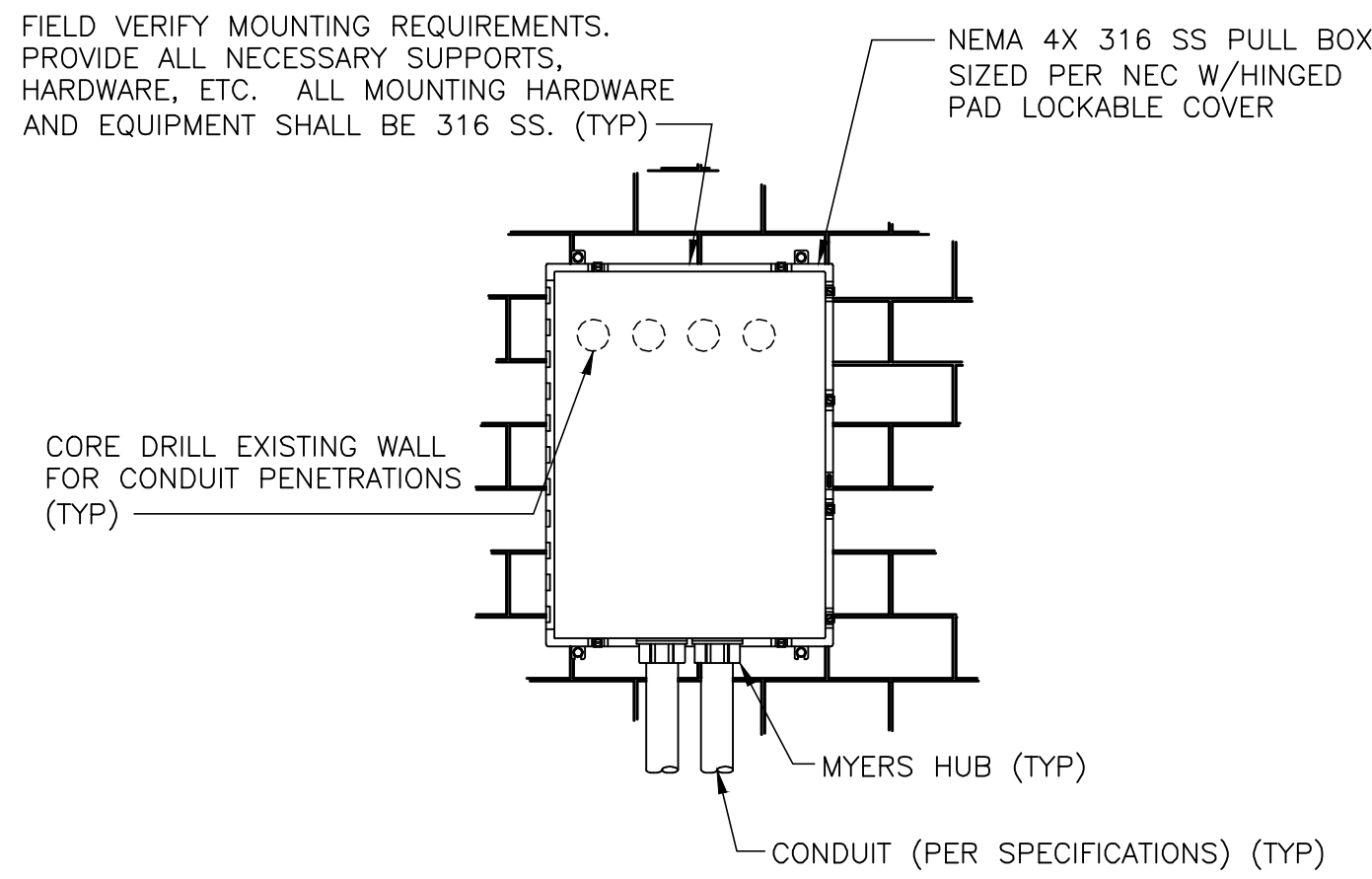
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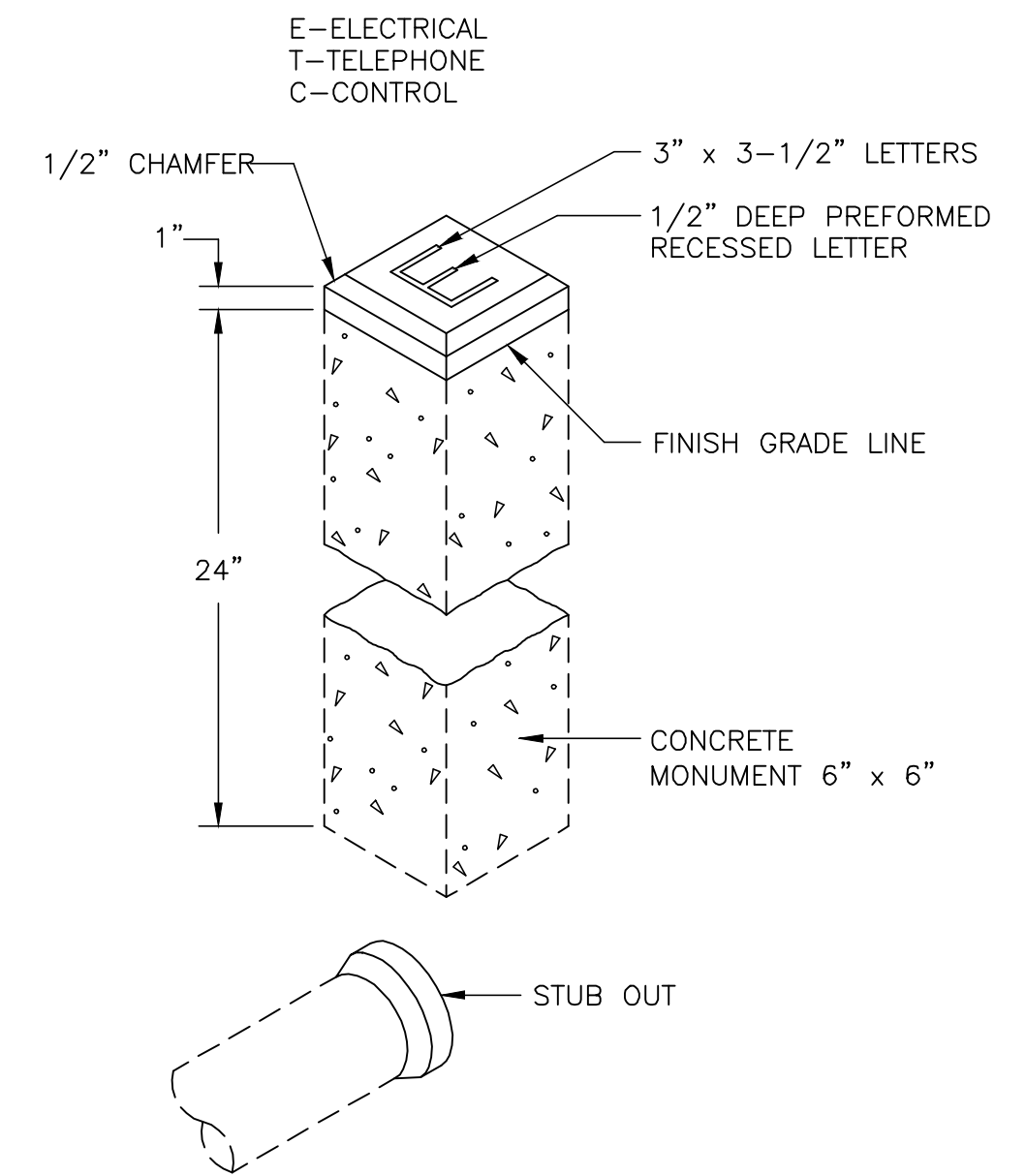
TYPICAL DISCONNECT DETAIL
 SCALE: NONE



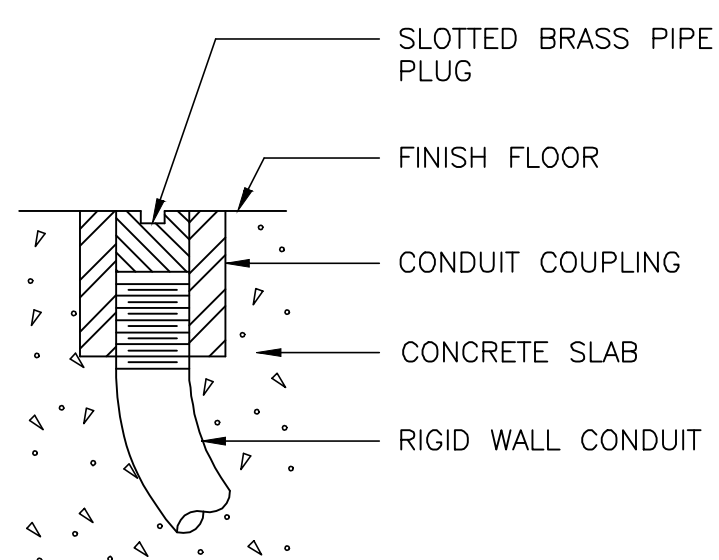
TYPICAL TRANSMITTER DETAIL
 SCALE: NONE



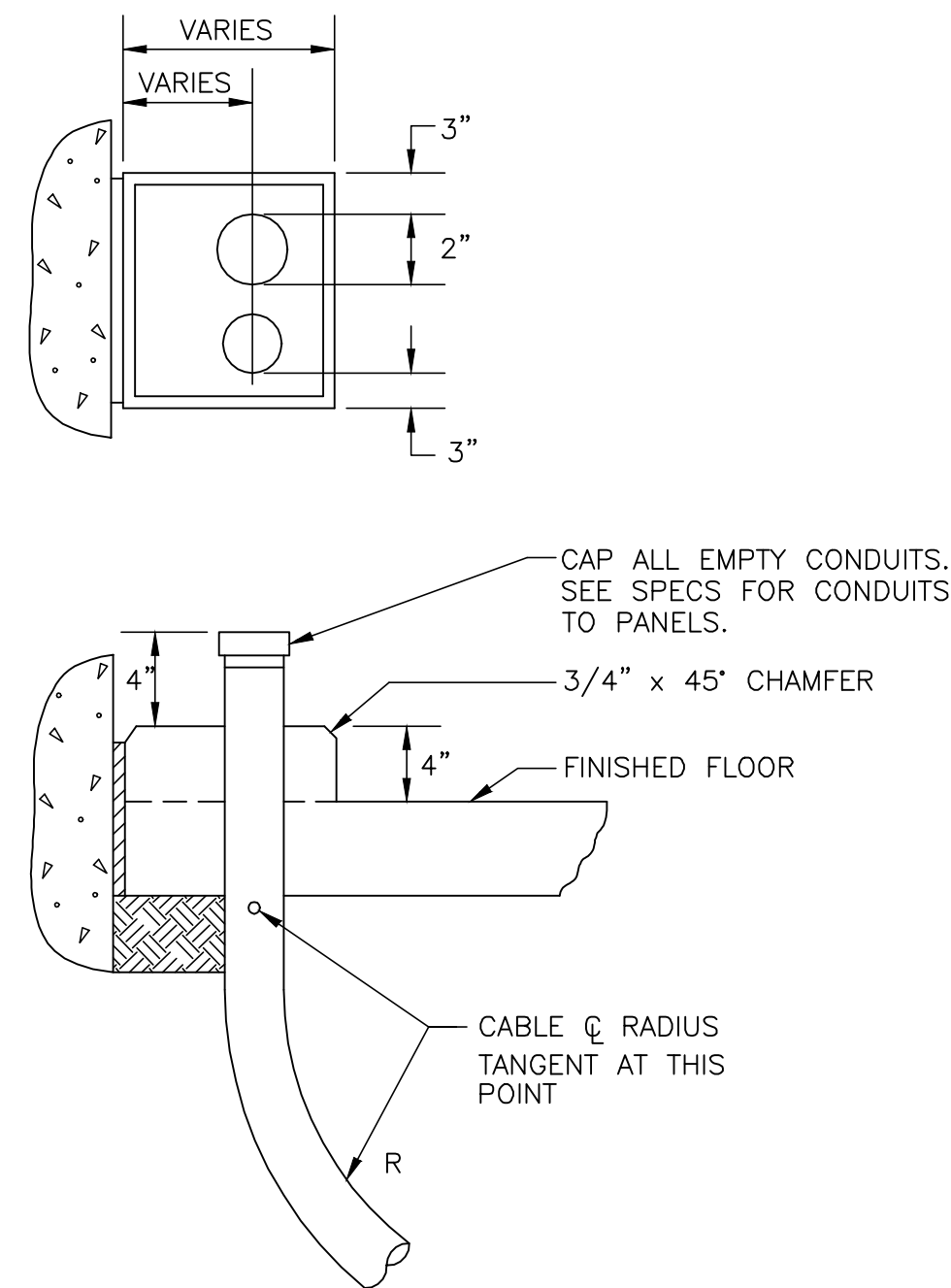
WALL MOUNT PULL BOX
 SCALE: NONE



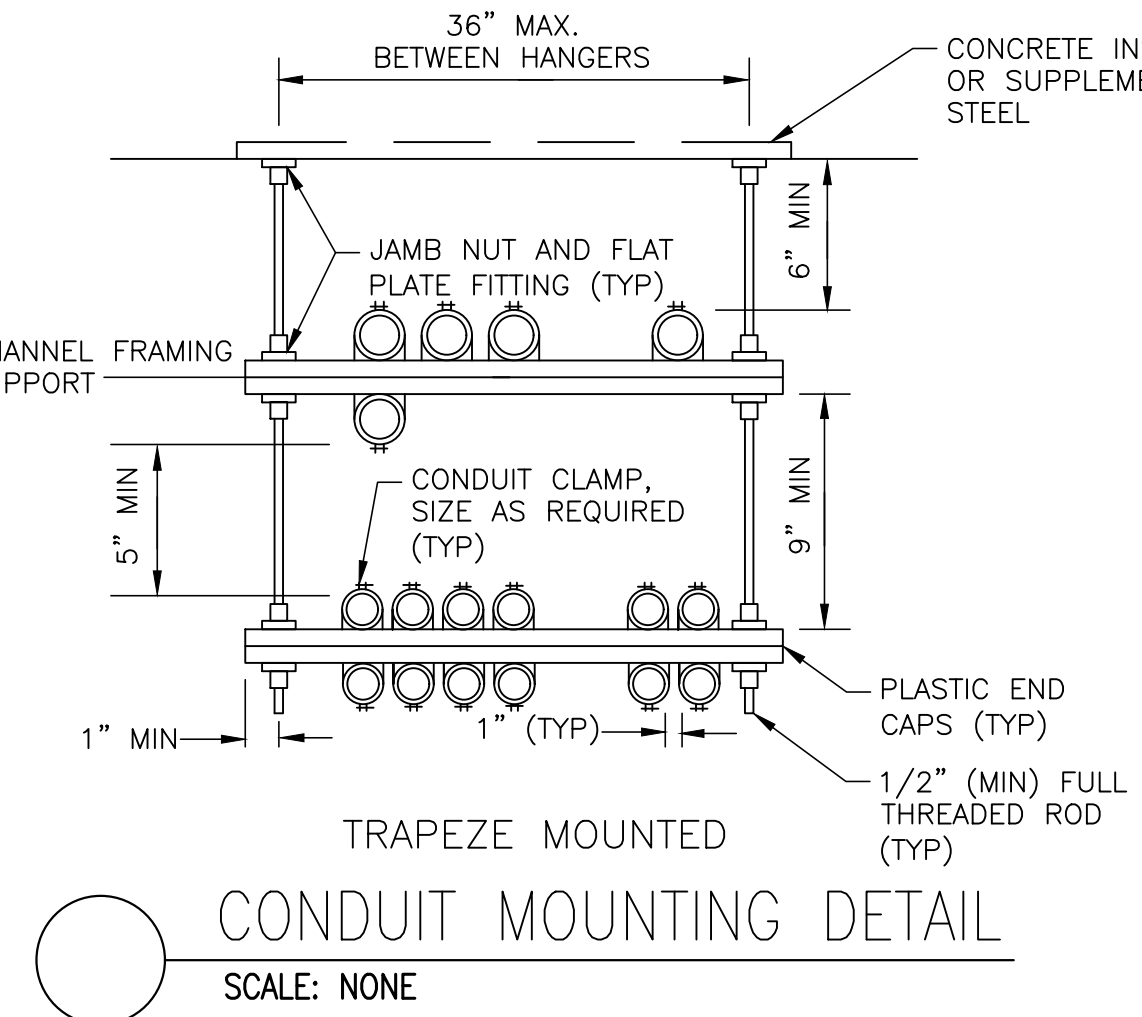
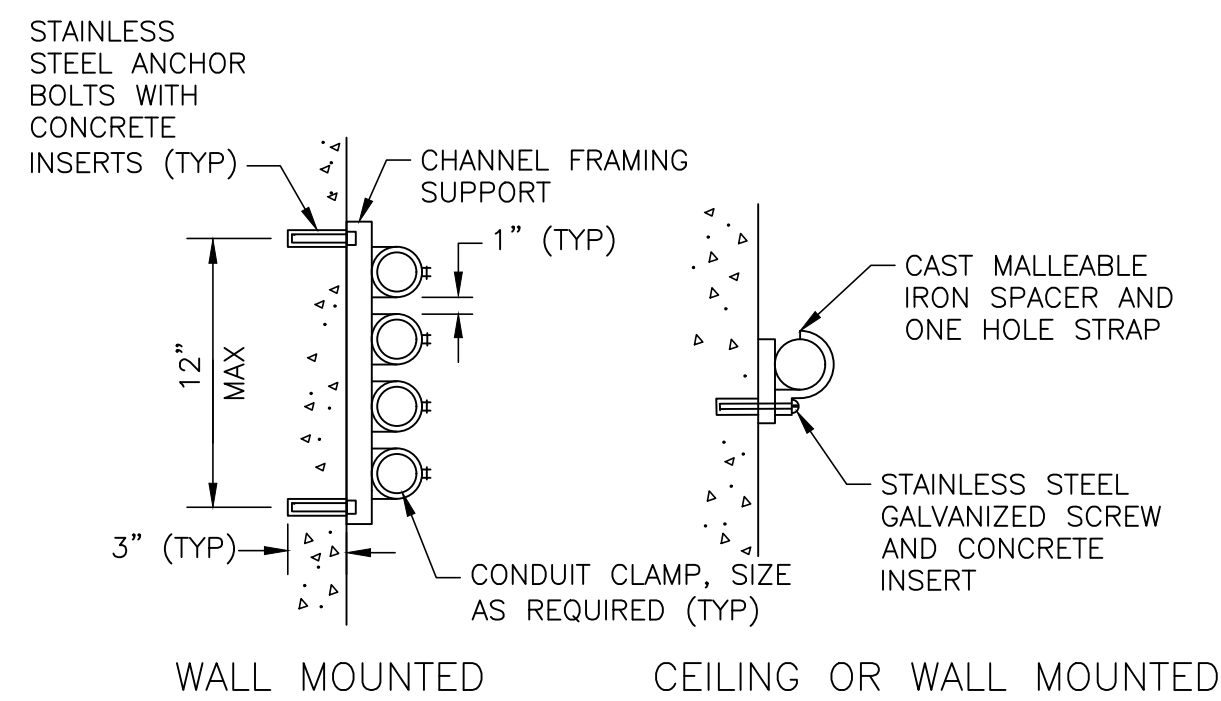
CONDUIT STUB MONUMENT DETAIL
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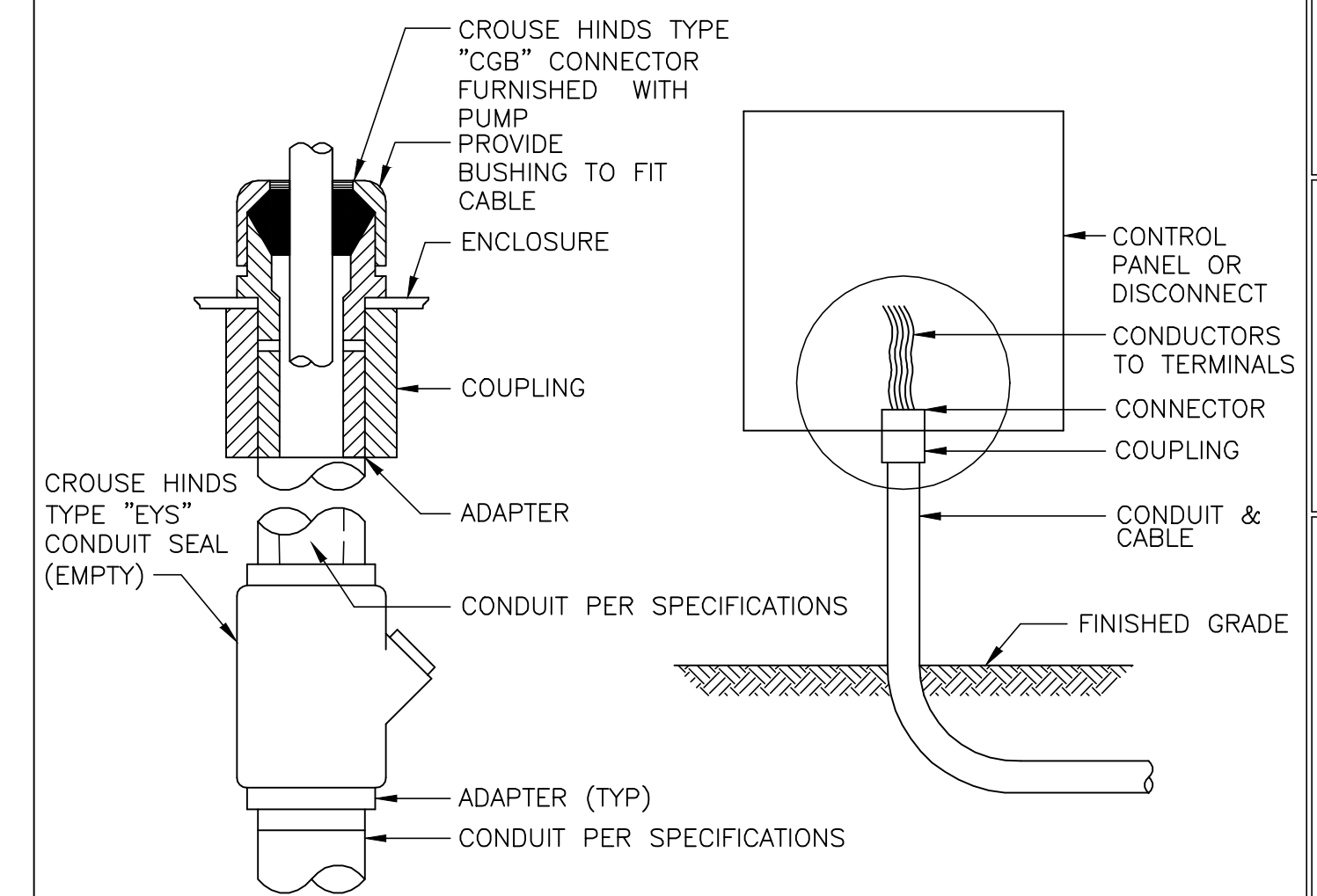
CONDUIT TERMINATION STUB UP DETAIL
 SCALE: NONE



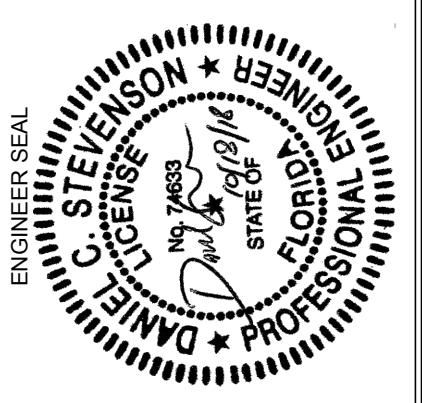
TYPICAL CONDUIT THROUGH SLAB DETAIL
 SCALE: NONE



CONDUIT MOUNTING DETAIL
 SCALE: NONE



WATER TIGHT CONNECTION DETAIL
 SCALE: NONE



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ELECTRICAL DETAILS
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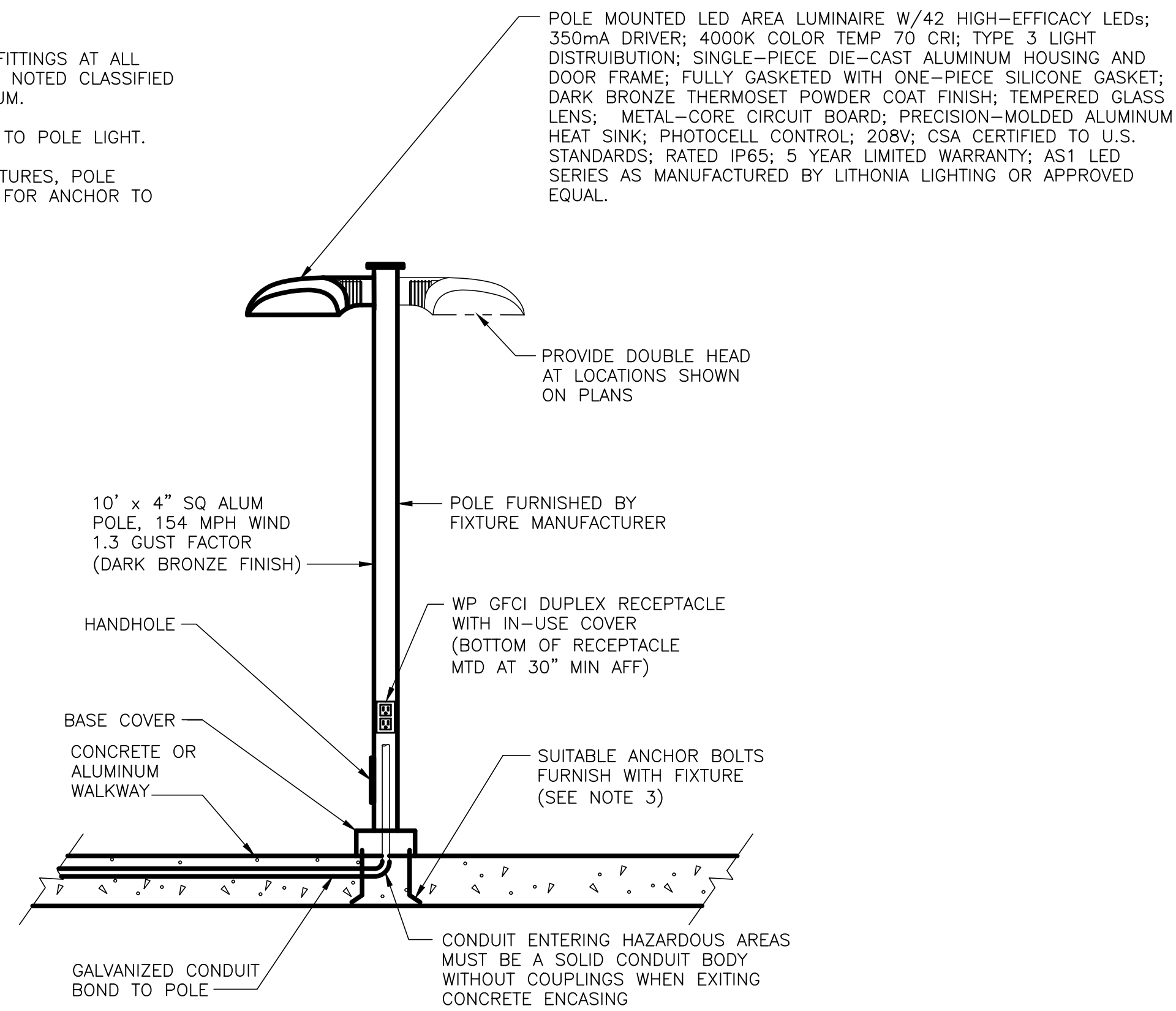
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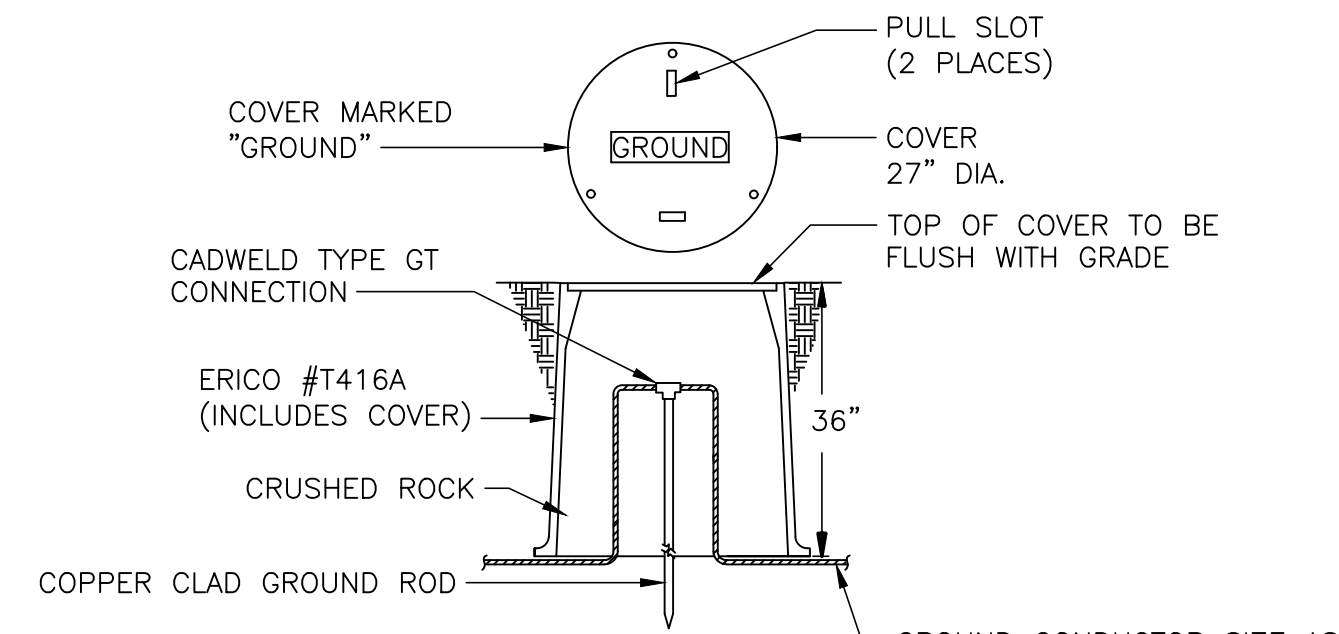
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NOTES:

1. PROVIDE EXPLOSION-PROOF SEAL OFF FITTINGS AT ALL AREAS REQUIRED BY THE NEC FOR THE NOTED CLASSIFIED AREA. FITTINGS SHALL BE CAST ALUMINUM.
2. PROVIDE SEAL OFF FITTING AT CONDUIT TO POLE LIGHT.
3. WHERE POLES ARE MOUNTED TO STRUCTURES, POLE MANUFACTURER SHALL PROVIDE DESIGN FOR ANCHOR TO MEET THE SPECIFIED WIND RATINGS.

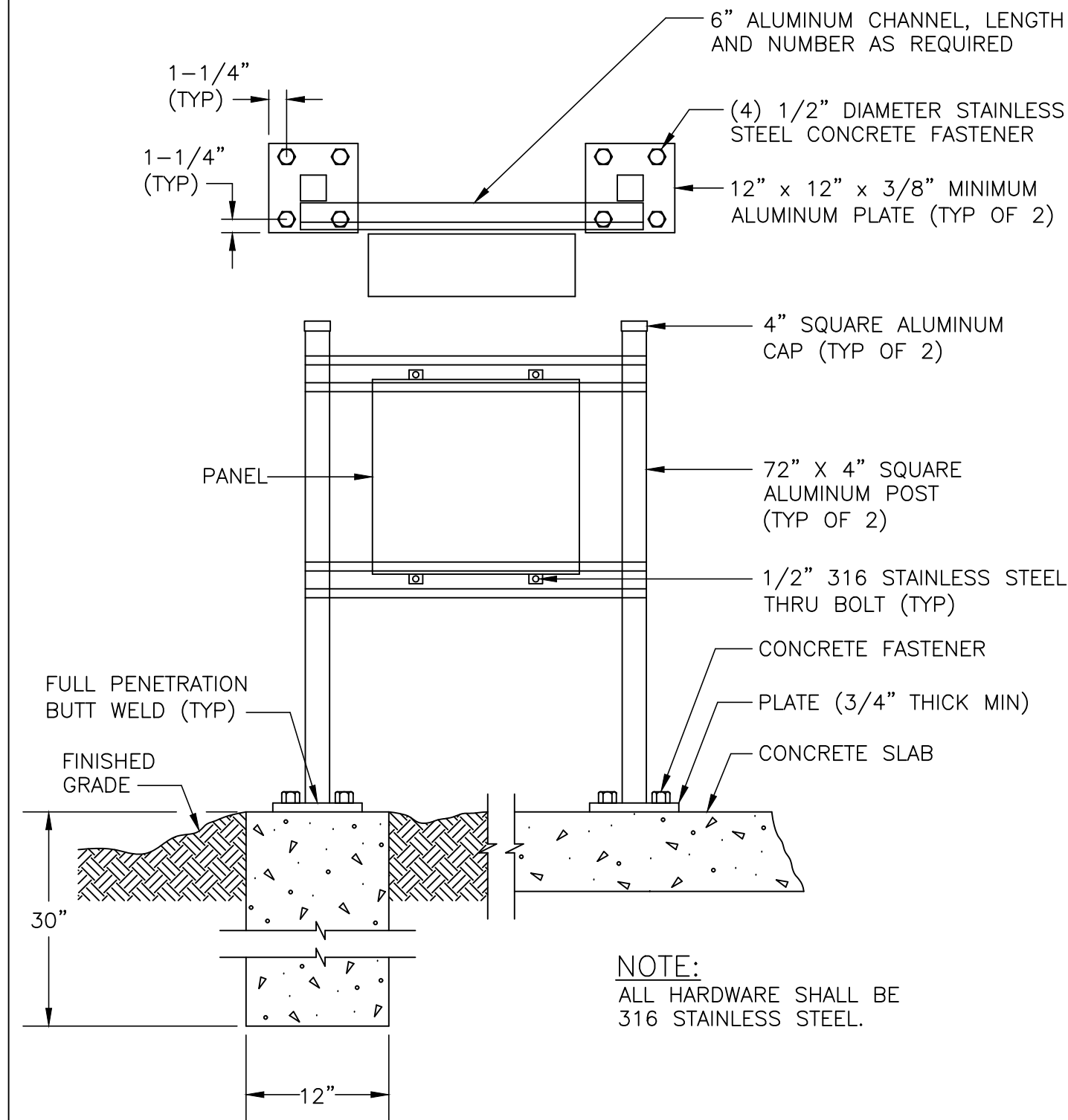


○ POLE MOUNTED FIXTURE
SCALE: NONE



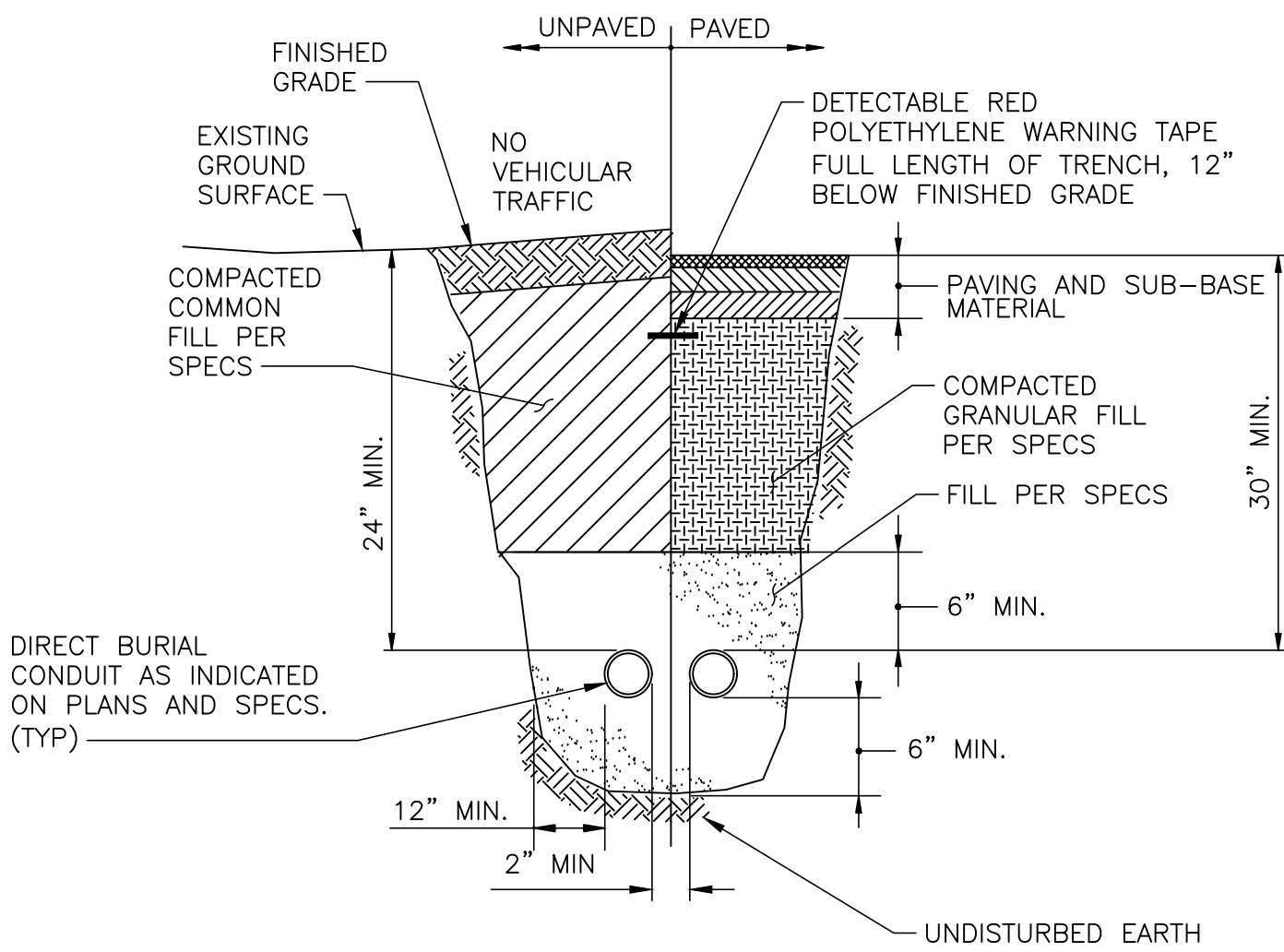
NOTE:
 1. TO IMPROVE SYSTEM RESISTANCE, ERICO GEM MAY BE USED AS A BACKFILL MATERIAL IN AN AUGERED HOLE.

○ GND ROD TEST WELL STATION DETAIL
SCALE: NONE

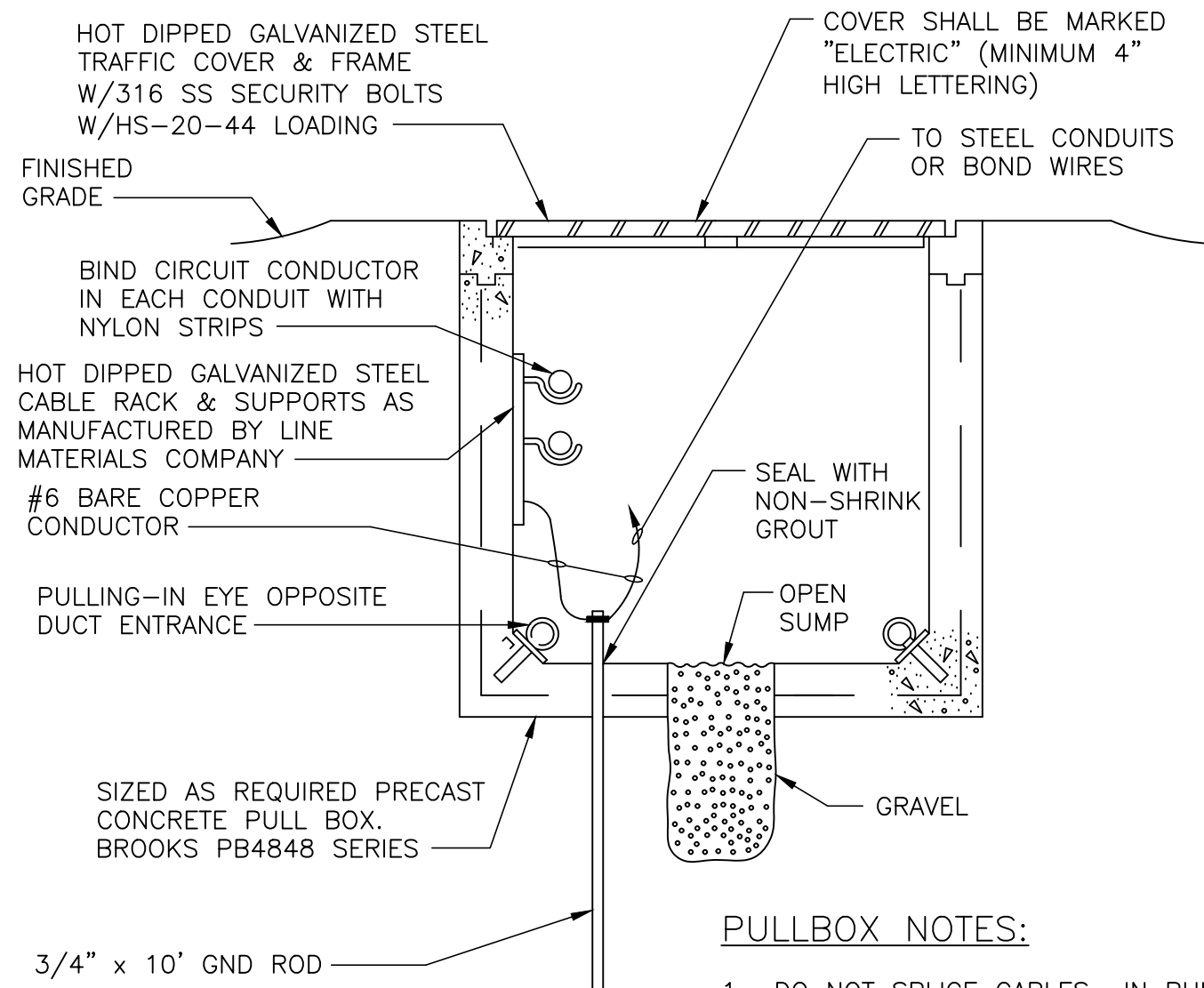


NOTE:
 ALL HARDWARE SHALL BE 316 STAINLESS STEEL.

○ PANEL MOUNTING DETAIL
SCALE: NONE

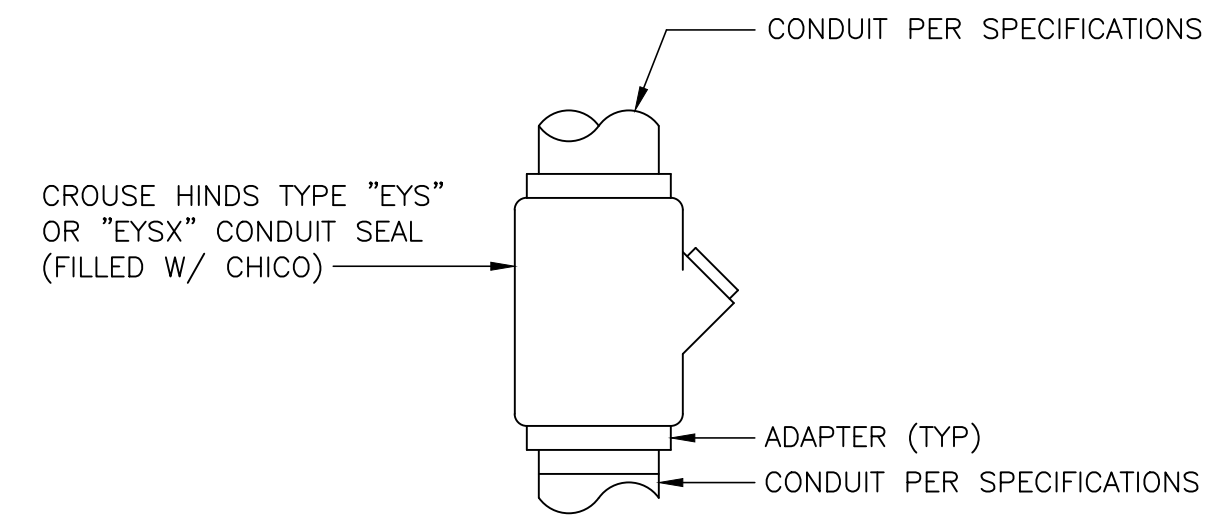


○ HTYPICAL DIRECT BURIED CONDUIT INSTALLATION DETAIL
SCALE



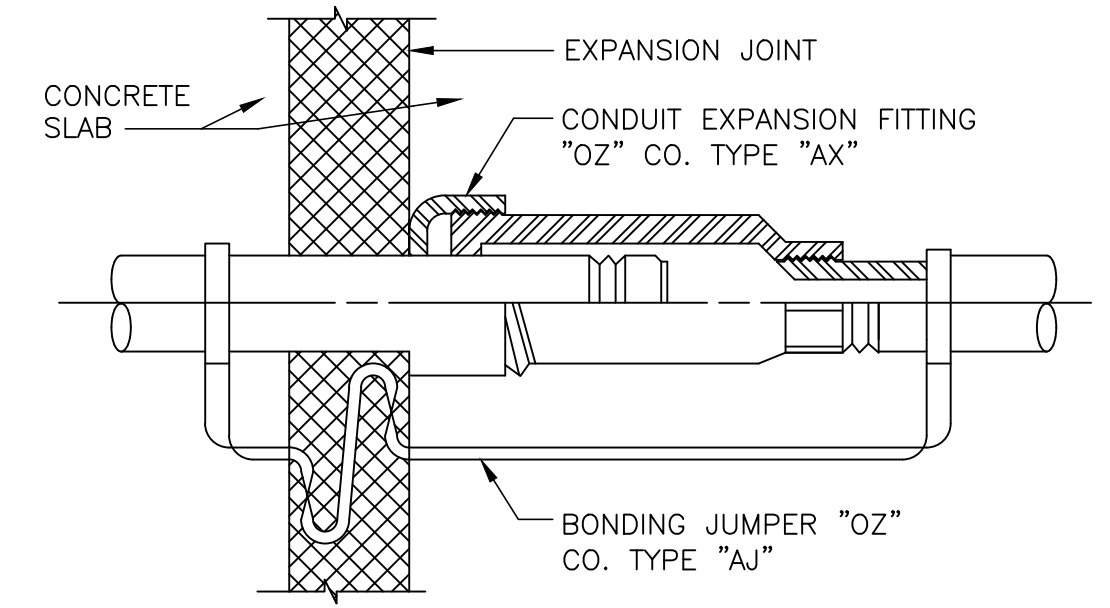
PULLBOX NOTES:
 1. DO NOT SPLICE CABLES IN PULL BOXES UNLESS OTHERWISE NOTED.
 2. ALL MOUNTING HARDWARE SHALL BE 316 SS.
 3. PULLBOX TO BE PLACED ON 6" BASE OF GRAVEL.

○ TYPICAL PULLBOX DETAIL
SCALE: NONE



NOTE:
 PROVIDE COPPER-FREE ALUMINUM BODIES, NIPPLES AND ENCLOSURES.

○ CONDUIT SEAL CONNECTION DETAIL
SCALE: NONE



○ EXPANSION FITTING DETAIL
SCALE: NONE



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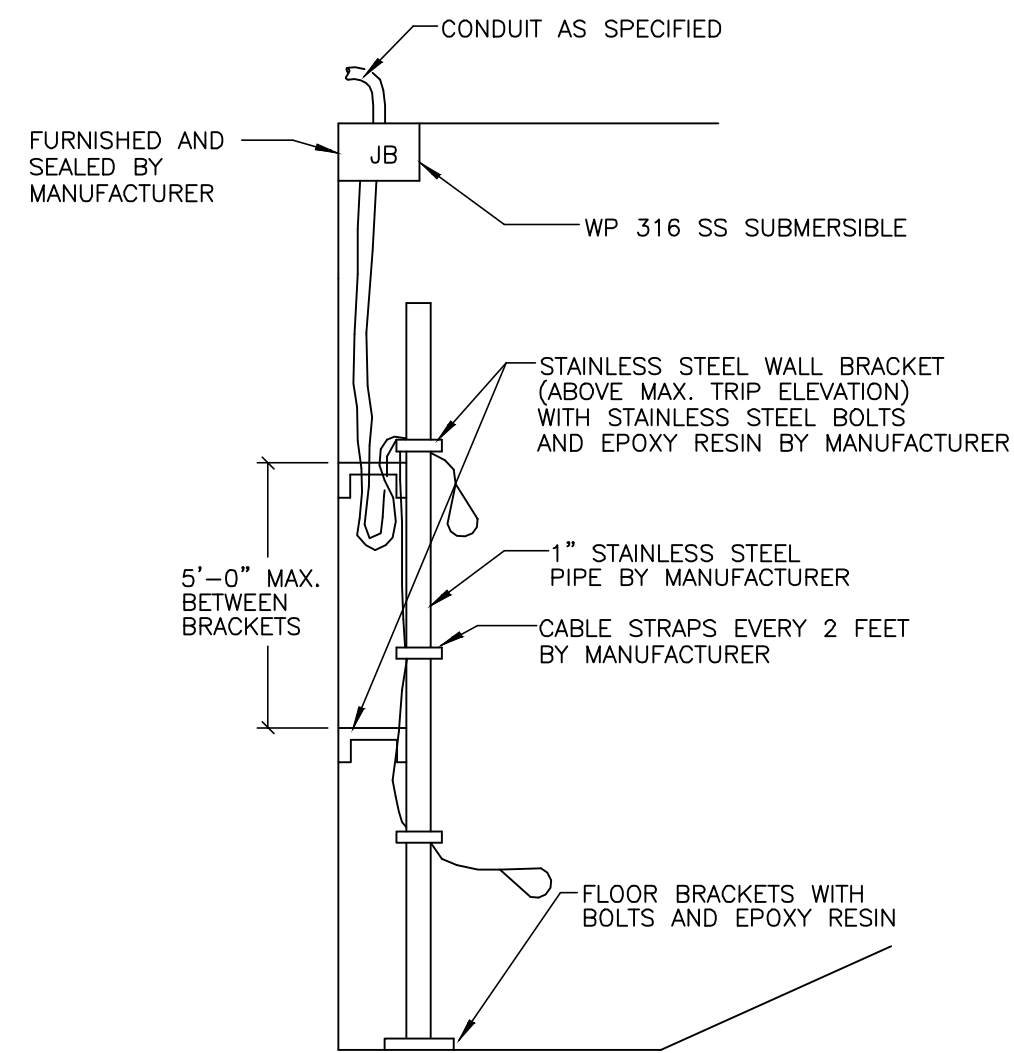
ELECTRICAL DETAILS
 OCWS APWRF RECLAIM EXPANSION



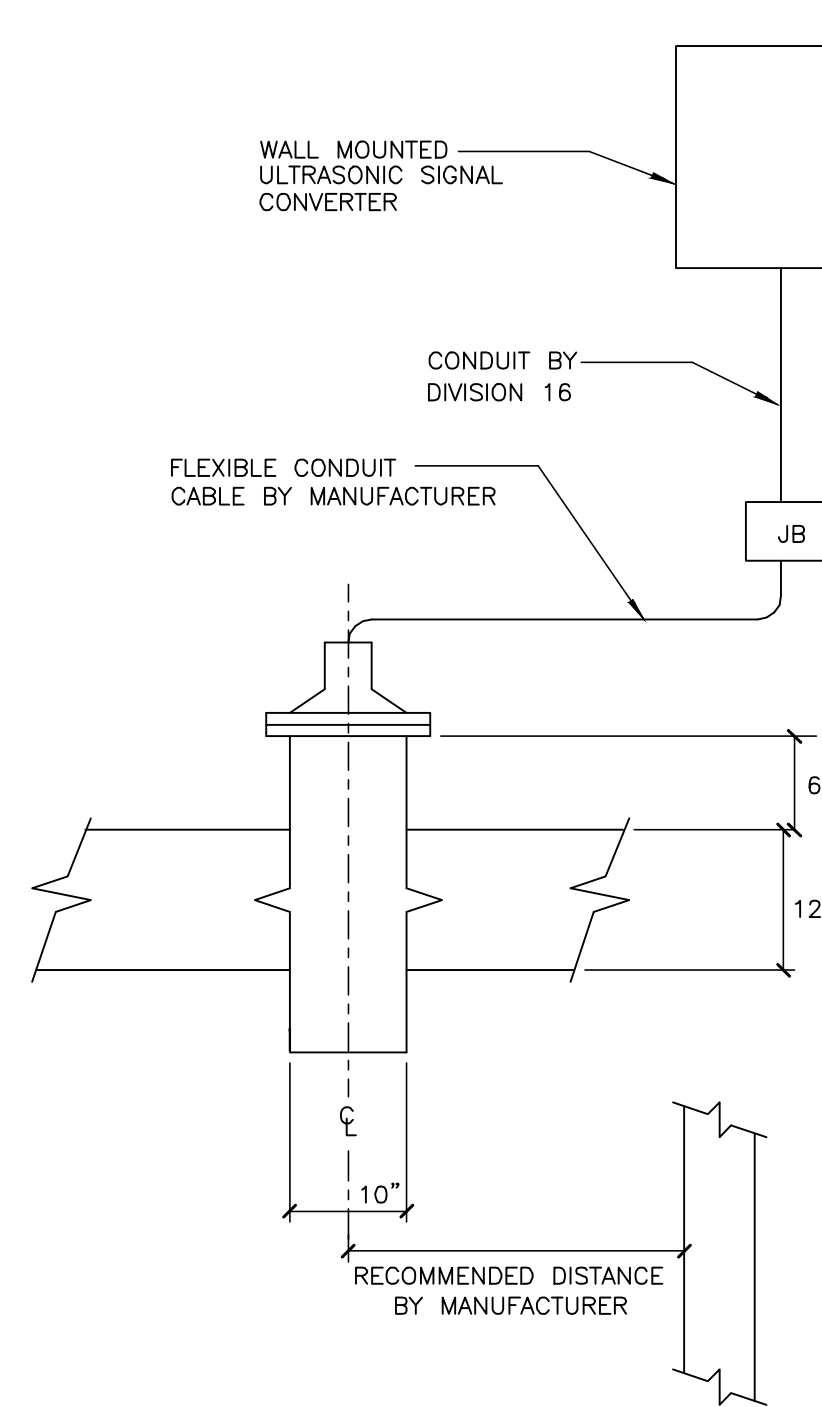
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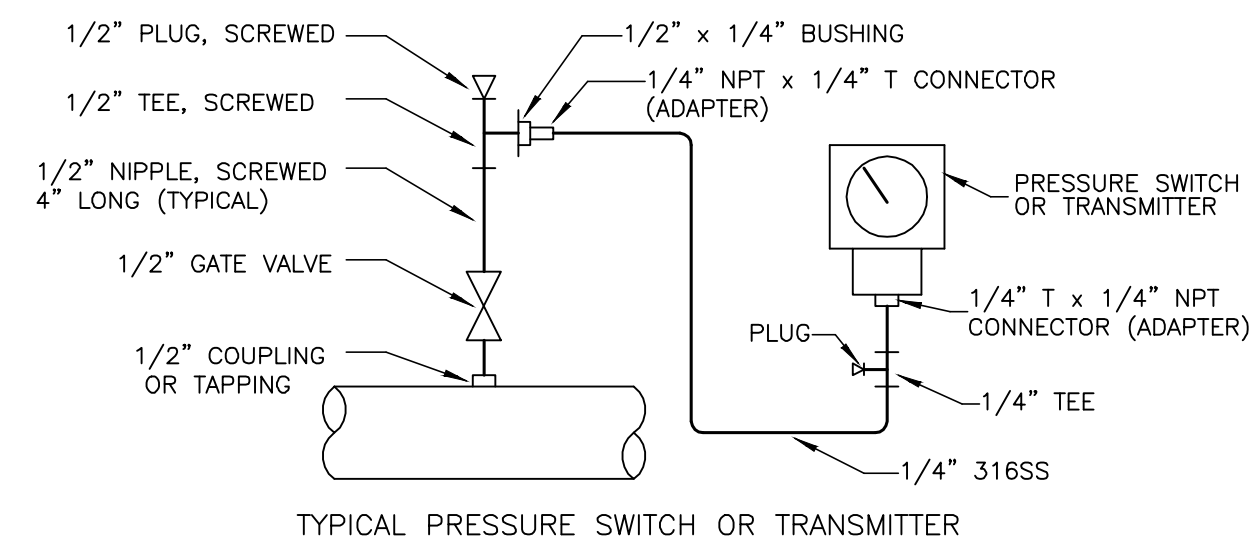
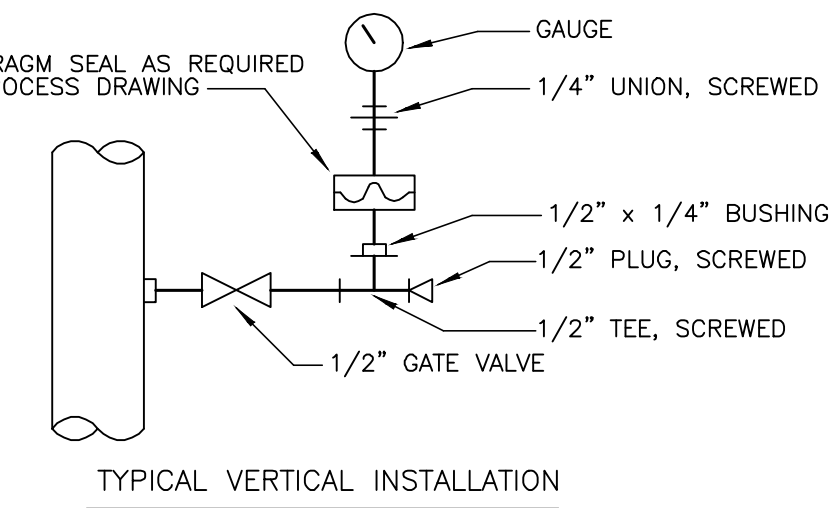
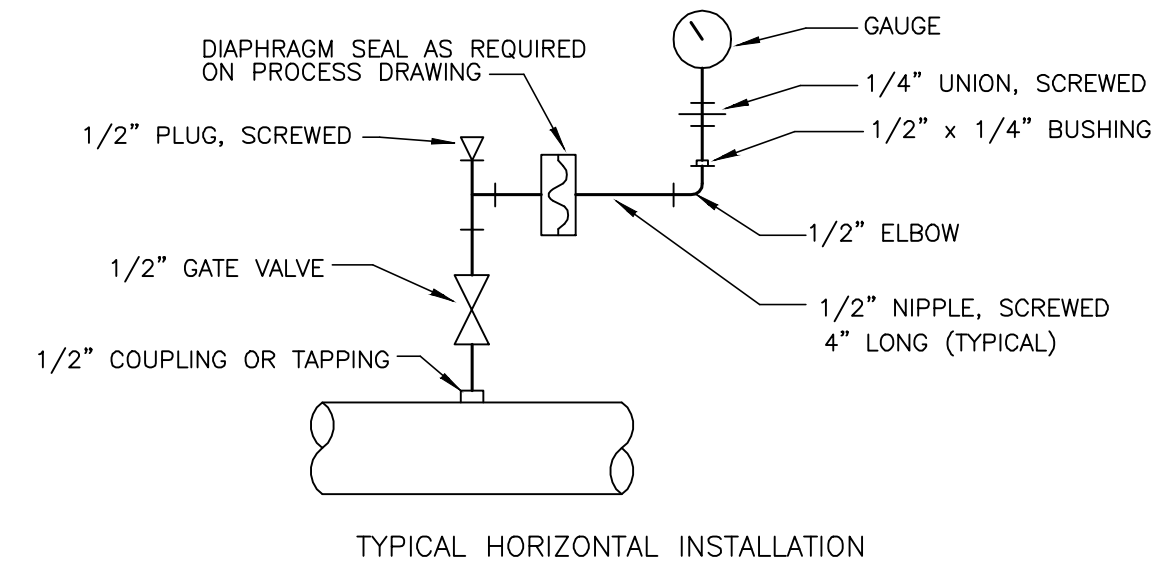
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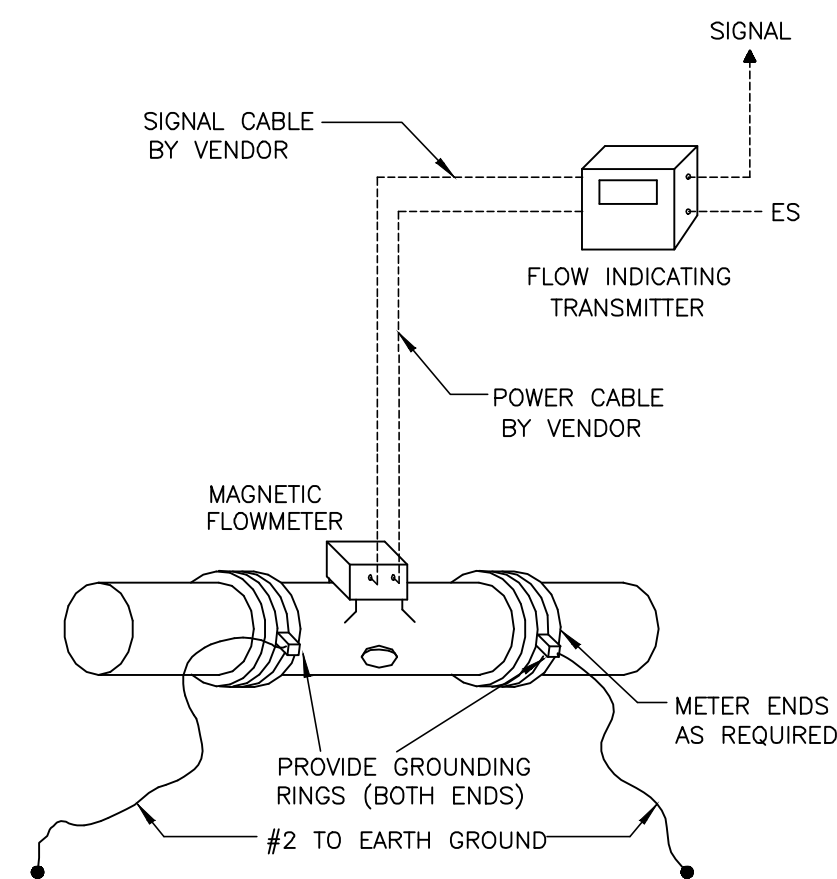
FLOAT SWITCH INSTALLATION DETAIL
 SCALE: NONE



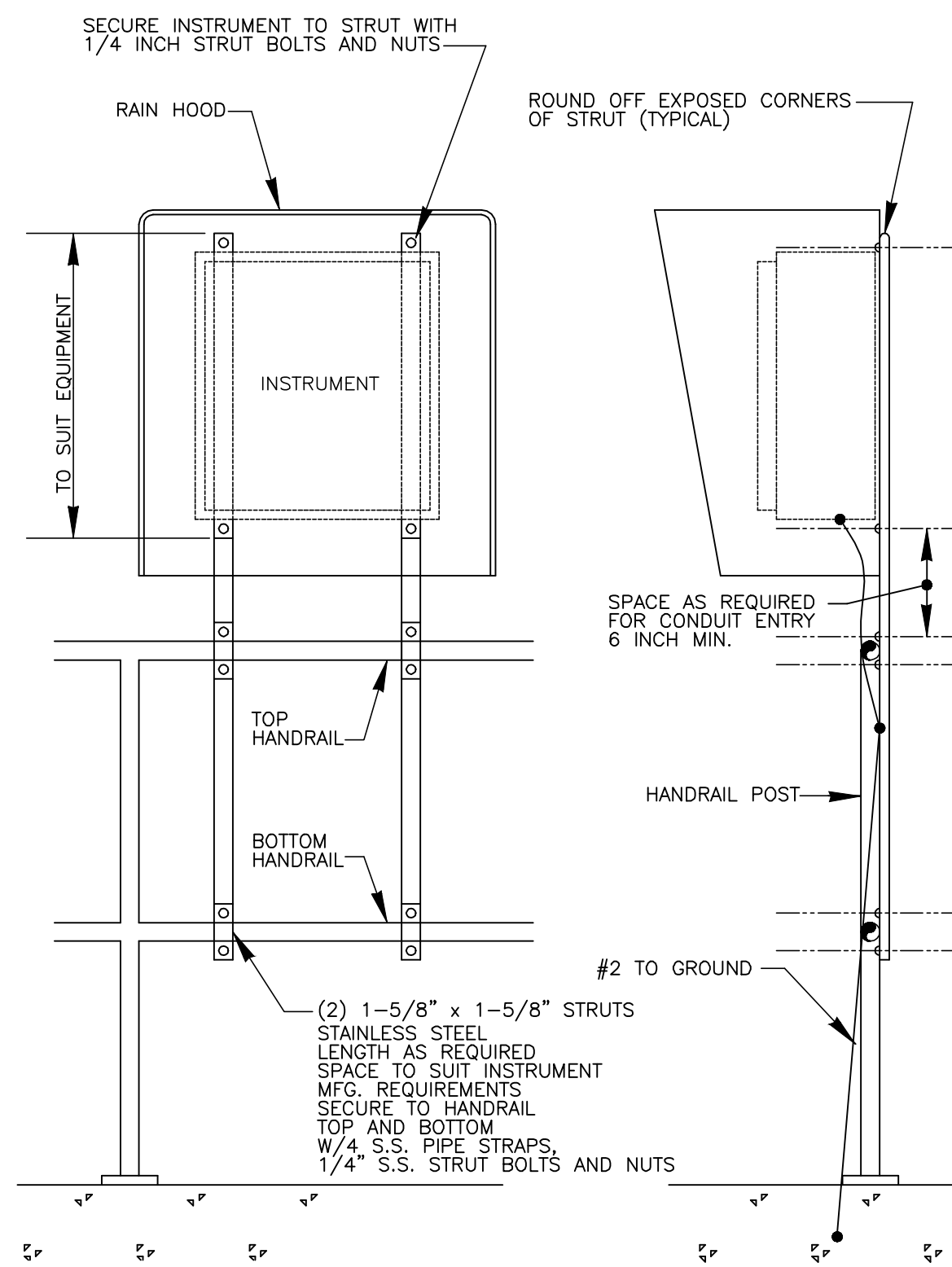
ULTRASONIC LEVEL TRANSMITTER DETAIL
 SCALE: NONE



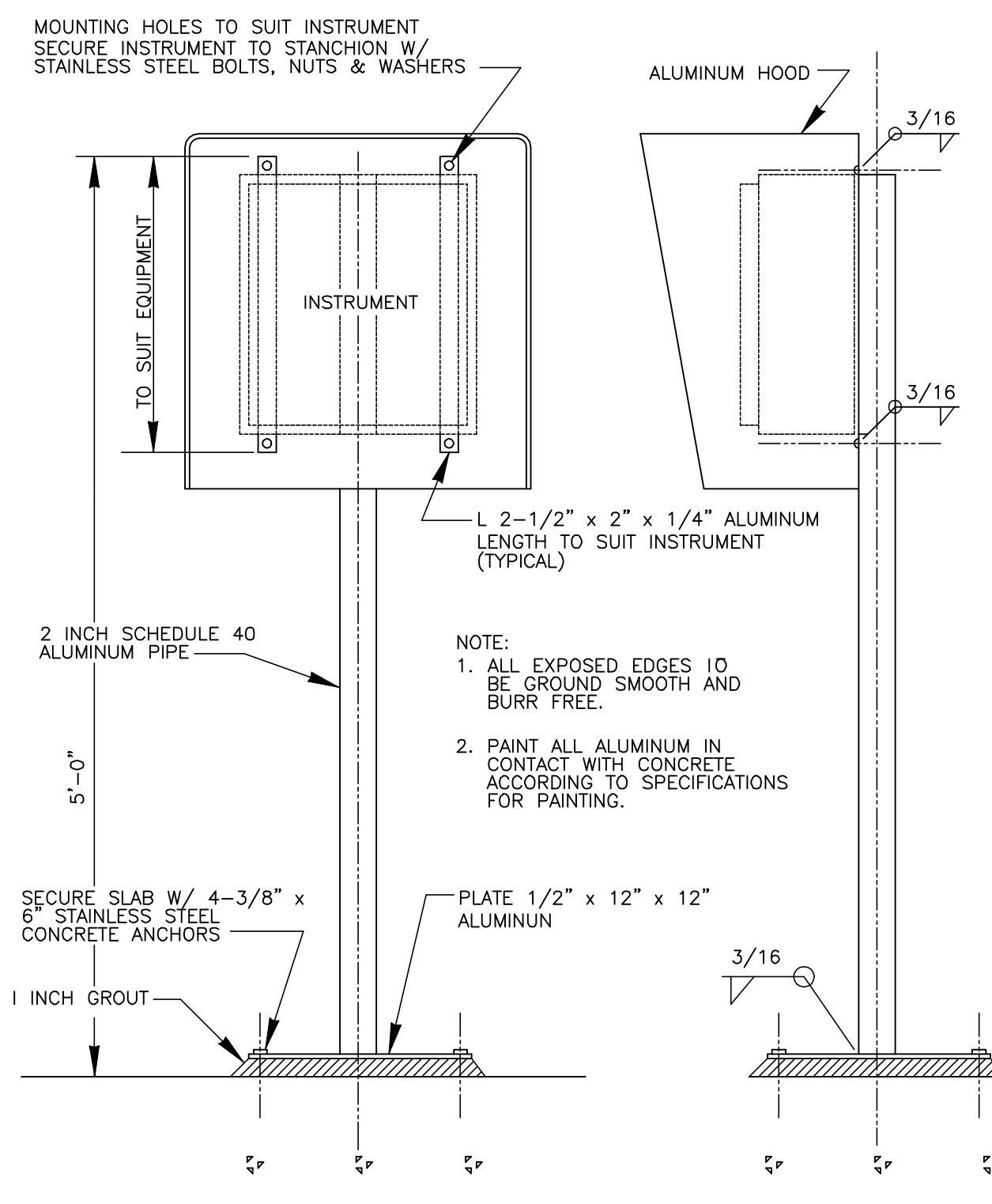
PRESSURE INSTRUMENTS INSTALLATION
 SCALE: NONE



MAGNETIC FLOWMETER INSTALLATION
 SCALE: NONE



HANDRAIL MOUNTING FOR CASE MOUNTED INSTRUMENTS
 SCALE



STANCHION MOUNTING FOR CASE MOUNTED INSTRUMENTS
 SCALE



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INSTALLATION DETAILS

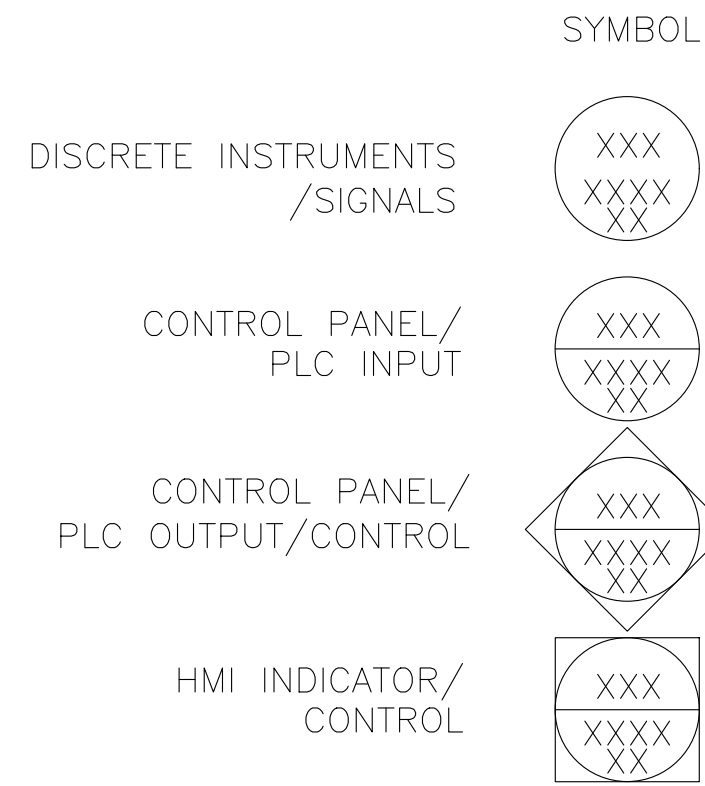
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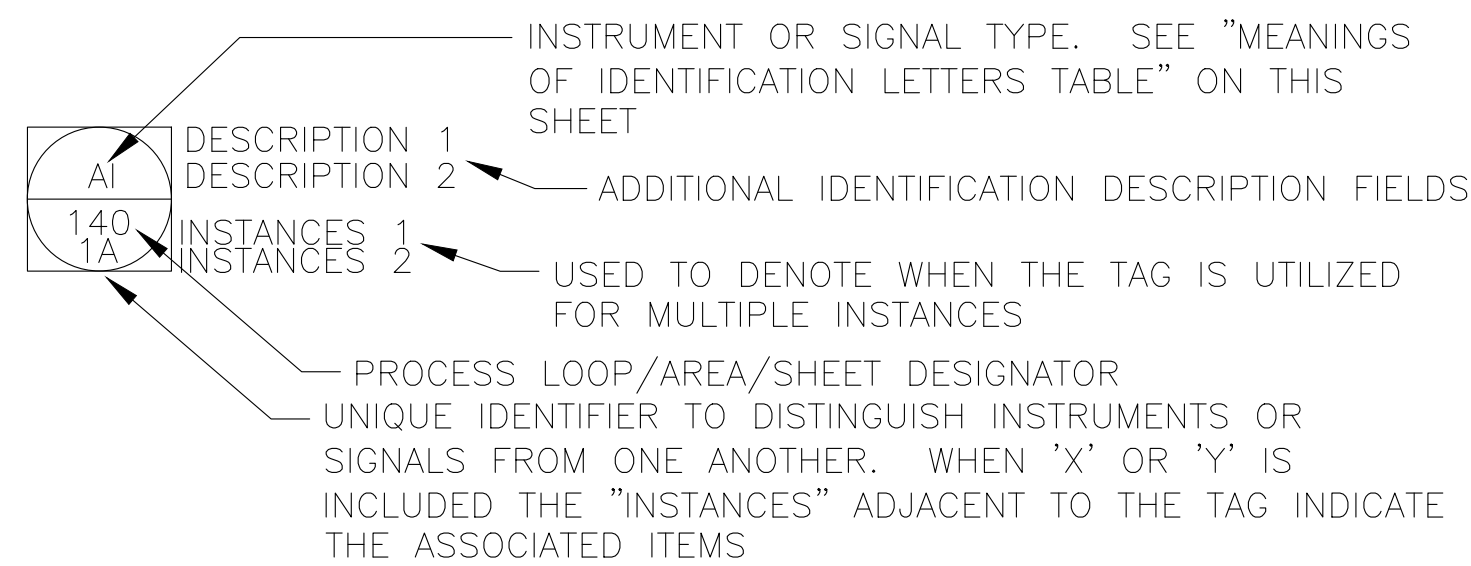
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DATE	OCTOBER 2018
PROJ.	100501.00
DWG.	E-9.2

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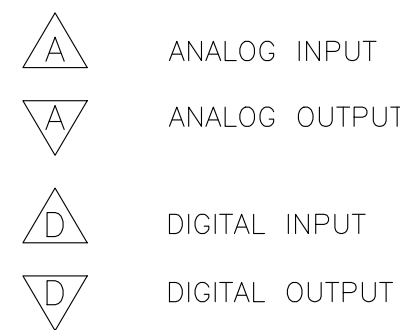
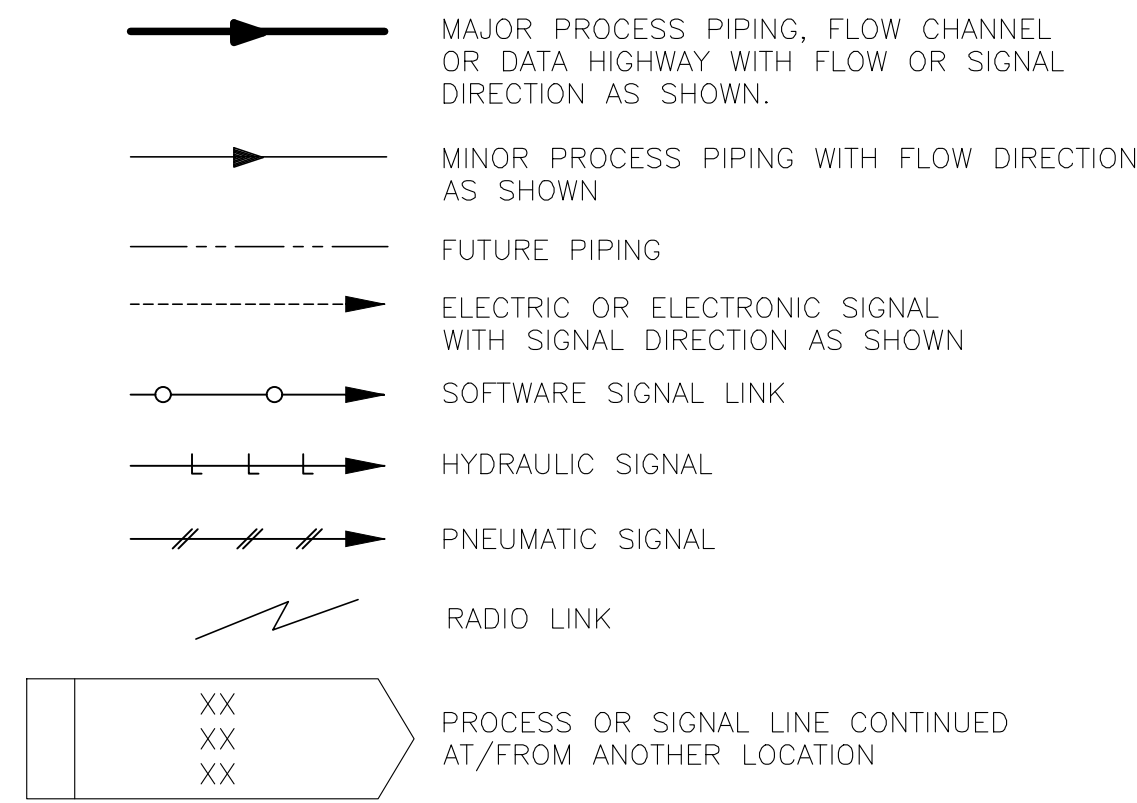
GENERAL INSTRUMENT OR FUNCTION SYMBOLS



TYPICAL TAG NUMBERS & DESIGNATION



LINE SYMBOLS



GENERAL ABBREVIATIONS

AI	ANALOG IN	FO	FAIL OPEN OR FIBER OPTIC	PRESS	PRESSUP
AO	ANALOG OUT	FOE	FIBER OPTIC ETHERNET	PS	POWER SUPPLY
AS	AIR SUPPLY	FOC	FIBER OPTIC CABLE	PTZ	PAN/TILT/ZOOM
ASC	ANTISCALANT SYSTEM	FOM	FIBER OPTIC MODEM	RCP	RELAY CONTROL PANEL
BCM	BACKUP CONTROL MODULE	FOR	FIBER OPTIC REPEATER	RIO	REMOTE INPUT/OUTPUT RACK
BGS	BELOW THE GROUND SURFACE	FP	FIELD PANEL	RIOD	REMOTE I/O DROP MODULE
BLD	BLEED	FREQ	FREQUENCY	RIOH	REMOTE I/O HEAD MODULE
BLW	BLEND WATER	FSP	FILL SUPPLY PANEL	ROP	REVERSE OSMOSIS PUMP
BW	BACKWASH	FW	FEED WATER	RTU	REMOTE TERMINAL UNIT
BYP	BYPASS	FWP	FEED WATER PUMP	RW	RAW WATER
CAFP	CONTAINMENT FLOOD ALARM PANEL	HMI	HUMAN MACHINE INTERFACE	SUA	SULFURIC ACID
CAT5	CATEGORY 5 CABLE	HSTDBY	HOT STANDBY	SCAFP	SECONDARY CONTAINMENT
CIP	CLEAN IN PLACE	INT	INTERSTAGE	SDI	FLOOD ALARM PANEL
CONC	CONCENTRATE	I/O	INPUT/OUTPUT	SCFM	STANDARD CUBIC FEET PER MINUTE
COND	CONDUCTIVITY	IS	IN-SERVICE	SDI	SILT DENSITY INDEX
CORI	CORROSION INHIBITOR	KVM	KEYBOARD/VIDEO/MOUSE SWITCH	SHC	SODIUM HYPOCHLORITE
CPU	CENTRAL PROCESSOR UNIT	LB	LOWER BEARING	SP	SETPOINT
CRT	CATHODE-RAY TUBE	L/C	LOCAL/COMPUTER	SPL	SAMPLE
CTU	CENTRAL TELEMETRY UNIT	MC	MOTOR CONTROLLER	SR	SURGE RELIEF
CS	CONSTANT SPEED	MCC	MOTOR CONTROL CENTER	SSM	SOLID STATE METERING
D	DRAIN	NAOH	SODIUM HYDROXIDE	ST	STORAGE
DCU	DISTRIBUTED CONTROL UNIT	NC	NORMALLY CLOSED	SW	SEAL WATER
DNB	DEVICENET MODULE	NIC	NETWORK INTERFACE CARD	SWGR	SWITCHGEAR
DI	DIGITAL OR DISCRETE INPUT	NO	NORMALLY OPEN	TDR	TIME DELAY RELAY
DO	DIGITAL OUTPUT OR DISSOLVED OXYGEN DURATION	NPW	NON POTABLE WATER	UB	UPPER BEARING
DUR	DURATION	OCM	OPTICAL COMMUNICATION MODULE	UP	MICROPROCESSOR
EFAP	EYEWASH FLOW ALARM PANEL	OFO	OVERHEAD FIBER OPTIC	UPS	UNINTERRUPTIBLE POWER SUPPLY
EFW	EMERGENCY FLUSHING WATER	OIU	OPERATOR INTERFACE UNIT	US	MICRO SIEMENS
ENBT	ETHERNET MODULE	OL	OVERLOAD	VFD	VARIABLE FREQUENCY DRIVE
ES	ELECTRIC SUPPLY, 120 VAC	OWS	OPERATOR WORKSTATION	VIB	VIBRATION
FC	FAIL CLOSED	P	PUMP	VS	VARIABLE SPEED
FCC	FILTER CONTROL CONSOLE	PC	PERSONAL COMPUTER	VSD	VARIABLE SPEED DRIVE
FCP	FILTER CONTROL PANEL	PERM	PERMEATE	WAN	WIDE AREA NETWORK
FFP	FEED PUMP PANEL	pH	HYDROGEN ION CONCENTRATION		
FIN	FINISHED WATER	PLC	PROGRAMMABLE LOGIC CONTROLLER		
FLP	FAIL LAST POSITION	PMU	POWER MONITOR UNIT		
FNIC	FIBER NETWORK INTERFACE CARD	POLM	POLYMER		
		POS	POSITION		

HAND SWITCH ABBREVIATIONS

A/M	AUTO/MANUAL
H/O/A	HAND/OFF/AUTO
L/O/C	LOCAL/OFF/COMPUTER
L/O/R	LOCAL/OFF/REMOTE
O/C/S	OPEN/CLOSE/STOP
R/S/L	RAISE/STOP/LOWER
L/C	LOCAL/COMPUTER
L/R	LOCAL/REMOTE
O/C	OPEN/CLOSE
S/S	START/STOP (MAINTAINED)
O/O	ON/OFF (MAINTAINED)
O/H/C	OPEN/HOLD/CLOSE
A/H	AUTO/HAND
L/A	LOCAL/AUTO
O/C/S/C	OPEN/CLOSE/STOP/COMPUTER
O/O/A	ON/OFF/AUTO
O/O/C	ON/OFF/COMPUTER
O/C/LOS	OPEN/CLOSE/LOCK-OUT-STOP
N/B	NORMAL/BYPASS

VALVE ABBREVIATIONS

BFV	BUTTERFLY VALVE
BV	BALL VALVE
CHV	CHECK VALVE
GTV	GATE VALVE
KV	KNIFE VALVE
PLGV	PLUG VALVE
PRV	PRESSURE RELIEF VALVE

AREA LIST

01	PLANT INFLUENT	17	RAS/WAS PUMPING
02	EFFLUENT PUMPS	18	UV DISINFECTION
11	SCREENS	19	THICKENING
12	GRIT SCREEN	20	DIGESTERS
13	SEPTAGE RECEIVING	21	DEWATERING
14	ODOR CONTROL	31	POLYMER
15	ACTIVATED SLUDGE SYSTEM	32	HYPOCHLORITE
16	SECONDARY CLARIFIER	45	PLANT DRAINS

MEANINGS OF IDENTIFICATION LETTERS

THIS TABLE APPLIES TO THE FUNCTIONAL IDENTIFICATION OF INSTRUMENTS.

FIRST LETTER	SUCCEEDING LETTERS				
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		EMERGENCY	USER'S CHOICE	USER'S CHOICE
C	USER'S CHOICE		CLEANER	CONTROL	
D	DENSITY (MASS) OR SPECIFIC GRAVITY	DIFFERENTIAL			
E	VOLTAGE (EMF)		PRIMARY ELEMENT		
F	FLOW RATE	RATIO (FRACTION)			HIGH OR OPEN
G	GAUGING (DIMENSIONAL)		GLASS		
H	HAND (MANUALLY INITIATED)				
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME OR TIME SCHEDULE			CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW OR CLOSED
M	USER'S CHOICE	MOMENTARY			MIDDLE OR INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE (RESTRICTION)		
P	PRESSURE OR VACUUM		POINT (TEST CONNECTION)		
Q	QUANTITY	INTERGRATE OR TOTALIZE			
R	RUN		RECORD		
S	SPEED OR FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VISCOSITY, VIBRATION			VALVE, DAMPER OR LOUVER	
W	WEIGHT OR FORCE		WELL		
X	FAILURE	X AXIS			
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS		DRIVE, ACTUATE OR UNCLASSIFIED CONTROL ELEMENT	

FUNCTION SYMBOLS AND ABBREVIATIONS

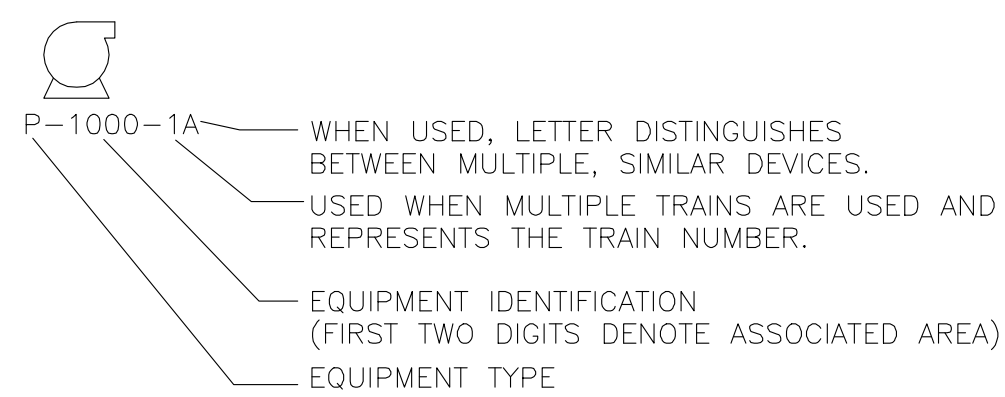
<	PROPORTIONAL GAIN OR ATTENUATE (INPUT:OUTPUT)
	REVERSE PROPORTIONAL GAIN OR ATTENUATE (INPUT:OUTPUT)
<	SUMMING
∑	AVERAGING
∑/n	SUBTRACTING
∑/n	EXTRACT SQUARE ROOT
∑/n	DIVIDE
X	MULTIPLY
S	INTEGRATE
+	BIAS POSITIVE
-	BIAS NEGATIVE
(x)	NONLINEAR OR UNSPECIFIED FUNCTION
FV	HIGH SELECT
<	LOW SELECT
>	HIGH LIMIT
<	LOW LIMIT
F/*	SIGNAL TRANSDUCER OR CONVERTER (INPUT:OUTPUT) * DEFINED AS FOLLOWS:

INDICATOR COLORS

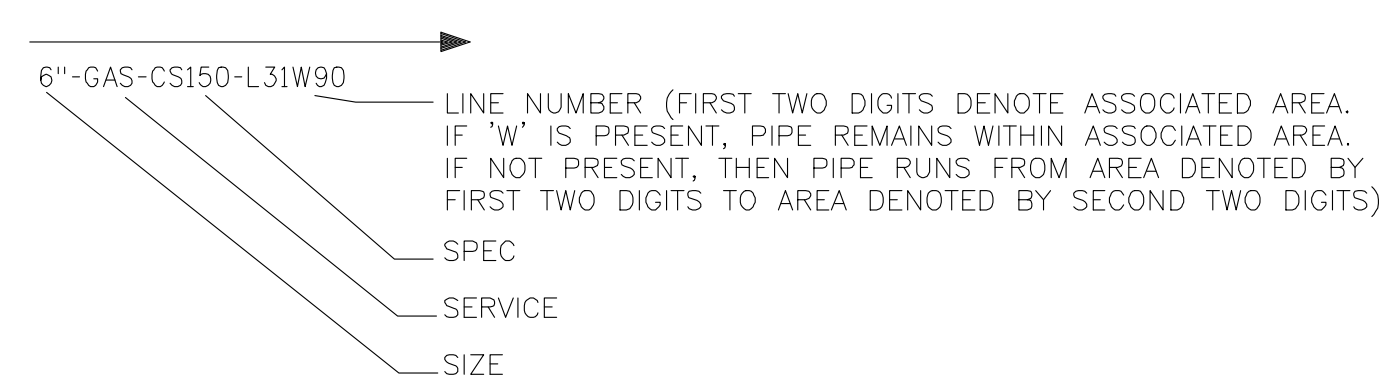
THE FOLLOWING COLORS SHALL BE APPLIED TO ALL PILOT LIGHTS, BEACONS, AND COMPUTER DISPLAY INDICATORS, UNLESS NOTED OTHERWISE IN THE INDIVIDUAL LOOP DIAGRAMS.

EQUIPMENT RUNNING	GREEN
EQUIPMENT STOPPED	RED
EQUIPMENT TROUBLE/FAIL	AMBER
EQUIPMENT POWER ON	WHITE
VALVE OPENED	GREEN
VALVE CLOSED	RED
VALVE HOLD	BLUE
EQUIPMENT OR VALVE IN AUTOMATIC OR COMPUTER MODE	WHITE
HIGH/LOW PROCESS CONDITIONS (PILOT LIGHT)	AMBER
BEACONS AND REMOTE ALARM PANELS	RED

TYPICAL EQUIPMENT TAG NUMBERS & DESIGNATION

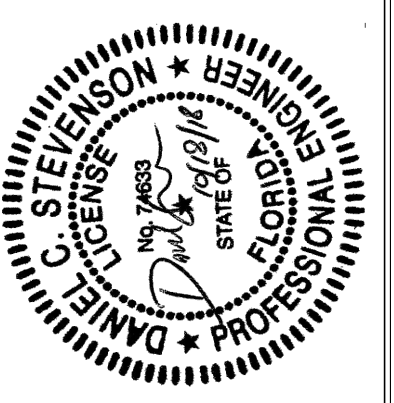


TYPICAL PIPE TAG NUMBERS & DESIGNATION



GENERAL NOTES

- THIS IS A GENERAL LEGEND SHEET, SOME SYMBOLS AND ABBREVIATIONS MAY NOT APPLY TO THIS SPECIFIC PROJECT.
- THIS LEGEND APPLIES TO INSTRUMENTATION DIAGRAMS ONLY AND MAY DIFFER FROM LEGENDS FOR OTHER SHEETS.
- IN GENERAL THIS LEGEND SHEET AND THE INSTRUMENTATION DIAGRAMS ARE BASED ON INSTRUMENTATION, SYSTEMS AND AUTOMATION SOCIETY (ISA), STANDARDS FOR PRACTICES FOR INSTRUMENTATION. SOME MODIFICATIONS, ADDITIONS AND ALTERATIONS HAVE BEEN MADE AS REQUIRED TO ACCOMMODATE THE PROJECT REQUIREMENTS.
- SOME PROCESS ITEMS, SUCH AS EQUIPMENT ISOLATION VALVES, BYPASS LINES, ETC., WHICH ARE NOT CRITICAL FOR AN UNDERSTANDING OF THE INSTRUMENTATION FUNCTIONS ARE NOT SHOWN ON THE INSTRUMENTATION SHEETS.
- SEE ELECTRICAL SHEETS AND SPECIFICATIONS FOR ADDITIONAL CONTROL AND INTERLOCK REQUIREMENTS FOR EQUIPMENT NOT SHOWN OR NOT PROVIDED BY THE INSTRUMENTATION SUPPLIER.



NO.	DATE	DESIGNED BY:	TCG
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APPROVED BY:			DS

ABBREVIATIONS AND LEGEND

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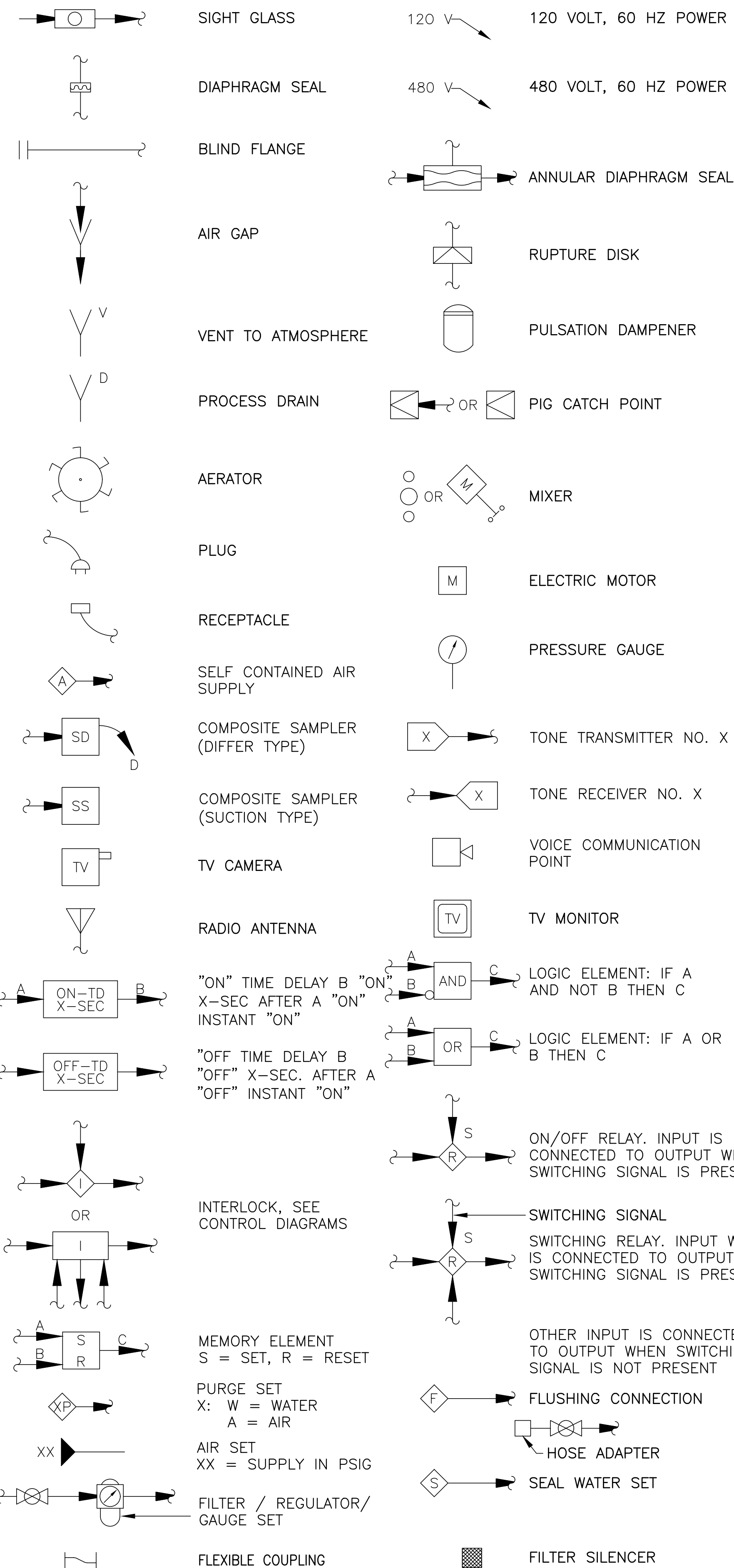


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BAR IS ONE INCH ON ORIGINAL DRAWING	
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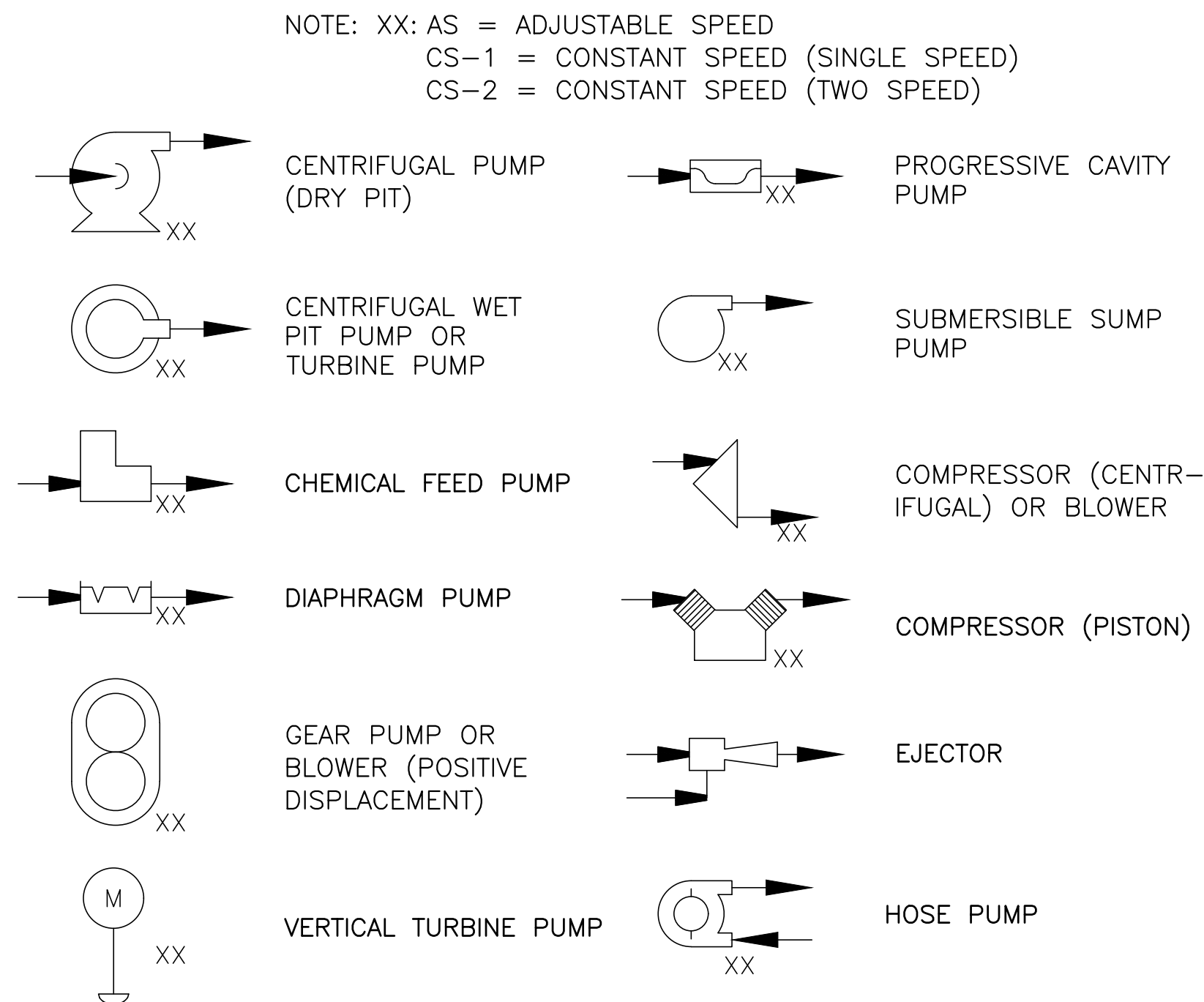
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 FL CERTIFICATE OF AUTHORIZATION # 9816

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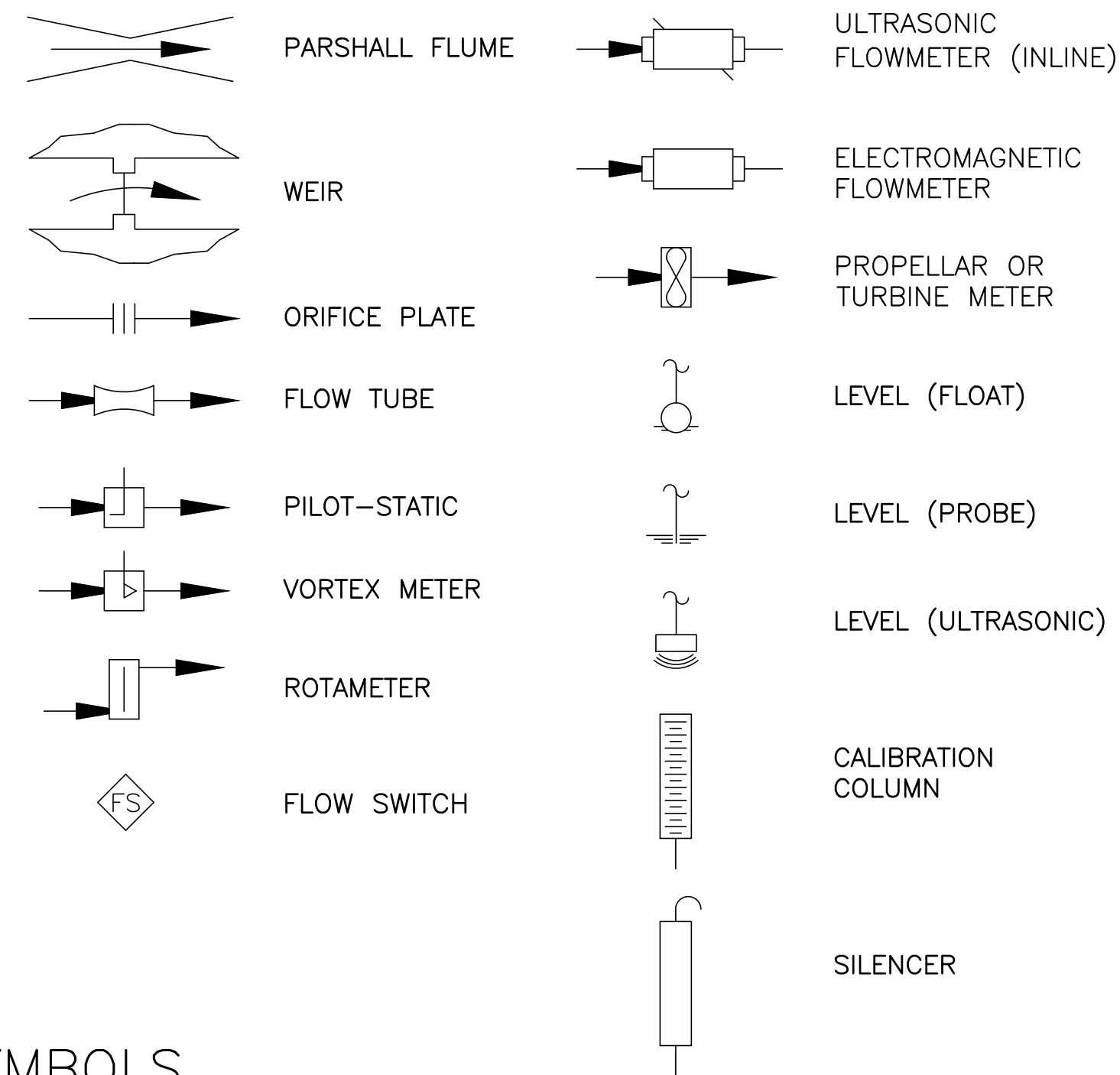
MISCELLANEOUS SYMBOLS



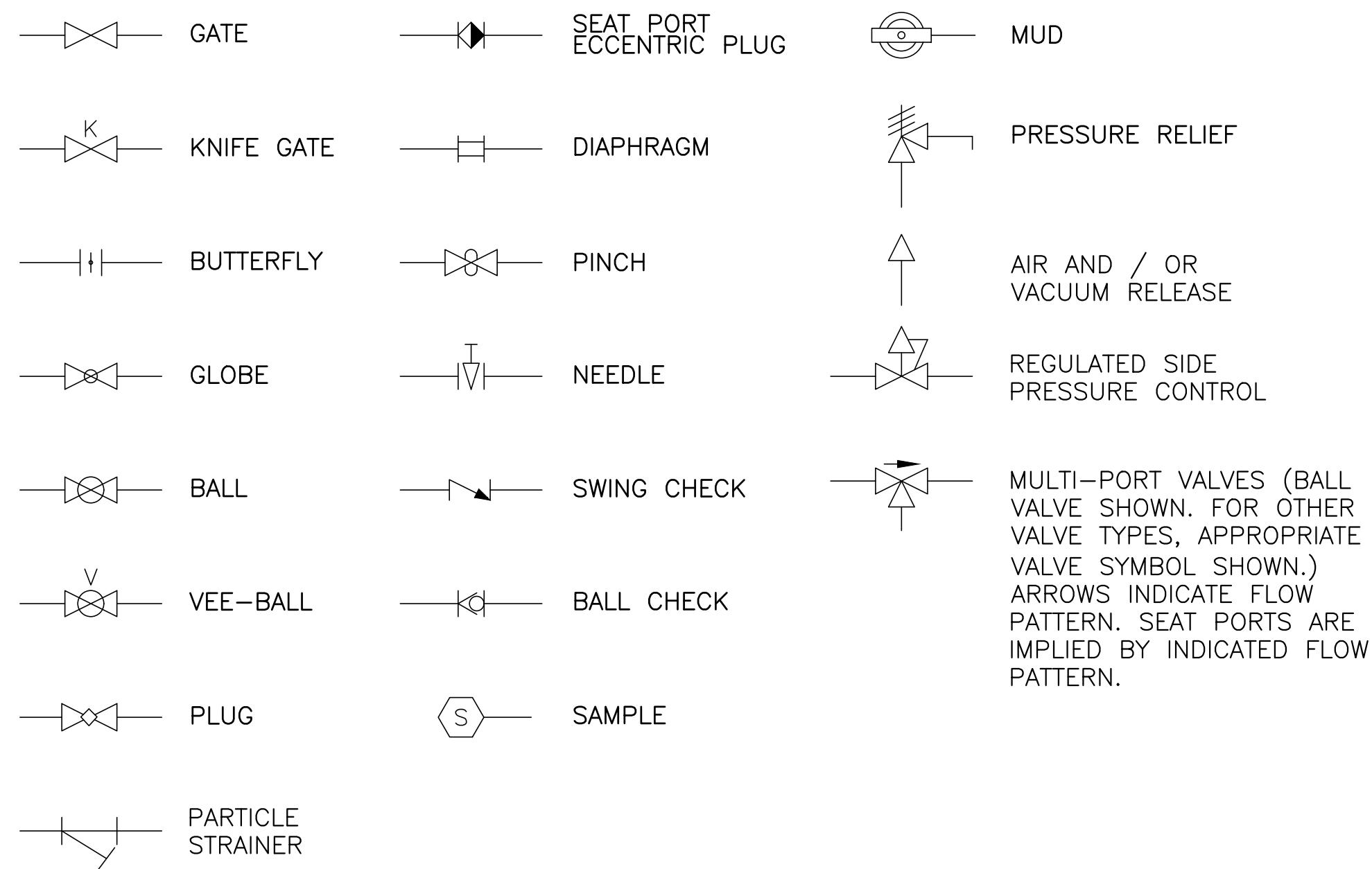
PUMP AND COMPRESSOR SYMBOLS



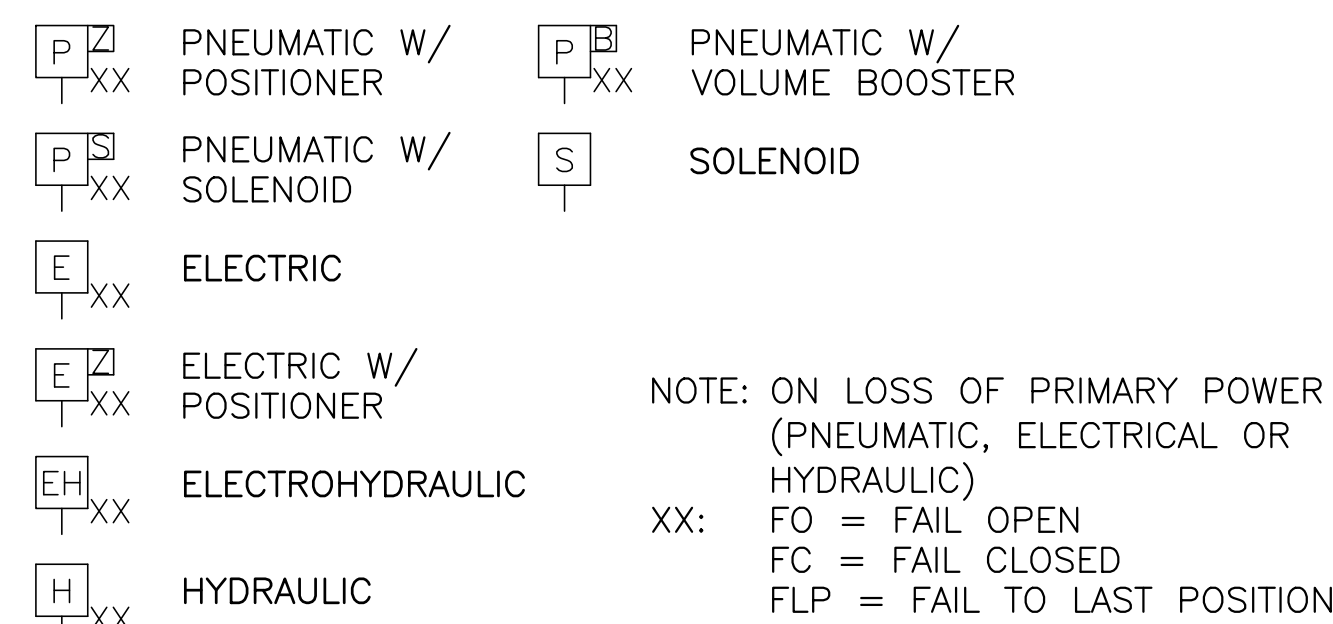
PRIMARY ELEMENT SYMBOLS



VALVE SYMBOLS

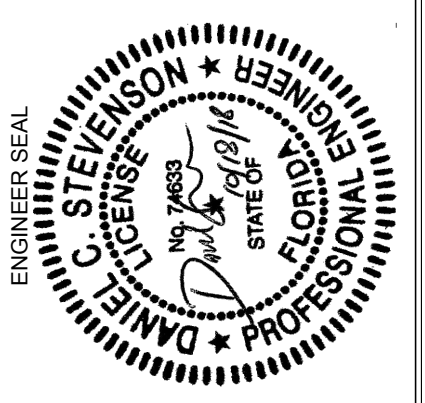


ACTUATOR SYMBOLS



FLOW STREAM IDENTIFICATION

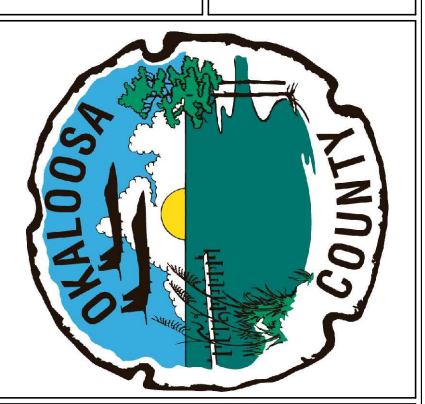
AIR	AIR
BRN	BRINE
CLDX	CHLORINE DIOXIDE
DRN	DRAIN
FIL	FILTERED WATER
FM	FORCE MAIN
FS	FLUORIDE SOLUTION
FW	FINISHED WATER
HS	HIGH SERVICE
LS	LIME SOLUTION
NPW	NON-POTABLE WATER
OVF	OVERFLOW
PUR	PURATE
PW	POTABLE WATER
REC	RECIRCULATION
SA	SAMPLE
SD	STORM DRAIN
SH	SODIUM HYPOCHLORITE SOLUTION
SR	SURGE RELIEF
SW	SEALED WATER
S	SANITARY SEWER
TW	TREATED WATER
UDRN	UNDERDRAIN
VNT	VENT
WW	WASH WATER
ZS	ZINC HETAMEXAMETA PHOSPHATE



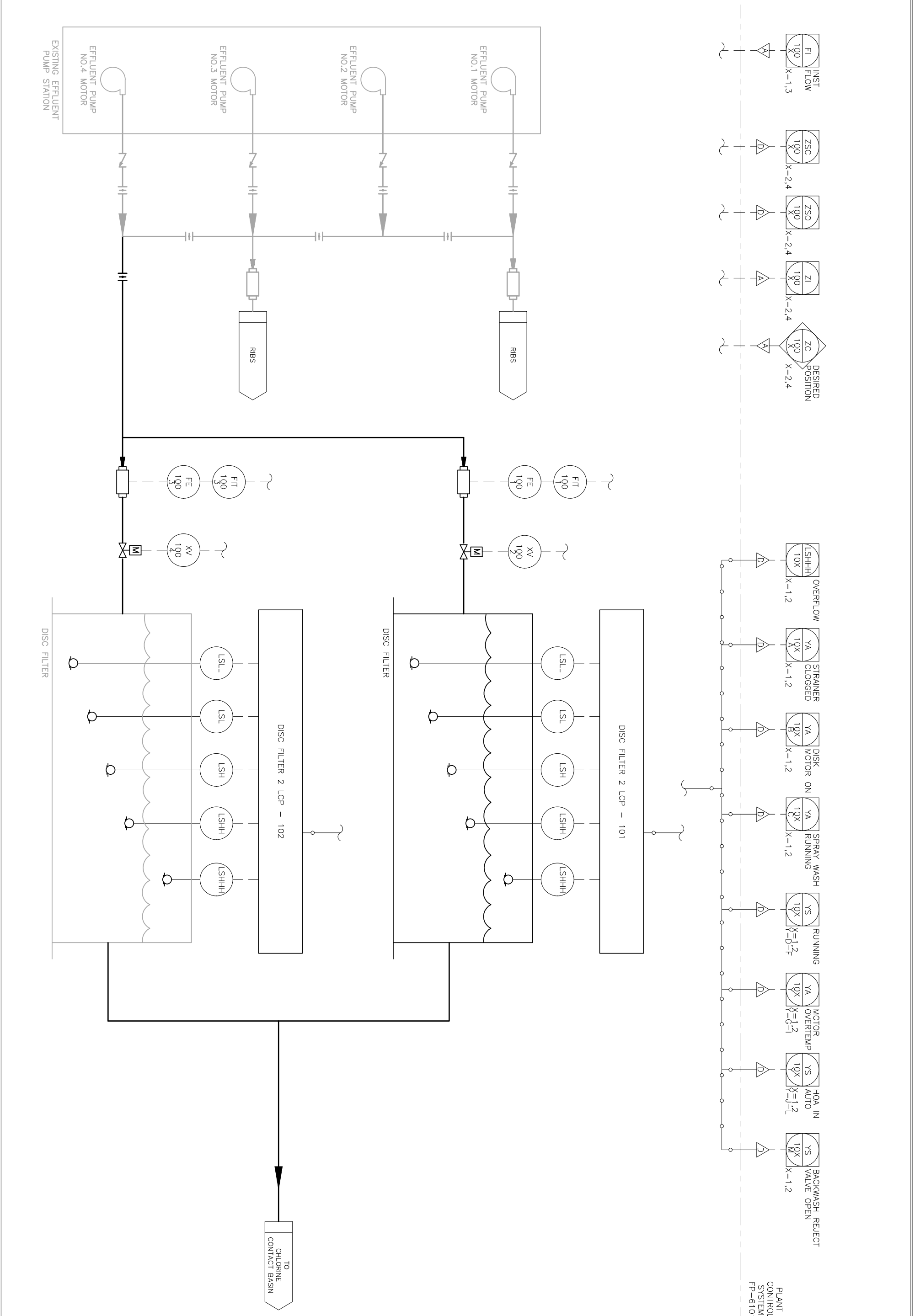
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P&ID SYMBOLS

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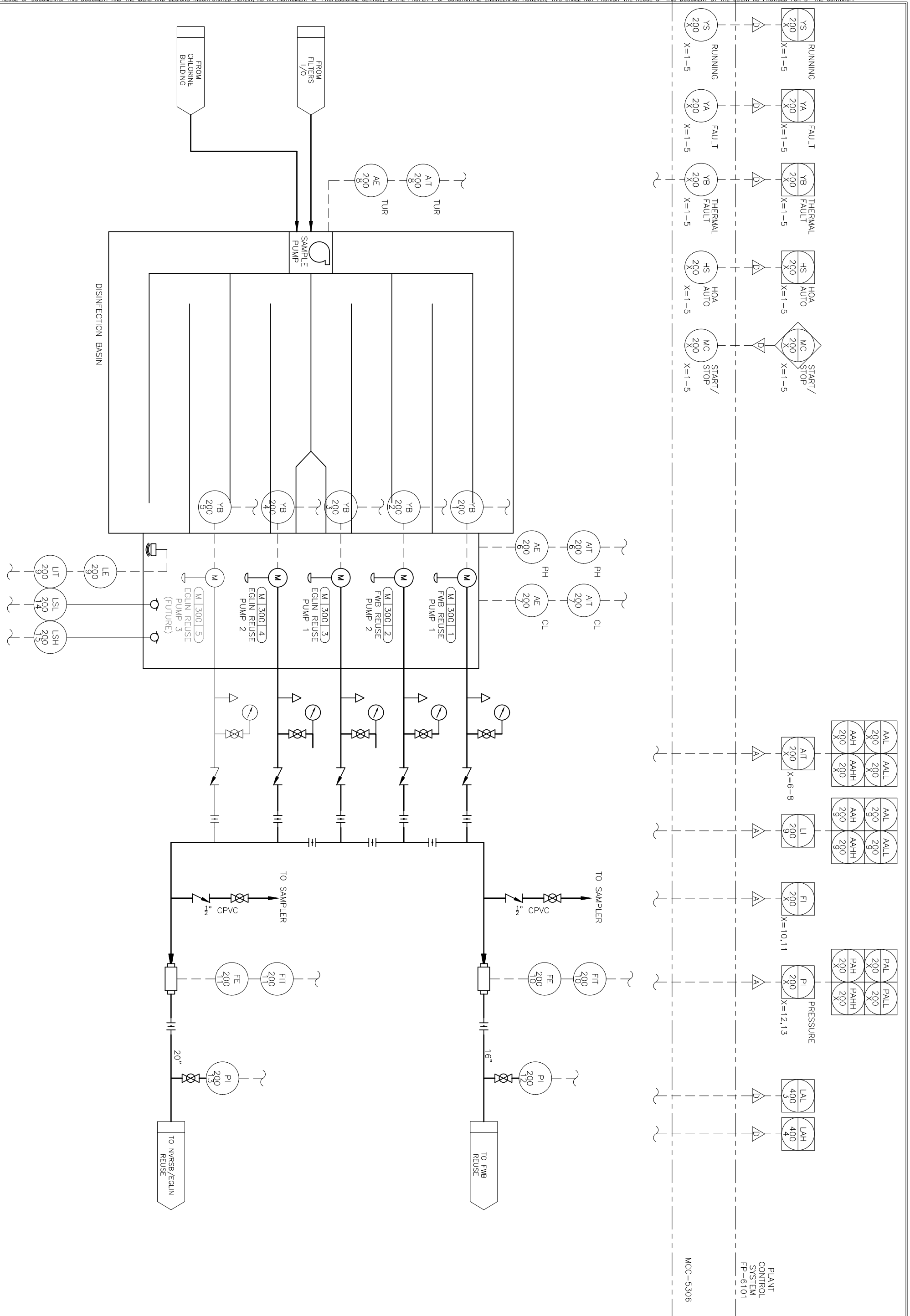


FILTERS

OCWS APWRF RECLAIM EXPANSION

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DWG.	1-1.0

ENGINEER SEAL
DANIEL C. STEVENSON
 LICENSE No. 74633
 10/13/14
 FLORIDA
 PROFESSIONAL ENGINEER



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 DATE OCTOBER 2018
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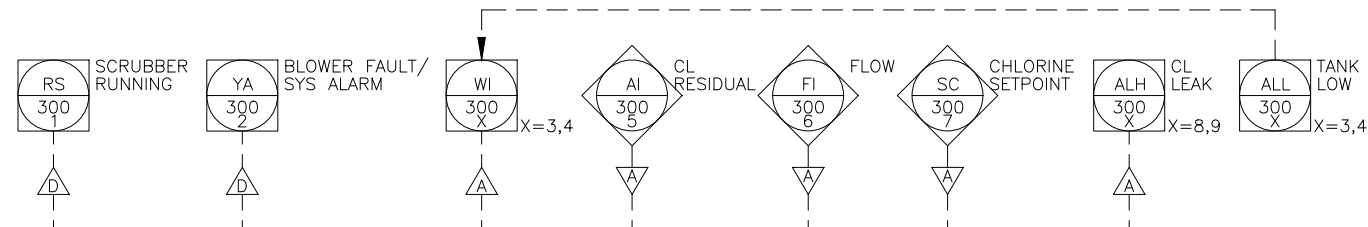


CHLORINE CONTACT CHAMBER
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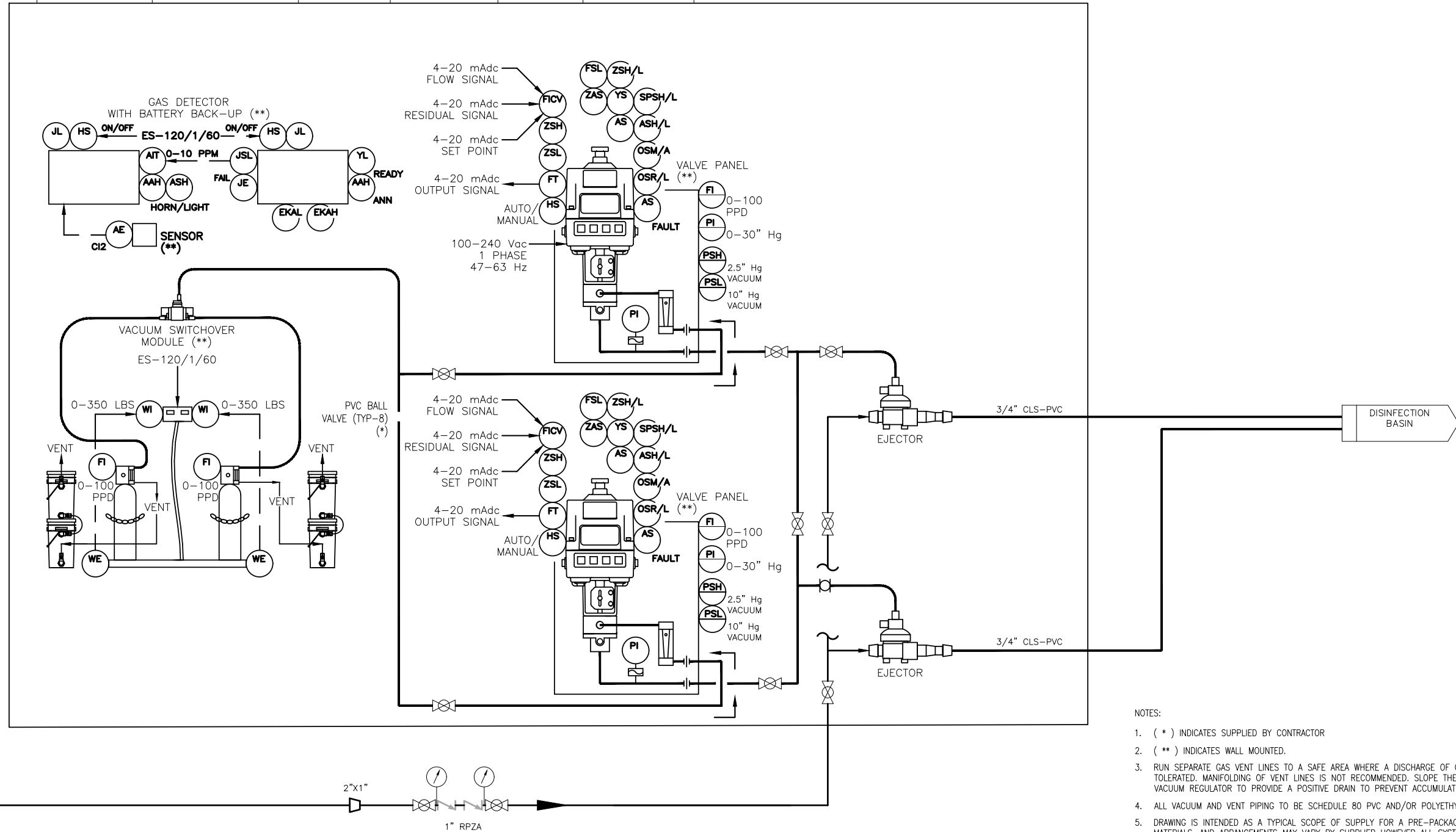
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 PROFESSIONAL ENGINEER

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PLANT CONTROL SYSTEM FP-6101

PRE-PACKAGED CHLORINE GAS SYSTEM & ENCLOSURE



- NOTES:
- (*) INDICATES SUPPLIED BY CONTRACTOR
 - (**) INDICATES WALL MOUNTED.
 - RUN SEPARATE GAS VENT LINES TO A SAFE AREA WHERE A DISCHARGE OF GAS BEING DISPENSED CAN BE TOLERATED. MANIFOLDING OF VENT LINES IS NOT RECOMMENDED. SLOPE THE VENT LINE DOWNWARD FROM VACUUM REGULATOR TO PROVIDE A POSITIVE DRAIN TO PREVENT ACCUMULATION OF ANY MOISTURE.
 - ALL VACUUM AND VENT PIPING TO BE SCHEDULE 80 PVC AND/OR POLYETHYLENE TUBING.
 - DRAWING IS INTENDED AS A TYPICAL SCOPE OF SUPPLY FOR A PRE-PACKAGED CHLORINATION SYSTEM. SYSTEMS, MATERIALS, AND ARRANGEMENTS MAY VARY BY SUPPLIER HOWEVER ALL SYSTEMS SHALL MET THE CHLORINE DEMANDS, PROVIDE THE NEEDED CONTROLS, SAFETY MEASURES, AND BE EQUIVALENT IN FEATURES.



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		TCG	TCG	DS

CHLORINATION SYSTEM
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