COLUMBIA COUNTY BOARD OF COUNTY COMMISSIONERS
PROJECT NUMBER 2016-10
Ellisville Wastewater Treatment Plant

NOTICE TO CONTRACTORS

Notice is hereby given that sealed bids will be received in the Columbia County Manager's office until **11:00 AM** on **December 2, 2016**, for Columbia County Project No. **2016-10.** This office is located on the second floor of the Courthouse Annex at 135 Hernando Avenue, Room 203 Lake City FL 32055.

This project consists of furnishing all labor, equipment, materials, tools and services required to construct, test, and startup the proposed new Ellisville Wastewater Treatment Plant. The specific area of work include, but are not limited to items 1-6 listed below, along with associated site work, yard piping , valves, support systems and appurtenances, structural, painting, electrical, instrumentation, tie-ins to existing systems, and testing.

1. Site clearing, grubbing, grading, filling, restoration, erosion control, seeding and sodding.
2. Installation of new 105 gpm packaged lift station adjacent to existing lift station. Conversion and rehabilitation of existing lift station to a manhole with manhole cover.
3. Installation of 11,000 foot long force main to connect the new packaged lift station to the new treatment plant.
4. Installation of a 25,000 gpd packaged wastewater treatment plant, associated pumps, blowers, mixers, piping, valves, appurtenances, structural, electrical, controls, and site improvements. Installation of emergency back-up power system at the new facility.
5. Installation of rapid infiltration basins, associated piping, valves and appurtenances.
6. Demolition of existing packaged wastewater treatment plant, removal of existing structures, closure and fill of RIBs, site grading, seeding and sod.

The Bid Forms and Construction specifications may be obtained from the County's web site at http://www.columbiacountyfla.com/PurchasingBids.asp. Deadline for questions regarding construction plans, specifications, and/or bid documents must be received before **5:00 PM** on **November 29, 2016.**

The successful bidder will be required to furnish the County Manager with a bid bond (5%), performance bond, and proof of liability insurance prior to commencing work.
The Columbia County Commission reserves the right to reject any or all bids and to add to the contract or delete from the contract to stay within their funding capabilities.

Columbia County Board of County Commissioners

_____

Bucky Nash, Chair

COLUMBIA COUNTY BOARD OF COUNTY COMMISSIONERS
PROJECT NUMBER 2016-10
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Purchasing Department – General Instructions to Bidders

These instructions will bind bidders and conditions herein set forth, except as specifically qualified in special bid and contract terms issued with any individual bid.

1. The following criteria are used in determining low responsible bidder:

    A. The ability, capacity and skill of bidder to perform required service.
    B. Whether the bidder can perform service promptly or within specified time.
    C. The character, integrity, reputation, judgment, experience and efficiency of bidder.
    D. The performance of previous contracts with Columbia County.
    E. The suitability of equipment or material for county use.
    F. The ability of bidder to provide future maintenance

2. Payment Terms are net (30) unless otherwise specified. Favorable terms, discounts, may be offered and will be considered in determining low bids if they are deemed by Purchasing Department to be advantageous to the County.

3. All bids should be tabulated, totaled and checked for accuracy. All blanks on the Bid Form shall be filled in and unit price will prevail in case of errors.

4. All requested information shall be included in the envelope. All desired information must be included for your bid to receive full consideration.

5. If anything on the bid request is not clear, you should contact the Purchasing Director immediately.

6. A bidders list is available at the Purchasing Office.

7. Quote all prices F.O.B. our warehouse or as specified in bid documents.

8. Each proposal shall be clearly marked on the outside of the envelope including Fed Ex, UPS or other delivery service envelopes, as a sealed bid. The name of the item being bid shall be shown on the outside in full.

9. No responsibility shall attach to any County representative or employee for the premature opening of bids not properly addressed or identified.

10. If only one (1) bid is received, the bid may be rejected and re-advertised or excepted if determined to be in the counties best interest.

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may request and shall receive a receipt showing the day and time any bid is delivered to the appropriate office of the County from the personnel thereof.

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14. All bidders must be recognized dealers in the materials or equipment specified and is qualified to advise in their application or use. A bidder at any time requested must satisfy the Purchasing Office and the County Manager that he has the requisite organization, capital, plant, stock ability and experience to satisfactorily execute the contract in accordance with the provisions of the contract in which he is interested.

15. Any alterations, erasures, additions, or admissions of required information or any changes to specifications or bidding schedule are done at the risk of the bidder. Any bid will be rejected that has a substantial variation, that is; a variation that affects price, quantity, and quality or delivery date (when delivery is required by a specific time).

16. When requested, samples will be furnished to the County free of expense, properly marked for identification and accompanied by a list where there is more than one (1) sample. The County reserves the right to mutilate or destroy any sample submitted whenever it may be to the best interest of the County to do so for the purpose of testing.

17. The County will reject any material, supplies or equipment that did not meet the specifications, even though the bidder lists the trade names or names of such material on the bid or price quotation form.

18. The unauthorized use of patented articles is done entirely at the risk of the successful bidder.

19. The ESTIMATED QUANTITY given in the specifications or advertisements is for the purpose of bidding only. The County may purchase more or less than the estimated quantity and the vendor must not assume that such estimated quantity is part of the contract.

20. Only the latest model equipment as evidenced by the manufacture’s current published literature will be considered. Obsolete models of equipment not in production will not be acceptable. The equipment shall be composed of new parts and materials. Any unit containing used parts or having seen any service other than the necessary tests will be rejected. In addition to the equipment specifically called for in the specification, all equipment catalogued by the manufacturer as standard or required by the State of Florida shall be furnished with the equipment. Where required by the State of Florida Motor Vehicle Code, vehicles shall be inspected and bear the latest inspection sticker of the Florida Department of Revenue.

21. Prospective bidders are required to examine the location of the proposed work or delivery and determine, in their own way, the difficulties, which are likely to be encountered in the prosecution of the same.

22. All materials, equipment and supplies shall be subject to rigid inspection, under the immediate supervision of the Purchasing Department, its designee and /or the department to which they are delivered. If defective material, equipment, or supplies are discovered, the contractor, upon being instructed by the Purchasing Department or designee, shall remove, or make good such material, equipment, or supplies without extra compensation. It is expressly understood and agreed that the inspection of materials by the County will in no way lessen the responsibility of the Contractor release him from his obligation to perform and deliver to the County Sound and satisfactory materials, equipment, or supplies. The Contractor agrees to pay the costs of all tests upon defective material, equipment, or supplies or allow the costs to be deducted from any monies due him from the County.

23. Unless otherwise specified all materials, supplies, or equipment quoted herein must be delivered within thirty (30) days from the day of notification or exceptions noted on bid sheets.

24. A contract will not be awarded to any corporation, firm, or individual who is, from any cause, in arrears to the County or who has failed in former contracts with the County to perform work satisfactorily, either to the character of the work, the fulfillment or guarantee, or the time consumed in completing the work.

25. Reasonable grounds for supposing that any bidder is interested in more than one proposal for the same item will be considered sufficient cause for rejection of all proposals in which he is interested.

26. Submitting a proposal when the bidder intends to sublet the contract may be a cause for rejection of bids or cancellation of the contract by the County Manager.

27. Unless otherwise specified the County reserves the right to award each items separately or on a lump sum basis whichever is in the best interest of the County.

28. The County reserves the right to reject any and/or all quotations, to waive any minor discrepancies in the bids for all bidders equally, quotations, or specifications, when deemed to be in the best interest of the County and also to purchase any part, all or none of the materials, supplies, or equipment specified.

29. Failure of the bidder to sign the bid or have the signature of an authorized representative or agent on the bid proposal in the space provided will be cause for rejection of the bid. Signature must be written in ink. Typewritten or printed signatures will not be acceptable.

30. Any bidder may withdraw his bid at any time before the time set for the opening of the

bids. No bid may be withdrawn in the thirty- (30) day period after bids are opened.

31. It is mutually understood and agreed that if at any time the Purchasing Department or designee shall be of the opinion that the contract or any part thereof is unnecessarily delayed or that the rate of progress or delivery is unsatisfactory, or that the contractor is willfully violating any of the conditions or covenants of the agreement, or executing the same in bad faith, the Purchasing Department or his designee shall have the power to notify the aforesaid contractor of the nature of the complaint. Notification shall constitute delivery of notice, or letter to address given in the proposal. If after three (3) working days of notification the conditions are not corrected to the satisfaction of the Purchasing Director, he shall thereupon have the power to take whatever action he may deem necessary to complete the work or delivery herein described, or any part thereof, and the expense thereof, so charged, shall be deducted from any paid by the County out of such monies as may become due to the said contractor, under and by virtue of this agreement. In case such expense shall exceed the last said sum, then and in that event, the bondsman or the contractor, his executors, administrators, successors, or assigns, shall pay the amounts of such excess to the County on notice made by the Purchasing Department or his designee of the excess due.

32. If the bidder proposes to furnish any item of foreign make or product, he shall write “foreign” together with the name of the originating country opposite such item on a proposal.

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37. A person or affiliate who has been placed on the convicted vendor's list following a conviction for a public entity crime may not submit a bid on a contract to provide any goods or services to Columbia County, may not submit a bid on a contract with Columbia County for the construction or repair of a public building or public work, may not submit

bids on leases of real property to Columbia County, may not be awarded or perform work as a contractor, supplier, subcontractor, or consultant under a contract with Columbia County, and may not transact business with Columbia County for a period of 36 months from the date of being placed on the convicted vendor list.

38. Vendor/Contractor shall utilize the U.S. Department of Homeland Security's E-Verify system, in accordance with the terms governing use of the system, to confirm the employment eligibility of;

    A. all persons employed by the Vendor/Contractor during the term of the Contract to perform employment duties within Florida; and

    B. all persons, including subcontractors, assigned by the Vendor/Contractor to perform work is pursuant to the contract with the County.

39. Contractor shall register online at http://www.columbiacountyfla.com/PurchasingBids.asp for this specific project. All addendums are delivered via email through this website, and it is the contractor's responsibility to ensure all addendums are used in the bid submittal.

40. Any existing materials demolished within county right of way may be retained by Columbia County.

Technical Specifications

For

ELLISVILLE WASTEWATER TREATMENT PLANT DESIGN



PREPARED BY:

Arcadis U.S., INC.
3109 W. Dr. Martin Luther King, Jr. Blvd.
Tampa, Florida 33607

Bid Set
October 2016

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COLUMBIA COUNTY
ELLISVILLE WASTEWATER TREATMENT PLANT DESIGN

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COLUMBIA COUNTY
ELLISVILLE WASTEWATER TREATMENT PLANT DESIGN

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COLUMBIA COUNTY
ELLISVILLE WASTEWATER TREATMENT PLANT DESIGN

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COLUMBIA COUNTY
FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

SEALS AND CERTIFICATIONS PAGE

ENGINEER:
ARCADIS U.S., Inc.
3109 W. Dr. Martin Luther King, Jr. Blvd., Suite 351
Tampa, FL 33607

For: General, Civil, Mechanical: Sean Chaparro, PE License No. 75865	For: Structural: Adarsh Shah, PE License No. 79948
For: Electrical, Instrumentation: Keff S. Kurrella, PE License No. 63077	

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00 41 13

BID FORM

COLUMBIA COUNTY CATYLIST SITE
WATER TREATMENT PLANT CONSTRUCTION

TABLE OF ARTICLES

1. Bid Recipient
2. Bidder's Acknowledgements
3. Bidder's Representations
4. Basis of Bid
5. Time of Completion
6. Attachments to this Bid
7. Defined Terms
8. Bid Submittal

ARTICLE 1 - BID RECIPIENT

1.01 Sealed Bids shall be submitted to:

Ray Hill
Purchasing Director
Columbia County Purchasing
135 NE Hernando Avenue, Suite 203
Lake City, FL 32056

1.02 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 price(s) and within the times indicated in this Bid and in accordance with the Bidding Documents.

ARTICLE 2 - BIDDER'S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Advertisement or Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 120 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of OWNER. Bidder will sign the AGREEMENT and

will furnish the required contract security, and other required documents within the time periods set forth in the Bidding Documents.

ARTICLE 3 - BIDDER'S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, the other related data identified in the Bidding Documents, if any, and the following Addenda, receipt of all of which is hereby acknowledged.

Addendum No.	Date Received	Addendum No.	Date Received
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

B. Bidder has visited the Site 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. Bidder is familiar with and is satisfied as to all federal, state and local 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 contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in Paragraph 4.02 of the General Conditions, and (2) reports and drawings of Hazardous Environmental Conditions identified at the Site, if any, which that have been identified in the Supplementary Conditions as provided in Paragraph 4.06 of the General Conditions.

E. Bidder has obtained and carefully studied (or accepts the consequences for not doing so) all additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the Site which may effect cost, progress or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents to be employed by Bidder, and safety precautions and programs incident thereto.

F. Bidder does not consider that any further examinations, investigations, explorations, tests, studies or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Bidding Documents.

G. Bidder is aware of the general nature of work (if any) to be performed by OWNER and others at the Site that relates to the Work as indicated in the Bidding Documents.

H. Bidder has correlated the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies and data with the Bidding Documents.

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

J. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.

3.02 Bidder further represents that:

A. this Bid is genuine and is not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any 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; Bidder has not solicited or induced any individual or entity to refrain from bidding;

C. Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over OWNER; and

D. No person or persons acting in any official capacity for the OWNER are directly or indirectly interested in this Bid, or in any portion of the profit thereof.

ARTICLE 4 - BASIS OF BID

4.01 The Total Base Bid shall be tabulated based upon:

A. The Total Base Bid shall be tabulated based upon the requirement that bidders furnish equipment of the specified manufacturers. Equipment of other manufacturers offered as "Or Equals" named on the Proposed "Or Equal" Major Equipment Schedule shall not be part of the Total Base Bid. The OWNER will determine the lowest responsive bidder based solely on the Total Base Bid. "Or Equals" will have no influence on the selection of the lowest responsive bidder.

B. Once a lowest responsive bidder is determined, the OWNER will evaluate any of that bidder's "Or Equals" and if any "Or Equals" are accepted, the total of the accepted "Or Equal" Deducts on the Proposed "Or Equal" Major Equipment Schedule will be subtracted from the Total Base Bid to determine the total award amount. If no "Or Equals" are accepted by the OWNER, the bidder shall furnish and install, in accordance with the contract documents, all equipment specified in the Major Equipment Schedule and the equipment required under each section of the specifications shall be furnished and installed in strict compliance with the requirements of the Contract Documents for the amount stated by the bidder in the Total Base Bid.

C. Allowance of an "Or Equal" manufacturer does not constitute a waiver of the requirements of the Contract Documents.

4.02 All items on the Major Equipment Schedule shall be bid in accordance with the following:

A. The Major Equipment Schedule designates major equipment items that shall be included in the Total Base Bid. Named manufacturers are defined as those listed in the Major Equipment Schedule. The bidder shall **circle** the names of the manufacturers that will be provided for the work and return the completed Major Equipment Schedule with the bid documents.

B. "Or Equal" manufacturers are defined as those proposed and written in by the bidder in the Proposed "Or Equal" Major Equipment Schedule. If the bidder desires to propose an "Or Equal" for any named manufacturer of a specified item, the bidder shall complete the Proposed "Or Equal" Major Equipment Schedule and return the Proposed "Or Equal" Major Equipment Schedule with the bid. The bidder shall provide the names of the offered "Or Equal" manufacturers and price deduction for the OWNER, should the OWNER accept use of each "Or Equal" manufacturer. Only one "Or Equal" Major Equipment manufacturer is allowed per specification section. Should the "Or Equal" manufacturer be determined not equal in the OWNER's discretion, the bidder, if awarded, shall provide the **circled** named manufacturer in the Major Equipment Schedule. "Or Equal" manufacturers shall be offered for the OWNER's consideration in accordance with Specification Section 01 25 00.

B. The bidder shall provide with the bid package returned to the OWNER on the

designated bid receipt day and time, a qualifications package for all proposed "Or Equal" manufacturers proposed by bidder. The qualification packages will be used solely by the OWNER to evaluate the proposed "Or Equal" manufacturer.

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

COLUMBIA COUNTY ELLISVILLE
WASTEWATER TREATMENT PLANT CONSTRUCTION
CONTRACT NO. 1G – GENERAL

NAME OF BIDDER:_____

Item	Description	Quantity	Unit	Total Price (In Numbers)
1	Mobilization/demobilization.	1	Lump Sum	
2	Site civil improvements	1	Lump Sum	
3	Furnish and install 105 gpm package Lift Station #1.	1	Lump Sum	
4	Furnish and install 105 gpm package Lift Station #2.	1	Lump Sum	
5	Furnish and install 11,000 LF of 4” DR 18 PVC force main.	1	Lump Sum	
6	Furnish and install 320 LF of 4” DR 13.5 HDPE force main.	1	Lump Sum	
7	Furnish and install 300 LF of 8” DR 35 PVC gravity sewer.	1	Lump Sum	
8	Furnish and Install 25,000 gpd packaged wastewater treatment plant, associated pumps, blowers, mixers, piping, valves, appurtenances, structural, electrical, instrumentation, control panels, and site improvements, complete in place.	1	Lump Sum	
9	Furnish and install three (3) rapid infiltration basins, associated piping, valves and appurtenances.	1	Lump Sum	
10	Demolition of existing structures and filling of existing rapid infiltration basins.	1	Lump Sum	
11	Dream Inn WWTF: Decommissioning of existing wastewater treatment facility including structures, mechanical equipment, tanks, electrical conduits, piping and stairway as shown and specified. Filling of existing ponds, existing underground tanks and grade the site to match existing as shown and specified.	1	Lump Sum	

COLUMBIA COUNTY ELLISVILLE
WASTEWATER TREATMENT PLANT CONSTRUCTION
CONTRACT NO. 1G – GENERAL

NAME OF BIDDER:_____

12	Owner's contingency allowance for additional civil, mechanical, electrical, instrumentation, and structural work, as authorized by OWNER.	1	Additional	$50,000
13	Allowance for required permitting fees, as authorized by OWNER.	1	Additional	$2,000

Total Base Bid (Sum of Items 1 through 13, inclusive) **$** _____.

(in numbers)

Total Base Bid in Words (Sum of Items 1 through 13, inclusive)

$ _____.

COLUMBIA COUNTY
ELLISVILLE WASTEWATER TREATMENT PLANT
CONTRACT NO. 1G – GENERAL

NAME OF BIDDER:_____

SCHEDULE OF DEDUCTIVE ALTERNATES

Item	Description	Quantity	Unit	Amount of Decrease to Base Bid
5	Furnish and install 11,000 LF of 4" DR 18 PVC force main.	1	Lump Sum	Subtract $_____
9	Furnish and install three (3) rapid infiltration basins, associated piping, valves and appurtenances.	1	Lump Sum	Subtract $_____
10	Demolition of existing structures and filling of existing rapid infiltration basins .	1	Lump Sum	Subtract $_____
11	Dream Inn WWTF: Decommissioning of existing wastewater treatment facility including structures, mechanical equipment, tanks, electrical conduits, piping and stairway as shown and specified. Filling of existing ponds, existing underground tanks and grade the site to match existing as shown and specified.	1	Lump Sum	Subtract $_____

SCHEDULE OF ADDITIVE ALTERNATES

AA-1	Furnish and install second 25,000 gpd packaged wastewater treatment plant, associated pumps, blowers, mixers, piping, valves, appurtenances, electrical, control	1	Lump Sum	Add $_____

	panels and site improvements, complete in place.			
AA-2	Furnish and install three (3) additional rapid infiltration basins, associated piping, valves and appurtenances.	1	Lump Sum	Add $_____

The OWNER reserves the right to award project based on the Total Base Bid and any combination of Deductive Alternate Bid Items or Additive Alternate Bid Items.

COLUMBIA COUNTY ELLISVILLE
WASTEWATER TREATMENT PLANT CONSTRUCTION
CONTRACT NO. 1G – GENERAL

MAJOR EQUIPMENT SCHEDULE (Circle One)

Equipment	Specification Section	Named Manufacturers (Circle One)
1. Packaged Package Wastewater Treatment Plant	46 07 53	RWL Water USA
2. Emergency Generator/ATS	26 32 13/26 36 23	Cummins/ONAN, Caterpillar
3. Package Lift Station Pumps	Plan Sheet M-01	Flygt, Hydromatic, ABS, EMU

Bidder agrees to furnish and install equipment from the above circled manufacturers in accordance with the provisions and terms of the Contract Documents. The contractor shall base his bid on the circle items above.

NAME OF BIDDER:_____

BIDDER'S SIGNATURE:_____

DATE:_____

COLUMBIA COUNTY ELLISVILLE WASTEWATER TREATMENT PLANT CONSTRUCTION CONTRACT NO. 1G – GENERAL			
PROPOSED "OR EQUAL" MAJOR EQUIPMENT SCHEDULE			
Number	**Specification Section**	**Manufacturer's Name and Model Number**	**Amount of Deduct from Bid**
1.			$
2.			$
3.			$
4.			$
5.			$
6.			$
7.			$

The above listed "Or Equal" items are hereby guaranteed to perform in all respects the functions of the items or specified manufacturers and in accordance with the Contract Documents. It is fully understood that approval of such items is contingent upon this guarantee and at the sole discretion of the OWNER.

NAME OF BIDDER:_____

BIDDER'S SIGNATURE:_____

DATE:_____

4.04 Combined Bids: (Not Used)

4.05 Unit prices have been computed in accordance with Paragraph 11.03.B of the General Conditions.

4.06 Bidder acknowledges that estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids, and final payment for all Unit Price items will be based on actual quantities of Unit Price Work determined as provided in the Contract Documents.

4.07 All specified cash allowances are included in the price(s) set forth above and have been completed in accordance with Paragraph 11.02 of the General Conditions.

ARTICLE 5 - TIME OF COMPLETION

5.01 Bidder agrees that the Work will be substantially complete within 270 calendar days after the date when the Contract Times commence to run as provided in Paragraph 2.03 of the General Conditions, and will be completed and ready for final payment in accordance with paragraph 14.07.B of the General Conditions within 284 calendar days after the date when the Contract Times commence to run, which days will be entered by OWNER into the AGREEMENT as the Contract Times.

5.02 The existing Ellisville Utility WWTF is currently under a FDEP Domestic Wastewater Facility Permit that expires on June 09, 2017. The existing Utility WWTF shall be off-line prior the expiration of this permit to be in compliance with the FDEP permit. Therefore, proposed Lift Station No.1, the 4" force main from Lift Station No.1 to the new WWTP package plant and the proposed WWTP package plant shall be substantially completed no later than June 09, 2017.

5.03 Bidder accepts the provisions of the AGREEMENT as to liquidated and special damages, if any, in the event of failure to complete the Work within the Contract Times.

ARTICLE 6 - ATTACHMENTS TO THIS BID

6.01 The following documents are attached to and made a condition of this Bid:

A. Required Bid security.

B. Required Bidder Qualifications Statement with supporting data.

ARTICLE 7 - DEFINED TERMS

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

ARTICLE 8 - BID SUBMITTAL

8.01 This Bid submitted on _____, 20___ by:

If Bidder is:

Individual

Name (Typed or Printed): _____

By_____
(Individual's Signature)

Doing business as_____

License or Registration Number:_____

Business Address:_____

_____

Phone No.:_____Facsimile:_____

A Partnership

Partnership Name: _____

By:_____
(Signature of General Partner - Attach evidence of authority to sign)

(Name (Typed or Printed): _____

License or Registration Number:_____

Business Address:_____

_____

Phone No.:_____Facsimile:_____

A Corporation

Corporation Name: _____

_____
(State of Incorporation)

By_____
(Signature - Attach evidence of authority to sign)

Name and Title (Typed or Printed): _____

(CORPORATE SEAL)

Attest:_____
(Secretary)

License or Registration Number:_____

Business Address:_____

_____

Phone No.:_____Facsimile:_____

Limited Liability Company

By:_____
(Firm Name)

_____
(State of Formation)

By:_____
(Signature of Member/Authorized to Sign)

_____
(Printed or Typed Name and Title of Member Authorized to Sign)
(Attach evidence of authority to sign.)

License or Registration Number:_____

Business Address:_____

_____

Phone No.:_____Facsimile:_____

A Joint Venture

Name of Joint Venture:_____

First Joint Venturer Name: _____

By:_____
(Signature of First Joint Venturer - Attach evidence of authority to sign)

Name (Typed or Printed): _____ _____
(Title)

Title:_____

Second Joint Venturer Name: _____

By:_____
(Signature of Second Joint Venturer - Attach evidence of authority to sign)

Name (Typed or Printed): _____ _____
(Title)

(Each joint venturer must sign. The manner of signing for each individual, partnership, corporation or limited liability company that is a party to the joint venture shall be in the manner indicated above).

Business Address: _____

Phone and FAX number and address for receipt of communications to joint venture:

Phone: _____ Facsimile:_____

+ + END OF BID FORM + +

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SECTION 00 72 13

GENERAL CONDITIONS
OF THE CONSTRUCTION CONTRACT

Adapted from EJCDC C-700, Standard General Conditions
of the Construction Contract (2007 Edition)

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GENERAL CONDITIONS

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. 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 which is evidence of the agreement between Owner and Contractor covering the Work.

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. *Asbestos* – Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid* – The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidder* – The individual or entity who submits a Bid directly to Owner.

7. *Bidding Documents* – The Bidding Requirements and the proposed Contract Documents (including all Addenda).

8. *Bidding Requirements* – The Advertisement or Invitation to Bid, Instructions to Bidders, bid security of acceptable form, if any, and the Bid Form with any supplements.

9. *Change Order* – A document recommended by Engineer 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, issued on or after the Effective Date of the Agreement.

10. *Claim* – A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract* – The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents* – Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor's submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

13. *Contract Price* – The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times* – The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any, (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

15. *Contractor* or *CONTRACTOR* – The individual or entity with whom Owner has entered into the Agreement.

16. *Cost of the Work* – See Paragraph 11.01.A for definition.

17. *Drawings* – That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

18. *Effective Date of the Agreement* – The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

19. *Engineer* or *ENGINEER* – The individual or entity named as such in the Agreement.

20. *Field Order* – A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

21. *General Requirements* – Sections of Division 01 of the Specifications.

22. *Hazardous Environmental Condition* – The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.

23. *Hazardous Waste* – The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

24. *Laws and Regulations; Laws or Regulations* – Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

25. *Liens* – Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

26. *Milestone* – A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award* – The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

28. *Notice to Proceed* – A written notice given 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 under the Contract Documents.

29. *Owner* or *OWNER* – The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

30. *PCBs* – Polychlorinated biphenyls.

31. *Petroleum* – Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

32. *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.

33. *Project* – The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

34. *Project Manual* – The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

35. *Radioactive Material* – Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

36. *Resident Project Representative* – The authorized representative of Engineer who may be assigned to the Site or any part thereof.

37. *Samples* – Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

38. *Schedule of Submittals* – A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

39. *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.

40. *Shop Drawings* – All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

41. *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 for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

42. *Specifications* – That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.

43. *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 at the Site.

44. *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.

45. *Successful Bidder* – The Bidder submitting a responsive Bid to whom Owner makes an award.

46. *Supplementary Conditions* – That part of the Contract Documents which amends or supplements these General Conditions.

47. *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 Subcontractor.

48. *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 those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

49. *Unit Price Work* – Work to be paid for on the basis of unit prices.

50. *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, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

51. *Work Change Directive* – A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 T*erminology*

A. The words and terms referenced in this Paragraph 1.02 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 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 Paragraph 9.09 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 14.04 or 14.05).

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. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

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. 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 Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *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 Agreement 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 Agreement. 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 Agreement, whichever date is earlier.

2.04 *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 the date on which the Contract Times commence to run.

2.05 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule;

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.

2.06 *Preconstruction Conference; Designation of Authorized Representative*

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 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, 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 instructions, receive information, render decisions relative to the Contract and otherwise act on behalf of each respective party.

2.07 *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 2.05.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 component parts of the Work.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, 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. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, 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, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement 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 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 Contract Documents. 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 Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. Reporting Discrepancies

1. *Contractor's Review of Contract Documents Before Starting Work*: Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers or has actual knowledge of and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.

2. *Contractor's Review of Contract Documents During Performance of Work*: If, 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) any standard, specification, manual or code, or,

   c) 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 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

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 Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract

Documents and:

a. the provisions of any standard, specification, manual, code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); 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 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. a Field Order;

2. Engineer's approval of a Shop Drawing or Sample; (subject to the provisions of Paragraph 6.17.D.3); or

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier 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 Engineer's consultants, including electronic media editions; or

2. 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.

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.

3.06 *Electronic Data*

A. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner or Engineer to Contractor or by Contractor to Owner or Engineer that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 *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. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

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

4.02 *Subsurface and Physical Conditions*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. those reports of explorations and tests of subsurface conditions at or contiguous to the Site; that Engineer has used in preparing the Contract Documents; and

2. those drawings of physical conditions in or relating to existing surface or subsurface at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely on the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "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.

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed 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 4.02 is materially inaccurate; or

2. is of such a nature as to require a change in the Contract Documents; 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 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer's Review*: After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. *Possible Price and Times Adjustments*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition 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 meet any one or more of the categories described in Paragraph 4.03.A; and

   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 Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

   a. Contractor knew of the existence of such conditions at the time Contractor made a final 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

   b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

   c. Contractor failed to give the written notice as required by Paragraph 4.03.A.

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants or subcontractors shall be liable to Contractor for any claims, costs, losses, or 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) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous 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 shall not be responsible for 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 such information and data,

   b. locating all Underground Facilities shown or indicated in the Contract Documents,

   c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction, and

   d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, 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 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be

aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *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.

4.06 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.,

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "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 any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the

Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) 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 4.06.E.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered to Contractor written notice:: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. 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, either party may make a Claim therefor as provided in Paragraph 10.05.

F. 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. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

G. 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 a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's

own negligence.

H. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 – BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish performance and payment bonds, 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 Documents. 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 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds 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 each bond.

C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, 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 requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

A. Contractor shall deliver to Owner, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.

B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.

E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.04 *Contractor's Liability Insurance*

A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which 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:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

a. by any person as a result of an offense directly or indirectly related to the

employment of such person by Contractor, or

b. by any other person for any other reason;

5. 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; and

6. 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.

B. The policies of insurance required by this Paragraph 5.04 shall:

1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and 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;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;

4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and

6. include completed operations insurance;

a. such insurance shall remain in effect for at least two years after final payment, and

b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, 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.

5.06 (Not Used)

5.07 (Not Used)

5.08 (Not Used)

5.09 (Not Used)

5.10 *Acceptance of Bonds and Insurance; Option to Replace*

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, 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. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES

6.01 *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. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

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. Unless the Owner shall otherwise agree in writing, the superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

6.02 *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. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *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.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, 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.

6.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 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 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "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 specification or description 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 or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. "*Or-Equal" Items:* If in Engineer's sole discretion 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, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, 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; and

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; and

3) it has a proven record of performance and availability of responsive service; and

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.

2. *Substitute Items*

a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.

b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements and as Engineer may decide is appropriate under the circumstances.

d. 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:

1) shall certify that the proposed substitute item will:

a) perform adequately the functions and achieve the results called for by the general design,

b) be similar in substance to that specified, and

c) be suited to the same use as that specified;

2) will state:

a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,

b) 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

c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

3) will identify:

a) all variations of the proposed substitute item from that specified, and

b) available engineering, sales, maintenance, repair, and replacement services; and

4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.

C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

E. *Engineer's Cost Reimbursement*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. 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.

F. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. 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 any right of Owner or Engineer to reject defective Work.

C. 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. 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 anything in the Contract Documents create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. 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.

G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (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 such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *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, 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.

6.08 *Permits*

A. Unless otherwise provided in the Supplementary Conditions, 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 opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *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 knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear 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. However, it shall not be Contractor's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *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.

6.11 *Use of Site and Other Areas*

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

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. 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 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 by or based upon Contractor's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other 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 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 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 property to stresses or pressures that will endanger it.

6.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for

reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

6.13 *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 and 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, 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 owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. Contractor shall comply with the applicable requirements of 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 programs 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 6.13.A.2 or 6.13.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 (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 for protection of the Work 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 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *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.

6.15 *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.

6.16 *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.

6.17 *Shop Drawings and Samples*

A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. *Shop Drawings*

a. Submit number of copies specified in the General Requirements.

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 6.17.D.

2. *Samples*

a. Submit number of Samples specified in the Specifications.

b. 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 6.17.D.

B. 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. *Submittal Procedures*

1. Before submitting each Shop Drawing or Sample, Contractor shall have:

a. reviewed and coordinated each 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 offered with respect to indicated use, 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 and approval of that 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 both a written communication separate from the Shop Drawing or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and

approval of each such variation.

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 (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval 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 6.17.C.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's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

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.

6.18 *Continuing the Work*

A. 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, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *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 representation of 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 or the issuance of a notice of acceptability by Engineer;

6. any inspection, test, or approval by others; or

7. any correction of defective Work by Owner.

6.20 *Indemnification*

A. 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 performance of the Work, provided that any such claim, cost, loss, or damage:

1. is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of real or personal property (other than the Work itself), including the

loss of use resulting therefrom; and

2. is caused by any 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, regardless of whether or not caused in part by an individual or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws or Regulations.

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 6.20.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 6.20.A shall not be limited in any way by the amount or types of insurance provided by Contractor under Article 5 of the General Conditions.

D. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the sole negligence or willful misconduct of Owner or Engineer or to the officers, directors, members, partners, employees, agents, and consultants and subcontractors of each and any of them.

6.21 *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 law.

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, Shop Drawings 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 6.21, 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 6.17.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 – OTHER WORK AT THE SITE

7.01 *Related Work at Site*

A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and

2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and shall properly coordinate the Work with theirs. 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, Contractor may cut or alter the work of others with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for

the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, 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.

7.02 *Legal Relationships*

A. Paragraph 7.01.A is not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's actions or inactions.

C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's action or inactions.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

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

8.02 *Furnish Data*

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

8.03 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.04 *Lands and Easements; Reports and Tests*

A. Owner's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph

4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at or contiguous to the Site.

8.05 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.06 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.07 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.08 *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.

8.09 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.10 *Evidence of Financial Arrangements*

A. If and to the extent Owner has agreed to furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents, Owner's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

8.11 *Compliance With Safety Programs*

A. While on 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 pursuant to Paragraph 6.13.B.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *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 Documents and will not be changed without written consent of Owner and Engineer.

9.02 *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 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, or have control over Contractor's Work, nor shall Engineer have authority over or responsibility for the means, methods, techniques, sequences, or procedures of construction selected by Contractor, for safety precautions and programs incident to Contractor's Work in progress, nor for any failure of Contractor to comply with Laws and Regulations applicable to Contractor's furnishing and performing the Work.

9.03 *Project Representative*

A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. 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.

9.04 *Authorized Variations in Work*

A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which 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. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.

B. In connection with Engineer's authority, and limitations thereof, if any,

1. as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21;

2. as to Change Orders, see Articles 10, 11, and 12; and

3. as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

A. 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 Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents 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 14.07.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 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

9.10 *Compliance with Safety Programs*

A. While on the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of the Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.C.

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *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 by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *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 as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.B.

10.03 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:

1. changes in the Work which are:

a) ordered by Owner pursuant to Paragraph 10.01.A,

b) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or

c) agreed to by the parties;

2. 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; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *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.

10.05 *Claims*

A. *Engineer's Decision Required*: All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other

party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

C. *Engineer's Action*: Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part,

2. approve the Claim, or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event

giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs 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 11.01.B, 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, 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 11.01.

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, 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 5.06.D), 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 telegrams, long distance telephone calls, telephone 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 Contractor is required by the Contract Documents to purchase and maintain.

B. *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, expediters, 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 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which 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 Paragraphs 11.01.A.

C. *Contractor's Fee:* When all the Work 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 or when a Claim for an 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 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, 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.

11.02 *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*

1. Contractor agrees that:

a. 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

b. 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*

1. 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.

11.03 *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. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

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. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 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; and

2. there is no corresponding adjustment with respect to any other item of Work; and

3. Contractor believes that Contractor 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 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. The value of any Work covered by a Change Order or of any Claim for 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, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. *Contractor's Fee:* 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 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 11.01.A.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 Paragraph 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier

Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

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 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 *Delays*

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

C. If Owner, Engineer, or utility owners performing other work for Owner as contemplated by Article 7, 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 Price or the Contract Times, or both. 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.

D. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of other contractors or utility owners, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is 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 described in this Paragraph 12.03.D.

E. Owner and Engineer and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each of them shall not be liable to Contractor for any claims, costs, losses, or 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) sustained by Contractor on or in connection with any other project or anticipated project.

ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 *Notice of Defects*

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. Defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests 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 Site safety procedures and programs so that they may comply therewith as applicable.

13.03 *Tests and Inspections*

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

B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in said Paragraph 13.04.C; and

3. as otherwise specifically provided in the Contract Documents.

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 and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

E. 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.

F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.

B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, 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, furnishing all necessary labor, material, and equipment.

C. If it is found that the uncovered Work is defective, 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 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 Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

D. 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, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *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, 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.

13.06 *Correction or Removal of Defective Work*

A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. 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 removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *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 land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as

contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or

2. correct such defective Work; or

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 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. 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) will be paid by Contractor.

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 13.07, 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 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. 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) 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 pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *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 in accordance with Paragraph 13.06.A, 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, 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 13.09, 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, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, 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 (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) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. 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 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

A. The Schedule of Values established as provided in Paragraph 2.07.A 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.

14.02 *Progress Payments*

A. 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 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.

B. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, 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, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and to 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 Documents; 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 moneys 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 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

   a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;

   b. the Contract Price has been reduced by Change Orders;

   c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or

   d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. *Payment Becomes Due*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. *Reduction in Payment*

1. Owner may refuse to make payment of the full amount recommended by Engineer because:

   a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

   b. 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;

   c. there are other items entitling Owner to a set-off against the amount recommended; or

   d. Owner has actual knowledge of the occurrence of any of the events enumerated

in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.

2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action 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, when Contractor remedies the reasons for such action.

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 14.02.C.1 and subject to interest as provided in the Agreement.

14.03 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *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 (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.

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 tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will within 14 days after submission of the tentative certificate to Owner notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will within said 14 days execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.

E. 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 tentative list.

14.05 *Partial Utilization*

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. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and 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 14.04.A through D for that part of the Work.

2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and 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 14.04 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 5.10 regarding property insurance.

14.06 *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 is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *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, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;

   b. consent of the surety, if any, to final payment;

   c. a list of all Claims against Owner that Contractor believes are unsettled; and

   d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.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.

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 Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. 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 14.09. 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. *Payment Becomes Due*

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *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 notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will 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 established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

3. Contractor's disregard of the authority of Engineer; or

4. Contractor's repeated violation in any substantial way of any provisions of the Contract `Documents.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);

2. 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

3. complete the Work as Owner may deem expedient.

C. If Owner proceeds as provided in Paragraph 15.02.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 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) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed 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.

D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

E. 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. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B, and 15.02.C.

15.03 *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;

3. 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) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.

B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) 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 15.03.

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 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 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 16 – DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Dispute resolution methods and procedures, if any, shall be as set forth in the Supplementary Conditions. If no method and procedure has been set forth, and subject

to the provisions of Paragraph 10.05, Owner and Contractor may exercise such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any dispute.

ARTICLE 17 – MISCELLANEOUS

17.01 *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 to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

A. When any period of time is referred to in the Contract Documents 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.

17.03 *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 Documents. 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.

17.04 *Survival of Obligations*

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

17.05 *Controlling Law*

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

17.06 *Headings*

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

+ + END OF GENERAL CONDITIONS + +

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SECTION 00 73 01

SUPPLEMENTARY CONDITIONS

SCOPE

These Supplementary Conditions amend or supplement the General Conditions of the Construction Contract. All provisions of the General Conditions that are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions which are defined in the General Conditions have the meanings assigned to them in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to the singular and plural thereof.

The address system used in these Supplementary Conditions conforms to the address system used in the General Conditions, with the prefix "SC" added thereto.

SC-1.01.A.52 Add a new definition immediately following Paragraph 1.01.A.52, that is to read as follows:

SC-1.01.A.52 *Consulting Engineer:* The firm of Arcadis U.S., Inc. and subsidiaries, affiliates, and its duly authorized agents, such agents acting within the scope of the particular duties entrusted to them.

SC-4.02 Add a new Paragraph immediately after Paragraph 4.02.B that is to read as follows:

SC-4.02.C In the preparation of the Drawings and Specifications, Engineer has relied upon:

1. The following reports of explorations and tests of subsurface conditions at the Site.
   a. 1) Report of Geotechnical Exploration: Ellisville WWTP – New Water Storage Structures, June 12, 2014.
      2) Report of Geotechnical Exploration: Geotechnical Investigation for the expansion of the Columbia County wastewater treatment plant, July 21, 2016
      3) GPR and ERI Analysis of the RIB Area for the Ellisville WWTP, October 7, 2016
   b. The technical data contained in such reports upon which Contractor may rely are: the boring method, the locations and logs of the borings, the levels of subsurface water (if any), laboratory test methods and results, and similar factual data. Bore hole information represents subsurface characteristics to

the extent indicated, only for the point location of the bore hole and, with regard to the level of subsurface water (if any), only at the time the boring was made. Contractor shall make its own interpretations of the subsurface characteristics to be encountered between bore holes and its own interpretations of the fluctuation of the level of subsurface water (if any) at and between bore holes.

c. A copy of the above report is available for review upon request, upon 48 hours' notice to the Engineer.

SC-4.06 Delete Paragraphs 4.06.A and 4.06.B in their entirety and insert the following:

SC-4.06.A. In the preparation of the Drawings and Specifications, Engineer has not utilized any report or drawing related to a Hazardous Environmental Condition identified at the Site.

SC-4.06.B (Not Used)

SC-5.04 Add a new paragraph immediately after Paragraph 5.04.B that is to read as follows:

SC-5.04.C The Contractor, prior to commencing work, shall provide at his own cost and expense the following insurance to Columbia County, which insurance shall be evidenced by certificates and/or policies as determined by the County. Each certificate of policy shall require that, thirty days prior to cancellation or material change in the policies, notice thereof shall be given to the Prosecuting Attorney by certified mail, return receipt requested, for all of the following stated insurance policies. All such notices shall name the Contractor and identify the contract number.

1. Workers' Compensation Statutory in compliance with the requirements of the State of Florida.

2. General Liability Insurance with a minimum limit of liability of $1,000,000 per occurrence and $1,000,000 aggregate. The insurance shall indicate on the Certificate of Insurance the following coverages:

   a) Premises--Operations.
   b) Independent Contractor and Subcontractor.
   c) Products and Completed Operations.
   d) Broad Form Contractual.

Additional coverages and limits may be required based upon the particular services contracted. If such additional coverage and limits are required for a specific contract, those requirements will be described in the "Special Conditions" of the contract specifications.

All contracts involving the use of explosives and demolition shall provide the above coverage with proof that XCU (explosion, collapse or underground) is covered.

3. Automobile Liability Insurance with minimum limits of liability of $1,000,000 per occurrence, combined single limit, unless otherwise indicated in the "Special Conditions" of the Contract specifications. This insurance shall include for bodily injury and property damage the following coverages:

   a) Owned automobiles.
   b) Hired automobiles.
   c) Non-owned automobiles.

4. Protective Liability Insurance: Owners and Contractors. The Contractor shall provide the original and duplicate policy of insurance to the County. This insurance contract shall name Columbia County as the insured and remain in effect until the contract is accepted by the Board of County Commissioners of Columbia County, Florida.

   The insurance shall provide minimum limits of liability of $1,000,000 per occurrence and $1,000,000 aggregate. Said insurance shall provide that the term "Owner" or "The Commissioners of Columbia County" shall be deemed to include all authorities, boards, bureaus, commissions, divisions, departments, districts, and offices of the County and the individual members, employees, and agents thereof in their official capacities.

5. Additional Insurance may be required on an individual basis for extra hazardous contracts and specific service agreements. If such additional insurance is required for a specific contract, that requirement will be described in the "Special Conditions" of the contract specifications.

6. Construction Insurance: The Contractor at his own cost and expense shall provide and maintain the applicable construction insurance until the contract is accepted by the Board of Commissioners of Columbia County. This coverage shall be written for 100 percent of the completed value, covering the Commissioners of Columbia

County as the insured, with a deductible of not more than $5,000. The Contractor shall provide the original and duplicate policy to the County (unless the County shall accept, in lieu thereof, all contained endorsements including all applicable provisions and coverages).

a) For construction of new buildings: "Builders Risk Form"--All Risk Forms with an extension of building coverage to include personal property of others in the care, custody and control of the insured, and shall include a flat premium endorsement.
b) For additions or repairs of existing buildings or structures: "Builders Risk Completed Value Form," covering Contractors, interest in improvements, repairs, additions, alterations to completed buildings, and subject to the coverages described in Item 1 above.
c) For construction of bridges, viaducts, All Risk Contract, with flat premium endorsement.

D. If any of the Property and Casualty insurance requirements are not complied with at their renewal dates, payments to the Contractor will be withheld until those requirements have been met, or at the option of the County, the County may pay the Renewal Premium and withhold such payments from any monies due the Contractor.

E. All property losses shall be made payable to and adjusted with Columbia County.

F. All policies and certificates of insurance shall be approved by Columbia County prior to the inception of any work.

G. Other coverages may be required by Columbia County based on specific needs. If such other coverages are required for a specific contract, those coverages will be described in the "Special Conditions" of the contract specifications.

H. If at any time any of the foregoing policies shall be or become unsatisfactory to the County, as to form or substance, or if a company issuing any such policy shall be or become unsatisfactory to the County, the Contractor shall upon notice to that effect from the County promptly obtain a new policy submit the same to the Prosecuting Attorney for approval and submit a certificate thereof as hereinabove provided. Upon failure of the Contractor to furnish, deliver, and maintain such insurance as above provided, this contract, at the election of the County, may be forthwith declared suspended, discontinued or terminated. Failure of the Contractor to take out/or maintain or the taking out and/or maintenance of any required insurance, shall not relieve the Contractor from any

liability under the contract, nor shall the insurance requirements be construed to conflict with or otherwise limit the obligations of the Contractor concerning indemnification.

I. In the event that claims in excess of the insured amount provided herein, are filed by reason of any operations under the contract, the amount of excess of such claims, or any portion thereof, may be withheld from payment due or to become due to the Contractor until such time as the Contract shall furnish such additional security covering such claims as may be determined by Columbia County.

J. All policies and certificates of insurance of the Contractor shall contain the following clauses:

1. Insurers shall have no right of recovery or subrogation against Columbia County (including its agents and agencies as aforesaid), it being the intention of the parties that the insurance policies so effected shall protect both parties and be primary coverage for any and all losses covered by the above-described insurance.

2. The clause "other insurance provisions" in a policy in which the Commissioners of Columbia County, Florida is named insured, shall not apply to Columbia County.

3. The insurance companies issuing the policy or policies shall have no recourse against Columbia County (including its agents and agencies as aforesaid) for payment of any premiums or for assessments under form of policy.

4. Any and all deductibles in the above-described insurance policies shall be assumed by and be for the account of, and at the sole risk of the Contractor.

K. The following Indemnification Agreement shall be, and is hereby, a provision of the contract and shall be endorsed on the reverse side of all certificates of insurance.

"The Contractor agrees to protect, defend, indemnify, and hold Columbia County and its officers, employees, and agents free and harmless from and against any and all losses, penalties, damages, settlements, costs, charges, professional fees, or other expenses or liabilities of every kind and character arising out of or relating to any and all claims, liens, demands, obligations, actions, proceedings, or causes of action of every kind and character in connection with or arising directly out of this agreement and/or the performance hereof.

Without limiting the generality of the foregoing, and all such claims, etc., relating to personal injury, death, damage to property, defects in materials or workmanship, actual or alleged infringement of any patent, trademark, copyright (or application for any thereof) or of any other tangible or intangible personal or property right, or any actual or alleged violation of any applicable statute, ordinance, administrative order, rule or regulation, or decree of any court, shall be included in the indemnity hereunder. The Contractor further agrees to investigate, handle, and respond to, provide expense and agrees to bear all other costs and expenses related hereto, even if it (claims, etc.) is groundless, false or fraudulent."

SC-5.04.B.1 Change the second and third lines of Paragraph 5.04.B.1 by replacing the term, "Owner and" with the term, "Owner, Engineer, and Consulting Engineer,".

SC-5.06 through SC-5.09, inclusive.

Add new paragraphs immediately after Paragraph 5.05 that are to read as follows:

SC-5.06. *Property Insurance*

A. Contractor shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost of the Work. This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, Engineer, Consulting Engineer and other individuals or entities identified herein, and the officers, directors, members, partners, employees, agents and other consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured, additional insured, or loss payee as their interest may appear;

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, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), mechanical and electrical breakdown or

failure, and damage to electrical apparatus from electrical currents;

3. Include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. Allow for partial utilization of the Work by Owner;

6. Include testing and start-up; and

7. Be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor and Engineer with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

B. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with Paragraph SC-5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured or loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph SC-5.07.

C. The risk of loss within any deductible amount applicable to the policies of insurance purchased in accordance with this Paragraph SC-5.06 will be borne by Contractor, Subcontractors, or others suffering such loss.

SC-5.07. *Waiver of Rights*

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph SC-5.06 will protect Owner, Contractor, Subcontractors, Engineer, Consulting Engineer, and all other individuals or entities identified in Paragraph SC-5.06 to be listed as insureds or additional insured or loss payees (and the officers, directors, members, partners, employees, agents, and other

consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of loss or damage the insurers will have no rights of recovery against any of the insureds or additional insured or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents and other 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 Subcontractors, Engineer, Consulting Engineer, and all other individuals or entities identified in Paragraph SC-5.06 to be listed as insureds or additional insureds or loss payees (and the officers, directors, members, partners, employees, agents and other 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 as trustee or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, Engineer, Consulting Engineer, and the officers, directors, partners, employees, agents, and other 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 and 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 utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04 or after final payment pursuant to Paragraph 14.07.

C. Any insurance policy maintained by Owner covering any loss, damage, or consequential loss referred to in Paragraph SC-5.07.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, Engineer, Consulting Engineer, and the officers, directors, members, partners, employees, agents and other consultants and subcontractors of each and any of them.

SC-5.08. *Receipt and Application of Insurance Proceeds*

A. Any insured loss under the policies of insurance required by Paragraph SC-5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the insureds, additional insureds or loss payees as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph SC-5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof and the Work and the cost thereof covered by an appropriate Change Order.

B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

SC-5.09. *Partial Utilization, Acknowledgment of Property Insurer*

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph SC-5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

SC-6.02.B Add new paragraphs immediately after Paragraph 6.02.B that are to read as follows:

SC-6.02.B.3 If it shall become absolutely necessary to perform Work at night or on Saturdays, Sundays, or legal holidays, written notice shall be submitted to Owner and Engineer at least five days in advance of the need for such Work. Owner will only consider the performance of such Work as can be performed satisfactorily under the conditions. Good lighting and all other necessary facilities for carrying out and observing the Work shall be provided and maintained where such Work is being performed at night.

SC-6.02.B.4 If Owner authorizes Work during other than regular working hours, Contractor shall reimburse Owner for all Owner's additional costs associated with such Work, including, but not necessarily limited to, the overtime costs for Owner's, Engineer's, and Consulting Engineer's personnel on the Site and other additional costs assessed against or incurred by the Owner. At Owner's option, such additional costs may either be deducted from Contractor's progress payments or deducted from the retained amount prior to release following Substantial Completion.

SC-6.07.B Change the first sentence of Paragraph 6.07.B by replacing the term "Owner and Engineer" with the term "Owner, Engineer, and Consulting Engineer".

SC-6.12. Add a new paragraph immediately after Paragraph 6.12.A, that is to read as follows:

SC-6.12.B Contractor will be required to review with Engineer the status of record documents in connection with the Engineer's review of an Application for Payment. Failure to maintain record document current may be just cause for Engineer to recommend withholding of payments for Work performed.

SC-6.15 Add a new paragraph immediately after Paragraph 6.15.A that is to read as follows:

SC-6.15.B Contractor shall be responsible for coordinating 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 all Laws and Regulations. Contractor shall provide a centralized location for the maintenance of the material safety data sheets or other hazard communication information required to be made available by any employer on the Site. Location of

the material safety data sheets or other hazard communication information shall be readily accessible to the employees of employers on the Site.

SC-6.17 Add the following new paragraphs immediately after Paragraph 6.17.E that are to read as follows:

SC-6.17.F Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval or acceptance of submittal with no more than three submittals. Engineer will record Engineer's time for reviewing subsequent submittals of Shop Drawings, Samples, or other submittals or items requiring approval or acceptance, and Contractor shall reimburse Owner for Engineer's charges for such time.

SC-6.17.G In the event that Contractor requests a substitution for a previously approved item, Contractor shall reimburse Owner for Engineer's charges for such time unless the need for such substitution is beyond the control of Contractor.

SC-6.19.A Supplement Paragraph 6.19.A by adding, after the term, "Engineer" in the second sentence, the term "and Consulting Engineer".

SC-6.20.A. Change the first sentence of Paragraph 6.20.A by replacing the term "Owner and Engineer" in the first sentence, with the term ", Owner, Engineer, and Consulting Engineer".

SC-6.20.B Change the first sentence of Paragraph 6.20.B by replacing the term "Owner or Engineer" with the term "Owner, Engineer or Consulting Engineer".

SC-7.03 Add a new paragraph immediately after Paragraph 7.02 that is to read as follows:

SC-7.03 *Separate Contractor Claims*

A. Should Contractor cause damage to the work or property of another contractor at the Site, or should any claim arising out of Contractor's performance of the Work at the Site be made by any other contractor against Contractor, Owner or Engineer or Consulting Engineer, Contractor, without involving any other party, shall either:

1. remedy the damage,

2. agree to compensate the other contractor for remedy of the damage, or

3. remedy the damage and attempt to settle with such other contractor by agreement, or otherwise resolve the dispute by arbitration or at law.

B. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner, Engineer, Consulting 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 directly, indirectly, or consequentially out of or relating to any claim or action, legal or equitable, brought by any other contractor against Owner or Engineer to the extent said claim is based upon Contractor's performance of the Work.

C. Should another contractor cause damage to the Work or property of Contractor at the Site or should the performance of work by any other contractor at the Site give rise to any other claim, Contractor shall not institute any action, legal or equitable, against Owner or Engineer, or permit any action against any of them to be maintained and continued in its name or for its benefit in any court or before any arbiter which seeks to impose liability on or to recover damages from Owner or Engineer on account of any such damage or claim.

D. If Contractor is delayed at any time in performing or furnishing Work by any act or neglect of another contractor and Owner and Contractor are unable to agree as to the extent of any adjustment in Contract Times attributable thereto, Contractor may make a Claim therefore in accordance with Article 12. An extension of the Contract Times shall be Contractor's exclusive remedy with respect to Owner or Engineer for any delay, disruption, interference, or hindrance caused by any other contractor.

SC-9.03 Add a new paragraph immediately after Paragraph 9.03.A that is to read as follows:

SC-9.03.B Resident Project Representative (RPR) will be the Owner's or Engineer's employee or agent at the Site, will act as directed by and under the supervision of County or Engineer, and will confer with Engineer regarding RPR's actions. RPR's dealings in matters pertaining

to the Work in general shall be with Engineer and Contractor keeping Owner advised as necessary. RPR's dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner with the knowledge of and under the direction of Engineer.

1. Duties and Responsibilities to RPR:
    a. Schedules: Review the Progress Schedule, Schedule of Submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.
    b. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.
    c. Liaison:
        1) Serve as Engineer's liaison with Contractor, working principally through Contractor's superintendent, and assist in providing understanding of the intent of the Contract Documents; and assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's operations on the Site.
        2) Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.
    d. Shop Drawings and Samples:
        1) Record date of receipt of Shop Drawings and Samples that are received at the Site.
        2) Receive Samples that are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.
        3) Advise Engineer and Contractor of the commencement of any Work requiring a Shop Drawing or Sample if the submittal has not been approved by Engineer.
    e. Review of Work, Rejection of Defective Work, Inspections and Tests:
        1) Conduct observations of the Work in progress on the Site to assist Engineer in determining if the Work is, in general, proceeding in accordance with the Contract Documents.
        2) Report to Engineer when RPR believes that any Work is unsatisfactory, faulty, or defective or does not conform generally to the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test, or approval required to be made; and advise Engineer of Work that RPR believes should be corrected or rejected or should be uncovered for

observation, or requires special testing, inspection, or approval.

3) Verify that tests, equipment, and systems startups, and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof; and observe, record, and report to Engineer appropriate details relative to the test procedures and startups.

4) Accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the results of these inspections and report to Engineer.

f. Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.

g. Modifications: Consider and evaluate Contractor's suggestions for modifications to Drawings or Specifications and report with RPR's recommendations to Engineer. Transmit to Contractor decisions issued by Engineer.

h. Records:

1) Maintain at the Site orderly files for correspondence, reports of job conferences, Shop Drawings and Samples, and reproductions of original Contract Documents including all Addenda, Change Orders, Work Change Directives, Field Orders, additional Drawings issued subsequent to the execution of the Agreement, Engineer's clarifications and interpretations of the Contract Documents, progress reports, and other Project-related documents.

2) Keep a record recording Contractor's hours on the Site, weather conditions, data relative to questions on Change Orders or changed conditions, list of visitors to the Site, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.

3) Record names, addresses, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.

i. Reports:

1) Furnish Engineer periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and Schedule of Submittals.

2) Consult with Engineer in advance of scheduled major tests, inspections, or start of important phases of the Work.

3) Prepare draft of proposed Change Orders, obtaining backup documents from Contractor, and provide recommendations to Engineer regarding Change Orders and Field Orders.
4) Report immediately to Engineer and Owner upon the occurrence of any Site accident, any Hazardous Environmental Condition, emergencies or acts of God endangering the Work, or property damage by fire or other cause.

j. Payment Requests: Review Applications for Payment with Contractor for compliance with the established procedure for their submission, and submit recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

k. Certificates, Maintenance and Operation Manuals: During the course of the Work, verify that certificates, maintenance and operation manuals, and other data required by the Specifications to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have this material delivered to Engineer for review and forwarding to Owner prior to final payment for the Work.

l. Completion:
1) Before Engineer issues a certificate of Substantial Completion, submit to Contractor a list of observed items requiring completion or correction.
2) Observe whether Contractor has arranged for inspections required by Laws and Regulations, including but not limited to those to be performed by public authorities having jurisdiction over the Work.
3) Conduct final inspection in the company of Engineer, Owner, and Contractor, and prepare a final list of items to be completed or corrected.
4) Observe that all items on final list have been completed or corrected and make recommendations to Engineer concerning acceptance of the Work.

2. The RPR shall not:
a. Authorize any deviation from the Contract Documents or substitution of materials or equipment, including "or equal" items.
b. Exceed limitations of Engineer's authority as set forth in the Contract Documents.

c. Undertake any of the responsibilities of Contractor, Subcontractors, or Contractor's superintendent.
d. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction, unless such advice or directions are specifically required by the Contract Documents.
e. Advise on, issue directions regarding, or assume control over safety precautions and programs in connection with the Work.
f. Accept Shop Drawing or Sample submittals from anyone other than Contractor.
g. Authorize Owner to occupy the Project in whole or in part.
h. Participate in specialized field or laboratory tests or inspections conducted by others except as specifically authorized by Engineer.

SC-12.01.C Delete the semicolon at the end of GC 12.01.C.2.c, and add the following:

provided, however, that on any subcontracted work the total maximum fee to be paid by Owner to Contractor under this Paragraph shall be no greater than 27 percent of the costs incurred by the Subcontractor who actually performs the work;

SC-16.01 Add new paragraphs immediately after Paragraph 16.01.A that are to read as follows:

SC-16.01.B Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the agreement in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the Owner and Engineer, and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

SC-16.01.C Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

SC-16.01.D If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor,

1. Agrees with the other party to submit the Claim to another dispute resolution process, or

2. Gives written notice to the other party of their intent to submit the Claim to a court of competent jurisdiction.

SC-16.01.E Notwithstanding any applicable statute of limitations, a party giving notice under Paragraph SC-16.01.D shall commence an action on the Claim within one year of giving such notice. Failure to do so shall result in the Claim being time-barred and Engineer's action or denial shall become final and binding.

SC-16.02 Add a new paragraph immediately after Paragraph 16.01 that is to read as follows:

SC-16.02 *Arbitration*

A. All Claims or counter claims, disputes, or other matters in question between Owner and Contractor arising out of or relating to the Contract Documents or the breach thereof (except for Claims that have been waived by the making or acceptance of final payment as provided by Paragraph 14.09), including but not limited to those not resolved under the provisions of Paragraph SC-16.01.B and SC-16.01.C will be decided by arbitration in accordance with the agreement, subject to the conditions and limitations of this Paragraph SC-16.02. This agreement to arbitrate and any other agreement or consent to arbitrate entered into will be specifically enforceable under the prevailing law of any court having jurisdiction.

B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitrator or arbitration provider, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the 30-day period specified in Paragraph SC-16.01.D. and in all other cases within a reasonable time after the Claim or counter claim, dispute, or other matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such Claim or counter claim, dispute, or other matter in question would be barred by the applicable statute of limitations.

C. No arbitration arising out of or relating to the Contract Documents shall include by consolidation, joinder, or in any other manner any

individual or entity (including Engineer, and the officers, directors, partners, employees, agents, or consultants of each and any of them) who is not party to this Contract unless:

1. The inclusion of such other individual or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration; and

2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings, and

D. The award rendered by the arbitrator(s) shall be:

1. consistent with the agreement between the parties, and

2. in writing, and shall include:

a. a concise breakdown of the award, and

b. a written explanation of the award specifically citing the Contract Document provisions deemed applicable and relied on in making the award.

E. Subject to provisions of the Controlling Law relating to vacating or modifying an arbitration award, the award will be final. Judgment may be entered upon it in any court having jurisdiction thereof and it will not be subject to modification or appeal.

F. The fees and expenses of the arbitrator(s) and any arbitration service shall be shared equally by Owner and Contractor.

SC-17. Add a new paragraph immediately after Paragraph 17.06, which is to read as follows:

SC-17.07 *Publicity*

A. Contractor shall not disclose to any third party the nature of its Work on the Project, nor engage in publicity or public media disclosures with respect to the Project without the prior written consent of Owner.

SC-18 Add new Article immediately after Article 17, which is to read as follows:

ARTICLE SC-18 – STATUTORY REQUIREMENTS

SC-18.01 This Article contains portions of certain Laws or Regulations which, by provision of Laws or Regulations, are required to be included in the Contract Documents. The material included in this Article may not be complete or current. Contractor's obligation to comply with all Laws and Regulations applicable to the Work is set forth in Paragraph 6.09 of the General Conditions.

+ + END OF DOCUMENT + +

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SECTION 01 11 13

SUMMARY OF WORK

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Table of Articles for this Section is:

Article	Title
1.1	Section Includes
1.2	Location and Description of Work
1.3	Other Construction Contracts
1.4	Work By Others
1.5	Work By Owner
1.6	Owner-furnished Equipment and Materials
1.7	Assigned Procurement Contracts
1.8	Sequence and Progress of Work
1.9	Contractor's Use of Site
1.10	Easements and Rights-of-Way
1.11	Notices to Owners and Authorities of Properties Adjacent to the Work
1.12	Salvage of Equipment and Materials
1.13	Partial Utilization by Owner

1.2 LOCATION AND DESCRIPTION OF WORK

A. The Work is located at South East Giles Martin Drive, approximately near the intersection of I-75 and US 41, as shown.

B. The work to be performed by the CONTRACTOR generally includes furnishing of all labor, equipment, materials, tools and services required to construct, test, and startup the proposed new Ellisville Wastewater Treatment Plant. The specific areas of work include, but are not limited to items 1- 10 listed below, along with associated site work, yard piping, valves, support systems and appurtenances, structural, painting, electrical, instrumentation, tie-ins to existing systems, and testing.
   1. Site clearing, grubbing, grading, filling, restoration, erosion control, seeding and sodding.
   2. Installation of new 105 gpm packaged Lift Station #1 adjacent to existing lift station. Conversion and rehabilitation of existing lift station to a manhole with manhole cover.
   3. Installation of new 105 gpm Packaged Lift Station #2.
   4. Installation of new precast concrete sewer manhole.

5. Open-cut installation of 11,000 foot long 4" PVC force main to connect the new packaged lift stations to the new treatment plant.
6. Directional drill installation of 320 foot long 4" HDPE force main under I-75.
7. Jack and bore installation of 300 foot long gravity sewer to connect sewer laterals to Lift Station #2.
8. Installation of a 25,000 gpd packaged wastewater treatment plant, associated pumps, blowers, mixers, piping, valves, appurtenances, structural, electrical, controls, and site improvements. Installation of emergency back-up power system at the new facility.
9. Installation of rapid infiltration basins, associated piping, valves and appurtenances.
10. Demolition of existing packaged wastewater treatment plant, removal of existing structures, closure and fill of RIBs, site grading, seeding and sod.
11. Decommissioning of existing Dream Inn WWTF including structures, mechanical equipment, tanks, electrical conduits, piping and stairway as shown and specified. Filling of existing ponds, existing underground tanks and grade the site to match existing as shown and specified.

C. The CONTRACTOR shall perform system startup and testing. The CONTRACTOR shall be responsible for coordinating and completing the overall system startup and testing. The CONTRACTOR is responsible for providing all labor equipment and materials for conducting systems startup and testing. The CONTRACTOR is responsible for ensuring that all provisions for the Contract Documents have been properly executed and successfully completed.

D. The Contract Documents indicate existing conditions only where they impact the proposed facility modifications and equipment installation. It is the CONTRACTOR'S responsibility to field verify existing and proposed equipment locations and notify the ENGINEER of any conflicts prior to construction. The contract documents have been developed to indicate the final location of equipment, piping, conduits and miscellaneous items associated with this project. The CONTRACTOR is responsible for developing and updating a construction schedule, which will allow installation of equipment in phases and partial startup, testing and final certification of portions of the project.

E. CONTRACTOR'S Duties:
   1. Coordinate with the ENGINEER, subcontractors, and the COUNTY.
   2. Except as specifically noted, provide and pay for:
      a. Labor, materials and equipment.
      b. Tools, construction equipment, and machinery.
      c. Water and utilities required for construction.
      d. Other facilities and services necessary for the proper execution and completion of the Work.
   3. Secure and pay for, as necessary for the proper execution and completion of the Work, and as applicable at time of receipt of bids:
      a. Permits.

b. Government fees.
c. Licenses.

4. Give required notices in writing.
5. Comply with codes, ordinances, rules, regulations, orders, and other
6. Legal requirements of public authorities that bear on performance of Work.
7. Promptly submit written notice to ENGINEER of observed variance of Contract Documents from legal requirements.
8. Enforce strict discipline and good order among employees. Do not employ persons lacking the required skills for their assigned task.
9. The CONTRATOR shall furnish personnel and equipment that will be efficient, appropriate, and large enough to secure a satisfactory quality of work and a rate of progress that will ensure the completion of the work within the time stipulated.
10. The CONTRACTOR shall be responsible for restoring all disturbed property, resulting from his construction activities, or the activities of his sub-consultant, at no additional cost to the COUNTY.
11. The CONTRACTOR shall confine his activities to the site(s) designated by the COUNTY for the Work or for materials storage.

F. Contracting Method: Work shall be constructed under one prime contract.

1.3 OTHER CONSTRUCTION CONTRACTS (NOT USED)

1.4 WORK BY OTHERS (NOT USED)

1.5 WORK BY OWNER (NOT USED)

1.6 OWNER-FURNISHED EQUIPMENT AND MATERIALS (NOT USED)

1.7 ASSIGNED PROCUREMENT CONTRACTS (NOT USED)

1.8 SEQUENCE AND PROGRESS OF WORK

A. Sequencing:
1. Incorporate sequencing of the Work into the Progress Schedule.

1.9 CONTRACTOR'S USE OF SITE

A. Contractor will have full use of the Site for storage and operations of workers.

B. Move stored products that interfere with operations of Owner, other contractors, and others performing work for Owner.

C. Site access shall be directed by the Owner and Engineer.

1.10 EASEMENTS AND RIGHTS-OF-WAY

A. Easements and rights-of-way will be provided by Owner in accordance with the General Conditions. Confine construction operations within Owner's property, public rights-of-way, easements obtained by Owner, and the limits shown. Use care in placing construction tools, equipment, excavated materials, and materials and equipment to be incorporated into the Work to avoid damaging property and interfering with traffic. Do not enter private property outside the construction limits without permission from the owner of the property.

B. On Private Property:
   1. General limits of easements are shown on the Drawings.

1.11 NOTICES TO OWNERS AND AUTHORITIES OF PROPERTIES ADJACENT TO THE WORK

A. Notify owners of adjacent property and utilities when prosecution of the Work may affect their property, facilities, or use of property.

B. When it is necessary to temporarily obstruct access to property, or when utility service connection will be interrupted, provide notices sufficiently in advance to enable affected persons to provide for their needs. Conform notices to Laws and Regulations and, whether delivered orally or in writing, include appropriate information concerning the interruption and instructions on how to limit inconvenience caused thereby.

C. Notify utility owners and other concerned entities at least 48 hours prior to cutting or closing streets or other traffic areas or excavating near Underground Facilities or exposed utilities.

1.12 SALVAGE OF EQUIPMENT AND MATERIALS (NOT USED)

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 14 16

COORDINATION WITH OWNER'S OPERATIONS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes requirements for coordinating with OWNER's operations during the Work, and includes requirements for tie-ins and shutdowns necessary to complete the Work without impact on OWNER's operations except as allowed in this Section.
   2. CONTRACTOR shall provide labor, materials, tools, equipment and incidentals shown, specified and required to coordinate with OWNER's operations during the Work.

B. Coordination:
   1. Review installation procedures under other Specification sections and coordinate Work that must be performed with or before the Work specified in this Section.

C. Related Sections:
   1. Section 01 11 13, Summary of Work.
   2. Section 01 51 41, Temporary Pumping.

D. Except for shutdowns specified in this Section, perform the Work such that OWNER's facility remains in continuous satisfactory operation during the Project. Schedule and conduct the Work such that the Work does not: impede OWNER's production or processes, create potential hazards to operating equipment and personnel, reduce the quality of the facility's products or effluent, or cause odors or other nuisances.

E. Work not specifically covered in this Section or in referenced Sections may, in general, be completed at any time during regular working hours in accordance with the General Conditions and Supplementary Conditions, subject to the requirements in this Section.

F. CONTRACTOR has the option of providing additional temporary facilities that can eliminate or mitigate a constraint without additional cost to OWNER, provided such additional temporary facilities: do not present hazards to the public, personnel, structures, and equipment; that such additional temporary facilities do not adversely affect OWNER's ability to comply with Laws and Regulations, permits, and operating requirements; that such temporary facilities do not

generate or foster the generation of odors and other nuisances; and that requirements of the Contract Documents are fulfilled.

G. Coordinate shutdowns with OWNER and ENGINEER. When possible, combine multiple tie-ins into a single shutdown to minimize impacts on OWNER's operations and processes.

H. Do not shut off or disconnect existing operating systems, unless accepted by ENGINEER in writing. Operation of existing equipment will be by OWNER unless otherwise specified or indicated. Where necessary for the Work, CONTRACTOR shall seal or bulkhead OWNER-operated gates and valves to prevent leakage that may affect the Work, OWNER's operations, or both. Provide temporary watertight plugs, bulkheads, and line stops as required. After completing the Work, remove seals, plugs, bulkhead, and line stops to satisfaction of ENGINEER.

I. Bypassing:
   1. Diversion of flows around treatment processes is not allowed.

J. Requirements for temporary pumping are in Section 01 51 41, Temporary Pumping. Requirements for temporary pumping associated with specific shutdowns are in this Section.

1.2 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Substitute Sequence Submittal: When deviation from specified sequence is proposed, provide submittal explaining in detail the proposed sequence change and its effects, including evidence that OWNER's operations will not be adversely affected by proposed change. List benefits of proposed sequence change, including benefits to Progress Schedule. Submit in accordance with Section 01 25 00, Substitution Procedures.

B. Informational Submittals: Submit the following:
   1. Shutdown Planning Submittal:
      a. For each shutdown, submit an inventory of labor and materials required to perform the shutdown and tie-in tasks, an estimate of time required to accomplish the complete shutdown including time for OWNER to take down and start up existing equipment, systems, or conduits, and written description of steps required to complete the Work associated with the shutdown.
      b. Furnish submittal to ENGINEER at least thirty days prior to proposed shutdown start date. Do not start shutdown until obtaining ENGINEER's acceptance of shutdown planning submittal.
   2. Shutdown Notification: After acceptance of shutdown planning submittal and prior to starting the shutdown, provide written notification to OWNER

and ENGINEER of date and time each shutdown is to start. Provide notification at least 72 hours in advance of each shutdown.

1.3 GENERAL CONSTRAINTS

A. Specified in the Contract Documents are the sequence and shutdown durations, where applicable, for OWNER'S equipment, systems, and conduits that are to be taken out of service temporarily for the Work. New equipment, materials, and systems may be used by OWNER after the specified field quality controls and testing are successfully completed and the materials or equipment are Substantially Complete.

B. The following constraints apply to coordination with OWNER's operations:
   1. Operational Access: OWNER'S personnel shall have access to equipment and areas that remain in operation.
   2. Schedule and perform equipment and system start-ups for Monday through Thursday. Equipment and systems shall not be placed into operation on Friday, Saturday, and Sunday without prior approval of OWNER.
   3. Dead End Valves or Pipe: Provide blind flanges, watertight bulkheads, or valve at temporary and permanent terminuses of pipes and conduits. Blind flanges and bulkheads shall be suitable for the service and braced and blocked, as required, or otherwise restrained as directed by ENGINEER. Temporary valves shall be suitable for their associated service. Where valve is provided at permanent terminus of pipe or conduit, also provide on downstream side of valve a blind flange with drain/flushing connection.
   4. OWNER will assist CONTRACTOR in dewatering process tanks, basins, conduits, and other work areas to be dewatered for shutdowns. Maintain clean and dry work area by pumping and properly disposing of fluid that accumulates in work areas.
   5. Draining and Cleaning of Conduits, Tanks, and Basins:
      a. Unless otherwise specified, CONTRACTOR shall dewater process tanks, basins, conduits, and pipelines at beginning of each shutdown. Flush, wash down, and clean tanks, basins, pipelines, conduits, and other work areas.
      b. CONTRACTOR shall remove liquids and solids and dispose of them at a location approved by ENGINEER. Unless otherwise specified or indicated, contents of pipes, tanks, basins, and conduits shall be transferred to existing conduits at the Site with capacity sufficient to accept such discharges, using hoses, piping, pumps, or other means provided by CONTRACTOR. Discharge of fluids across floors is not allowed.
      c. If drainage point is not available on the piping or conduit to be drained, provide a wet tap using tapping saddle and valve or other method approved by ENGINEER. Uncontrolled spillage of contents of pipes or conduits is not allowed.

d. Spillage shall be brought to ENGINEER's attention immediately, both verbally and in writing, and reported in accordance with Laws and Regulations. CONTRACTOR shall wash down spillage to floor drains or sumps and flush the system to prevent clogging and odors. If spillage is not suitable for discharge to the drainage system, such as chemical spills, as determined by ENGINEER, CONTRACTOR shall remove spillage by other method, such as vactor truck, acceptable to ENGINEER.

1.4 SEQUENCE OF WORK

A. Perform the Work in the specified sequence. Certain phases or stages of the Work may require working 24-hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if OWNER's operations are not adversely affected by proposed sequence change, with ENGINEER's acceptance. Stages specified in this Article 1.4 are sequence-dependent. Follow the sequence of work as outlined on the plans.

1.5 TIE-INS

A. CONTRACTOR shall perform tie-ins required to complete the Work.

1.6 SHUTDOWNS

A. General:
   1. Terminology: A "shutdown" is when a portion of the normal operation of OWNER's facility, whether equipment, systems, piping, or conduit, has to be temporarily suspended or taken out of service to perform the Work.
   2. Work that may interrupt normal operations shall be accomplished at times convenient to OWNER.
   3. Furnish at the Site, in close proximity to the shutdown and tie-in work areas, tools, equipment, spare parts and materials, both temporary and permanent, necessary to successfully complete the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to the associated shutdown. Demonstrate to ENGINEER's satisfaction that CONTRACTOR has complied with these requirements before commencing the shutdown.
   4. If CONTRACTOR's operations cause an unscheduled interruption of OWNER's operations, immediately re-establish satisfactory operation for OWNER.
   5. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of OWNER's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by CONTRACTOR if, in ENGINEER's opinion, CONTRACTOR did not conform to the requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in conducting the Work.

6. Work requiring service interruptions for tie-ins shall be performed during scheduled shutdowns.
7. Temporary, short-term shutdowns of smaller piping, conduits, equipment, and systems shall be coordinated with ENGINEER and OWNER.

B. Shutdowns of Electrical Systems: Comply with Laws and Regulations, including the National Electric Code. CONTRACTOR shall lock out and tag circuit breakers and switches operated by OWNER and shall verify that affected cables and wires are de-energized to ground potential before shutdown Work is started. Upon completion of shutdown Work, remove the locks and tags and notify ENGINEER that facilities are available for use.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 22 13

MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.1 DESCRIPTION

A. Items listed starting in Article 1.4 of this Section refer to and are the same pay items listed in the Bid Form and constitute all pay items for completing the Work. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, plant services, CONTRACTOR's or ENGINEER's field offices, layout surveys, Project signs, sanitary requirements, testing, safety provisions and safety devices, submittals and record drawings, water supplies, power and fuel, traffic maintenance, removal of waste, security, coordination with OWNER's operations, information technology (including hardware, software, and services) required during construction, bonds, insurance, or other requirements of the General Conditions, Supplementary Conditions, General Requirements, and other requirements of the Contract Documents. Compensation for all services, items, materials, and equipment shall be included in prices stipulated for lump sum pay items listed in this Section and included in the Contract.

B. Each lump sum bid price shall include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR's overhead and profit for each separately identified item.

1.2 ENGINEER'S ESTIMATE OF QUANTITIES

A. ENGINEER's estimated quantities for items of Work, as included in the Contract, are approximate only and are included solely for purpose of comparing Bids and pricing. OWNER does not expressly or by implication agree that nature of materials encountered below the ground surface or actual quantities of material encountered or required will correspond with the quantities included in the Contract at the time of award and reserves right to increase or decrease quantities or to eliminate quantities as OWNER may deem necessary.

1.3 RELATED PROVISIONS

A. Payments to CONTRACTOR: Refer to General Conditions and Agreement.

B. Changes in Contract Price: Refer to General Conditions.

C. Schedule of Values: Refer to Section 01 29 73, Schedule of Values.

1.4 GENERAL CONSTRUCTION

A. Item 1 – Mobilization/Demobilization:
   1. Measurement: Lump sum payment for Item 1 will be full compensation for completing all work associated with mobilization and demobilization as shown and specified.
   2. Payment: The lump sum price bid shall include all expenses related to the amassing of all labor, equipment, temporary offices, transportation, storage and materials required for the construction of the project, as shown on the Drawings and as specified for mobilization. Demobilization shall include removal of equipment and temporary offices as well as cleaning of site.

B. Item 2 – Site Civil Improvements
   1. Measurement and Payment: Lump sum payment for Item 2 will be full compensation for completing the Work associated with site work, as shown and specified.
   2. The lump sum price bid shall include, but not be limited to: demolitions, earthwork, yard piping, concrete work, sodding, landscaping, erosion control, site restoration and grading, backfill, select fill material and all other work specified and shown on the plans.

C. Item 3 – Furnish and installation of new 105 gpm packaged Lift Station #1:
   1. Measurement: Lump sum payment for Item 3 will be full compensation for completing the Work required for the new 105 gpm package Lift Station #1, as shown or indicated under Division 01 through Division 49.
   2. Payment: The lump sum price bid shall include the installation of a new packaged lift station adjacent to the existing lift station and the associated piping, valves, appurtenances, concrete foundations, anchor systems, electrical equipment, control panels, and site work, as well as the rehabilitation and conversion of the existing lift station into a manhole with a manhole cover. Electrical work shall include, but not be limited to: local control stations, disconnect switches, site lighting, duct banks, conduits runs, cables and wiring, and field instrumentation work, as shown and specified.

D. Item 4 – Furnish and installation of new 105 gpm packaged Lift Station #2:
   1. Measurement: Lump sum payment for Item 4 will be full compensation for completing the Work required for the new 105 gpm package Lift Station #2, as shown or indicated under Division 01 through Division 49.
   2. Payment: The lump sum price bid shall include the installation of a new packaged lift station and the associated piping, valves, appurtenances, concrete foundations, anchor systems, electrical equipment, control panels, and site work, as well as the installation of the precast concrete manhole and gravity line connecting the manhole to the new lift station. Work also includes connecting existing sewer lines to the package lift station as shown on the drawings. Electrical work shall include, but not be limited to: local control

stations, disconnect switches, site lighting, duct banks, conduits runs, cables and wiring, and field instrumentation work, as shown and specified.

E. Item 5 – Furnish and installation of 11,000 LF of 4" SDR 18 PVC force main:
   1. Measurement: Lump sum payment for Item 5 will be full compensation for completing the Work required for the installation of the 4" PVC forcemain from the two new lift stations to the new package wastewater treatment plant, as shown or indicated under Division 01 through Division 49.
   2. Payment: The lump sum bid price shall include the installation and testing of the 4" SDR 18 PVC force main and associated valves and appurtenances.

F. Item 6 – Furnish and installation of 320 LF of 4" SDR 13.5 HDPE force main:
   1. Measurement: Lump sum payment for Item 6 will be full compensation for completing the Work for installation of the 4" HDPE pipe crossing Interstate 75, as shown or indicated under Division 01 through 49.
   2. Payment: The lump sum bid price shall include the installation and testing of the 4" SDR 13.5 HDPE force main crossing I-75 and associated valves and appurtenances.

G. Item 7 – Furnish and install 300 LF of 8" SDR 35 PVC gravity sewer:
   1. Measurement: Lump sum payment for Item 7 will be full compensation for completing the Work associated with the gravity sewer piping from the package wastewater treatment plant to the rapid infiltration basins, as shown or indicated under Division 01 through Division 49.
   2. Payment: The lump sum bid price shall include the installation and testing of the 8" PVC gravity sewer from the package wastewater treatment plant to the RIBs, associated valves and appurtenances.

H. Item 8 – Furnish and installation of a 25,000 gpd packaged wastewater treatment plant, associated piping, pumps, blowers, mixers, valves, appurtenances, electrical, control panels, and site improvements. Installation of emergency back-up power system at the new facility:
   1. Measurement: Lump sum payment for Item 8 will be full compensation for completing the Work associated with the package wastewater treatment plant, as shown or indicated under Division 01 through Division 49.
   2. Payment: The lump sum bid price shall include installation of a 25,000 gpd packaged wastewater treatment plant and the associated piping, valves, appurtenances, concrete foundations, anchor systems, electrical equipment including a new back-up power system, control panels, site fencing, and site lighting, as well as start-up and performance testing. Electrical work shall include, but not be limited to: local control stations, disconnect switches, site lighting, duct banks, conduits runs, cables and wiring, and field instrumentation work, as shown and specified.

I. Item 9 – Furnish and installation of three (3) rapid infiltration basins, associated piping, valves, and appurtenances:

1. Measurement: Lump sum payment for Item 9 will be full compensation for completing the Work associated with the installation of three rapid infiltration basins, as shown or indicated under Division 01 through Division 49.
2. Payment: The lump sum bid price shall include installation of rapid infiltration basins with associated site work, piping, valves, and appurtenances.

J. Item 10 – Demolition of existing structures:
   1. Measurement: Lump sum payment for Item 10 will be full compensation for completing all demolition work associated with the project as shown and specified.
   2. Payment: The lump sum bid price shall include demolition of the existing packaged wastewater treatment plant including all valves, appurtenances, electrical equipment and conduits, concrete, backfill and compact disturbed areas at the lift station location, fill and abandon existing tanks, and fill and compact the existing rapid infiltration basins, as shown and specified.

K. Item 11 - Dream Inn WWTF: Decommissioning of existing wastewater treatment facility including structures, mechanical equipment, tanks, electrical conduits, piping and stairway as shown and specified. Filling of existing ponds, existing underground tanks and grade the site to match existing as shown and specified.

L. Item 12 – Owner's Contingency Allowance for additional Civil, Mechanical, Electrical, Instrumentation, and Structural Work, as authorized by OWNER:
   1. Measurement: Includes a stipulated amount available as reserve for sole use by OWNER to cover unanticipated costs including, minor items unforeseen and necessary but not included in bid, unanticipated conflicts and/or design changes required during construction, and minor increases to existing bid item quantities, which are necessary for safe and timely completion of the Work.
   2. Payment: Payment for Work authorized under Item 11 will be full compensation for providing all Work authorized under the contingency allowance, complete as shown, indicated, or directed by ENGINEER, only upon written authorization from OWNER. Work authorized under contingency allowance may be included in subsequent Application(s) for Payment, as applicable, following authorization of and performance of contingency allowance Work.

M. Item 13 – Allowance for Required Permitting Fees, as authorized by OWNER:
   1. Measurement: Payment will be made to the Contractor based on actual invoiced amounts paid by the Contractor to obtain required permits.
   2. Payment:
      a. Payment for Work authorized under Item 12 will be full compensation for providing all fees authorized under the permitting allowance, complete as shown, indicated, or directed by ENGINEER. Fees authorized under permitting allowance may be included in subsequent Application(s) for Payment, as applicable, following authorization of and performance of permitting allowance fees.

b. Payment for Work authorized under Item 12 will not be compensation for CONTRACTOR markups or premiums, or effort to prepare any required permit applications. Item 12 will also not be compensation for fees incurred due to CONTRACTOR's negligence, permits required for items for the CONTRACTOR's convenience, but not required by the Contract Documents or ENGINEER, fees and costs associated with utility services to temporary construction trailers and electricity required by CONTRACTOR during construction activities.

1.5 DEDUCTIVE ALTERNATES

A. Any of the items listed in this section may be deducted from the Base Bid at the OWNER's discretion. The amount for each of these deduct alternates shall match the lump sum amount included for these associated items in the base bid.

B. Item 5 – Furnish and install 11,000 LF of 4" DR 18 PVC force main:
   1. This deduct item includes work associated with furnishing and installing the 4" DR 18 PVC force main, fittings and associated valves and appurtenances complete and in place between the new package Lift Station No. 1 and Lift Station No. 2 and the package wastewater treatment plant.

C. Item 9 – Furnish and Install three (3) rapid infiltration basins, associated piping, valves, and appurtenances:
   1. This deduct item includes all work required for the installation of the rapid infiltration basins, along with all associated piping, valves and appurtenances.

D. Item 10 – Demolition of existing structures and filling of existing rapid infiltration basin:
   1. This deduct item includes all work associated with demolition of the existing packaged wastewater treatment plant including all valves, appurtenances, electrical equipment and conduits, concrete, backfill and compact disturbed areas at the lift station location, fill and abandon existing tanks, and fill and compact the existing rapid infiltration basins, as shown and specified.

E. Item 11 - Dream Inn WWTF: Decommissioning of existing wastewater treatment facility including structures, mechanical equipment, tanks, electrical conduits, piping and stairway as shown and specified. Filling of existing ponds, existing underground tanks and grade the site to match existing as shown and specified.

1.6 ADDITIVE ALTERNATES

A. Any of the items listed in this section may be added to the Base Bid at the OWNER's discretion. The amount for each of these additive alternates shall match the lump sum amount included for these associated items in the base bid.

B. Item AA-1 – Furnish and installation of an additional 25,000 gpd packaged wastewater treatment plant, associated piping, pumps, blowers, mixers, valves, appurtenances, electrical, control panels, and site improvements, complete in place.

C. Item AA-2 – Furnish and install three (3) additional rapid infiltration basins, associated piping, valves, and appurtenances.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope: Section includes:
   1. Administrative and procedural requirements for selecting products for the Project.
   2. Procedural requirements for product substitutions.
   3. Procedural requirements for substitute construction methods or procedures, when construction methods or procedures are specified.

1.2 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning:
   1. "Products" includes materials, equipment, machinery, components, fixtures, systems, and other goods incorporated in the Work. Products do not include machinery and equipment used for preparing, fabricating, conveying, erecting, or installing the Work. Products include OWNER-furnished goods incorporated in the Work where use of such goods is specifically required in the Contract Documents.

1.3 PRODUCT SUBSTITUTIONS

A. Requests for approval of substitute products or items will be considered for a period of 45 days after the Effective Date of the Agreement. After end of specified period, requests will be considered only in case of unavailability of a specified product or other conditions beyond CONTRACTOR's control.

B. Procedure:
   1. Submit number of copies of request for substitution as specified for Shop Drawings and other submittals in Section 01 33 00, Submittal Procedures.
   2. Submit separate request for each substitution.
   3. Submit substitution request using forms attached to this Section by completing all information requested on the forms, and enclose with the forms supplementary information as required. In addition to requirements of the General Conditions and information required on substitution request forms, include with request the following:
      a. Product identification, including manufacturer's name and address.

b. Manufacturer's literature with product description, performance and test data, and reference standards with which product complies.
c. Samples, if appropriate.
d. Name and address of similar projects on which product was used, and date of installation.

1.4 SUBSTITUTE CONSTRUCTION METHODS OR PROCEDURES

A. Where construction methods or procedures are specified, for a period of 60 days after the Effective Date of the Agreement, ENGINEER will consider CONTRACTOR's written requests for substitute construction methods or procedures specified.

B. Procedure:
1. Submit number of copies of request for substitution as specified for Shop Drawings and other submittals in Section 01 33 00, Submittal Procedures.
2. Submit separate request for each substitution.
3. Submit substitution request using forms attached to this Section by completing all applicable information requested on the forms, and enclose with the forms supplementary information as required. In addition to requirements of the General Conditions and information required on substitution request forms, include with request the following:
   a. Detailed description of proposed method or procedure.
   b. Itemized comparison of the proposed substitution with the specified method or procedure.
   c. Drawings illustrating method or procedure.
   d. Other data required by ENGINEER to establish that proposed substitution is equivalent to specified method or procedure.

1.5 CONTRACTOR'S REPRESENTATION AND ACCEPTANCE

A. In submitting request for substitution, CONTRACTOR represents that:
1. CONTRACTOR has investigated proposed substitution and determined that it is equivalent to item, product, method, or procedure specified, as applicable.
2. CONTRACTOR will provide the same or better guarantees or warranties for proposed substitution as for the specified product, manufacturer, method, or procedure, as applicable.
3. CONTRACTOR waives all Claims for additional costs or extension of time related to proposed substitution that subsequently may become apparent.

B. A proposed substitution will not be accepted for review if:
1. Approval would require changes in design concept or a substantial revision of the Contract Documents.
2. Approval would delay completion of the Work or the work of other contractors.

3. Substitution request is indicated or implied on a Shop Drawing or other submittal, or on a request for interpretation or clarification, and is not accompanied by CONTRACTOR's formal request for substitution.

C. If ENGINEER does not approve the proposed substitute, CONTRACTOR shall provide the specified product, manufacturer, method, or procedure, as applicable.

D. Approval of a substitution request will not relieve CONTRACTOR from requirement for submitting Shop Drawings as set forth in the Contract Documents.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SUPPLEMENTS

A. The forms listed below, following the "End of Section" designation, are part of this Specification Section:
   1. Substitution Request Form (two pages).
   2. Product Substitution Checklist (one page).

+ + END OF SECTION + +

SUBSTITUTION REQUEST

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ Engineer Proj. No. _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

☐ Point-by-point comparative data attached — REQUIRED BY THE CONTRACT DOCUMENTS

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Engineer: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Owner for accepting substitution: ($)
(attach detailed, itemized estimate)

_____ _____

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.
(clarify whether change is to Substantial Completion, Milestone, or time for readiness for final payment)

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

SUBSTITUTION REQUEST
(Continued)

☐ Substitute product, method, or procedure is subject to payment of licensing fee or royalty (check if "yes" and attach information)

☐ Substitute product, method, or procedure is patented or copyrighted (check if "yes" and attach information)

The undersigned certifies:

- Representations in the General Conditions and in Section 01 25 00, Substitution Procedures, regarding substitutions are valid.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay Progress Schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for Engineer's review and changes, if any, to the design and Contract Documents, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: ☐

ENGINEER'S REVIEW AND ACTION (FOR ENGINEER'S USE ONLY)

☐ Substitution approved.
☐ Substitution approved as noted.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: _____ Date: _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ Engineer
☐ Other:

Adapted from CSI Form No. 13.0B, 2004 edition

PRODUCT SUBSTITUTION CHECKLIST

Date: _____ Re: _____

Engineer Proj No.: _____ Manufacturer's Project No.: _____

Filing No.: _____ Contract For: _____

Product Equivalence:

☐ Is the submitted product equivalent to the specified item? _____

☐ Does it serve the same function? _____

☐ Does it have the same dimensions? _____

☐ Does it have the same appearance? _____

☐ Will it last as long? _____

☐ Does it comply with the same codes, and standards and performance requirements? _____

☐ Has the product been used locally, and where are the projects? _____

_____

☐ Has a problem occurred with the product, and what was the remedy? _____

_____

Effect on the Project:

☐ Will the substitution affect other aspects of the construction? _____

☐ Are any details affected and are changes required? _____

☐ What is the cost of the changes? _____

☐ Who pays for the required changes? _____

☐ Is construction time affected? _____

_____

Effect on the Warranty:

☐ How does the proposed warranty differ from the specified warranty? _____

_____

☐ Does the manufacturer have a track record of standing behind the warranty? _____

_____

Adapted from CSI Form No. 20.3, 1998 edition

SECTION 01 29 73

SCHEDULE OF VALUES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Submit to ENGINEER for acceptance a Schedule of Values that allocates cost to each item of the Work. Schedule of Value list of line items shall correspond to each aspect of the Work, establishing in detail the portion of the Contract Price allocated to each major component of the Work.

B. Upon request of ENGINEER, support values with data that substantiate their correctness.

C. Submit preliminary Schedule of Values to ENGINEER for initial review. CONTRACTOR shall incorporate ENGINEER's comments into the Schedule of Values and resubmit to ENGINEER. ENGINEER may require corrections and re-submittals until Schedule of Values is acceptable.

D. Schedule of Values and the Progress Schedule updates specified in Section 01 32 16, Progress Schedule, shall be basis for preparing each Application for Payment. Schedule of Values may be used as a basis for negotiating price of changes, if any, in the Work.

E. Include in Schedule of Values unit price payment items with their associated quantity. Provide in the Schedule of Values detailed breakdown of unit prices when required by ENGINEER.

F. Include in Schedule of Values itemized list of Work for each major part of the Contract, for each payment item specified in Section 01 22 13, Measurement and Payment, and shall be grouped under the following areas:
   1. Installation of lift station #1 adjacent to existing lift station and conversion of existing lift station to a manhole.
   2. Installation of new lift station #2.
   3. Installation of new precast concrete sewer manhole, associated piping, fittings, and appurtenances.
   4. Installation of 11,000 foot long PVC force main to connect the new lift stations to the new treatment plant.
   5. Installation of 320 foot long HDPE force main using directional drilling.
   6. Installation of 300 foot long gravity sewer to connect sewer laterals to lift station #2.

7. Installation of a pre-engineered wastewater treatment plant, associated pumps, piping, valves, appurtenances, electrical, control panels, and site improvements.
8. Installation of rapid infiltration basins, associated piping, valves and appurtenances.
9. Demolition of existing wastewater treatment plant.
10. Installation of a manhole cover for existing lift station and rehabilitation of structure.
11. Installation of emergency back-up power system at new facility.
12. Construction of an access road and installation of site fencing and site lighting for the wastewater treatment plant site.

G. Requirements for preliminary Schedule of Values and Schedule of Values are:
1. Schedule of Values shall show division of Work between CONTRACTOR and Subcontractors. Line items for Work to be done by Subcontractor shall include the word, "(SUBCONTRACTED)".
2. Schedule of Values shall include breakdown of costs for materials and equipment, installation, and other costs used in preparing the Bid by CONTRACTOR and each Subcontractor. List purchase and delivery costs for materials and equipment for which CONTRACTOR may apply for payment as stored materials.
3. Include separate amounts for each Specification Section in the Contract Documents by structure, building, and work area.
4. Identify each line item with number corresponding to the associated Specification Section number. List sub-items of major products or systems, as appropriate or when requested by ENGINEER.
5. Sum of individual values shown on the Schedule of Values shall equal the total of associated payment item. Sum of payment item totals in the Schedule of Values shall equal the Contract Price.
6. Include in each line item a directly proportional amount of CONTRACTOR's overhead and profit. Do not include overhead and profit as separate item(s).
7. Include separate line item for each allowance, and for each unit price item
8. Include line item for bonds and insurance.
9. Include items for the General Conditions, permits (when applicable), construction Progress Schedule, and other items required by ENGINEER. Include such items in Applications for Payment on schedule accepted by ENGINEER
10. Line items for Site maintenance such as dust control, compliance with storm water pollution prevention plans and permits, spill prevention control and countermeasures plans, and for construction photographic documentation; temporary utilities and temporary facilities, field offices, temporary controls, field engineering, and similar Work shall be included in the Schedule of Values and proportioned in Applications for Payment throughout duration of the Work.
11. Include separate line items under each appropriate payment item for mobilization and demobilization. Document for ENGINEER the activities included in mobilization and demobilization line items.

12. Include costs for submittals, operations and maintenance manuals, field testing, training of operations and maintenance personnel, and similar Work.
13. Coordinate Schedule of Values with resource loading of the Progress Schedule, in accordance with Section 01 32 16, Progress Schedule.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Submit to ENGINEER four copies of Schedule of Values.
   2. Content of Schedule of Values submittals shall conform to Article 1.1 of this Section.
   3. Time Frames for Submittals:
      a. Submit preliminary Schedule of Values within ten days of date that the Contract Times commence running in accordance with the Notice to Proceed.
      b. Submittal of the Schedule of Values shall be in accordance with the General Conditions. ENGINEER will not accept Applications for Payment without an acceptable Schedule of Values.
      c. When required by ENGINEER, promptly submit updated Schedule of Values to include cost breakdowns for changes in the Contract Price.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 31 13

PROJECT COORDINATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall coordinate the Work, including testing agencies whether hired by CONTRACTOR, OWNER, or others; Subcontractors, Suppliers, and others with whom coordination is necessary, in accordance with the General Conditions, Supplementary Conditions, and this Section, to complete the Work within the Contract Times and in accordance with the Contract Documents.

B. In accordance with the General Conditions as may be modified by the Supplementary Conditions, CONTRACTOR shall cooperate with and coordinate the Work with other contractors, utility service companies, OWNER's employees working at the Site, and other entities working at the Site, in accordance with Section 01 11 13, Summary of Work.

C. CONTRACTOR will not be responsible or liable for damage unless damage is through negligence of CONTRACTOR, or Subcontractors, Supplier, or other entity employed by CONTRACTOR.

D. Attend and participate in all project coordination and progress meetings, and report on the progress of the Work and compliance with the Progress Schedule.

E. Maintain sufficient competent personnel, drafting and CADD equipment, and supplies at the Site for preparing layout drawings, coordination drawings, and record documents. With the Contract Documents and Shop Drawings, use such coordination drawings as tools for coordinating the Work of various trades. Where such coordination drawings are to be prepared by mechanical, electrical, plumbing, or heating-ventilating-air conditioning Subcontractors and other Subcontractors, ensure that each Subcontractor maintains required personnel and facilities at the Site.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 31 19

PRE-CONSTRUCTION CONFERENCE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. A pre-construction conference will be held for the Project.
   2. CONTRACTOR shall attend the conference prepared to discuss all items on the agenda.
   3. ENGINEER will distribute an agenda, preside at conference, and prepare and distribute minutes to all conference participants and others as requested.

B. Purpose of conference is to designate responsible personnel, establish working relationships, discuss preliminary schedules submitted by CONTRACTOR, and review administrative and procedural requirements for the Project. Matters requiring coordination will be discussed and procedures for handling such matters will be established.

C. Date, Time and Location: Conference will be held after execution of the Contract and before Work starts at the Site. ENGINEER will establish the date, time, and location of conference and notify the interested and involved parties.

D. At least 10 days prior to the conference, submit the following preliminary schedules in accordance with the General Conditions:
   1. Progress Schedule.
   2. Schedule of Submittals.
   3. Schedule of Values.

E. CONTRACTOR shall provide information required and contribute appropriate items for discussion. CONTRACTOR shall bring to the conference the following, with sufficient number of copies for each attendee:
   1. Preliminary Progress Schedule, as submitted to ENGINEER.
   2. Preliminary Schedule of Submittals, as submitted to ENGINEER.
   3. Preliminary Schedule of Values, as submitted to ENGINEER.
   4. List of emergency contact information, in accordance with Article 1.4 of this Section.

1.2 REQUIRED ATTENDANCE

A. Representative of each entity attending the conference shall be authorized to act on that entity's behalf.

B. Contractor Attendance: Conference shall be attended by CONTRACTOR's project manager, Site superintendent, project managers for major Subcontractors, and major equipment Suppliers as CONTRACTOR deems appropriate.

C. Other attendees will be representatives of:
   1. OWNER, if available.
   2. ENGINEER.
   3. Authorities having jurisdiction over the Work, if available.
   4. Utility owners, as applicable.
   5. Others as requested by OWNER, CONTRACTOR, or ENGINEER.

1.3 AGENDA

A. Preliminary Agenda: Be prepared to discuss in detail the topics listed below. Revisions to this agenda, if any, will be furnished to CONTRACTOR prior to conference.
   1. Procedural and Administrative:
      a. Personnel and Teams:
         1) Designation of roles and personnel.
         2) Limitations of authority of personnel, including personnel who will sign Contract modifications and make binding decisions.
         3) Lists of proposed Subcontractors and manufacturers (where applicable).
         4) Authorities having jurisdiction.
      b. Procedures for communications and correspondence.
      c. Copies of the Contract Documents and availability.
      d. Subcontractors.
      e. The Work and Scheduling:
         1) Scope of the Work.
         2) Contract Times, including Milestones (if any).
         3) Phasing and sequencing.
         4) Preliminary Progress Schedule.
         5) Critical path activities.
      f. Safety:
         1) Responsibility for safety.
         2) Designation of Contractor's safety representative.
         3) Emergency procedures and accident reporting.
         4) Emergency contact information.
         5) Confined space entry procedures.
         6) Hazardous materials communication program.

7) Impact of Project on public safety.

g. Permits.

h. Review of insurance requirements and insurance claims.

i. Coordination:
   1) Project coordination, and coordination among contractors.
   2) Coordination with Owner's operations.
   3) Progress meetings.

j. Products and Submittals:
   1) Preliminary Schedule of Submittals.
   2) Shop Drawings, Samples, and other submittals.
   3) Product options, "or equals", and substitutions.
   4) Construction photographic documentation.

k. Contract Modification Procedures:
   1) Requests for interpretation.
   2) Clarification notices.
   3) Field Orders.
   4) Proposal requests.
   5) Change Order proposals.
   6) Work Change Directives.
   7) Change Orders.
   8) Procedure for filing Claims.

l. Payment:
   1) Owner's Project financing and funding.
   2) Owner's tax-exempt status.
   3) Preliminary Schedule of Values, and procedures for measuring for payment.
   4) Retainage.
   5) Progress payment procedures.
   6) Prevailing wage rates and payrolls.

m. Testing and inspections, including notification requirements.

n. Disposal of demolition materials.

o. Record documents.

p. Preliminary Discussion of Contract Closeout:
   1) Procedures for Substantial Completion.
   2) Contract closeout requirements.
   3) Correction period.
   4) Duration of bonds and insurance.

2. Site Mobilization (if not covered in a separate meeting):
   a. Working hours and overtime.
   b. Field offices, trailers, and staging areas.
   c. Temporary facilities.
   d. Temporary utilities and limitations on utility consumption (where applicable).
   e. Utility company coordination (if not done as a separate meeting).
   f. Access to Site, access roads, and parking for construction vehicles.

g. Maintenance and protection of traffic.
h. Use of premises.
i. Protection of existing property.
j. Security.
k. Temporary controls, such as sediment and erosion control, noise control, dust control, storm water control, and other such measures.
l. Site barriers and temporary fencing.
m. Storage of materials and equipment.
n.. Reference points and benchmarks; surveys and layouts.
o. Site maintenance during the Project.
p. Cleaning and removal of trash and debris.
q. Restoration.

3. General discussion and questions.
4. Next meeting.
5. Site visit, if required.

1.4 EMERGENCY CONTACT INFORMATION

A. CONTRACTOR shall provide list of emergency contact information for 24-hour use throughout the Project. Emergency contact information shall be updated and kept current throughout the Project. If personnel or contact information change, provide updated emergency contact information list at the next progress meeting.

B. CONTRACTOR's list of emergency contact information shall include:
1. CONTRACTOR's project manager's office, field office, and cellular numbers.
2. CONTRACTOR's Site superintendent's office, field office, and cellular numbers.
3. CONTRACTOR's foreman's field office, and cellular numbers.
4. Major Subcontractors' and Suppliers' office, and cellular numbers of project manager and foreman (when applicable).

C. Additional Emergency Contact Information:
1. OWNER's office and cellular telephone numbers.
3. OWNER's central 24-hour emergency telephone number, if applicable.
4. ENGINEER's project manager's office and cellular telephone numbers.
5. Resident Project Representative's office, field office, and cellular telephone numbers for each RPR.
6. Utility companies' 24-hour contact telephone number(s), including gas, water, sewer, oil, telephone, cable television/telecommunications, and other companies or concerns having utilities in the vicinity of the Work.
7. Highway and street owners' 24-hour telephone number(s).
8. Emergency telephone numbers, including: "Emergency: Dial 911", and seven-digit telephone numbers for the hospital, ambulance, police, and fire department nearest to the Site. Provide names of each of these institutions.
9. Other involved entities as applicable.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 31 20

PROGRESS MEETINGS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Progress meetings will be held throughout the Project. CONTRACTOR shall attend each progress meeting prepared to discuss in detail all items on the agenda.
   2. ENGINEER will preside at progress meetings and will prepare and distribute minutes of progress meetings to all meeting participants and others as requested.

B. Date and Time:
   1. Regular Meetings: Every two weeks on a day and time agreeable to OWNER, ENGINEER, and CONTRACTOR.
   2. Other Meetings: As required.

C. Place: CONTRACTOR's field office at the Site or other location mutually agreed upon by OWNER, CONTRACTOR, and ENGINEER.

D. Handouts: CONTRACTOR shall bring to each progress meeting a minimum of four copies of each of the following:
   1. List of Work accomplished since the previous progress meeting.
   2. Up-to-date Progress Schedule.
   3. Up-to-date Schedule of Submittals.
   4. Detailed "look-ahead" schedule of Work planned through the next progress meeting, with specific starting and ending dates for each activity, including shutdowns, deliveries of important materials and equipment, Milestones (if any), and important activities affecting the OWNER, Project, and Site.
   5. When applicable, list of upcoming, planned time off (with dates) for personnel with significant roles on the Project, and the designated contact person in their absence.

1.2 REQUIRED ATTENDANCE

A. Representatives present for each entity shall be authorized to act on that entity's behalf.

B. Required Attendees:
   1. CONTRACTOR:
      a. Project manager.
      b. Site superintendent.
      c. Safety representative.
      d. When needed for the discussion of a particular agenda item, representatives of Subcontractors and Suppliers shall attend meetings.
   2. ENGINEER:
      a. Project manager or designated representative, as required.
      b. Resident Project Representative.
      c. Others as required by ENGINEER.
   3. OWNER's representative(s), as required.
   4. Testing and inspection agencies, as required.
   5. Others, as appropriate.

1.3 AGENDA

A. Preliminary Agenda: Be prepared to discuss in detail the topics listed below. Revised agenda, if any, will be furnished to CONTRACTOR prior to first progress meeting. Progress meeting agenda may be modified by ENGINEER during the Project as required.
   1. Review, comment, and amendment (if required) of minutes of previous progress meeting.
   2. Review of progress since the previous progress meeting.
   3. Planned progress through next progress meeting.
   4. Review of Progress Schedule
      a. Contract Times, including Milestones (if any).
      b. Critical path.
      c. Schedules for fabrication and delivery of materials and equipment.
      d. Corrective measures, if required.
   5. Submittals:
      a. Review of status of critical submittals.
      b. Review revisions to Schedule of Submittals.
   6. Contract Modifications
      a. Requests for interpretation.
      b. Clarification notices.
      c. Field Orders.
      d. Proposal requests.
      e. Change Order proposals.
      f. Work Change Directives.
      g. Change Orders.
      h. Claims.
   7. Applications for progress payments.
   8. Problems, conflicts, and observations.
   9. Quality standards, testing, and inspections.

10. Coordination between parties.
11. Site management issues, including access, security, maintenance and protection of traffic, maintenance, cleaning, and other Site issues.
12. Safety.
13. Permits.
14. Construction photographic documentation.
15. Record documents status.
16. Punch list status, as applicable.
17. Other business.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 32 16

PROGRESS SCHEDULE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall prepare and submit Progress Schedules and related documents in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and this Section, unless otherwise accepted by ENGINEER.
   2. Maintain and update Progress Schedules and related documents.
   3. Progress Schedule shall be resource-loaded CPM Progress Schedule.
   4. ENGINEER's acceptance of the Progress Schedule or related documents, and comments or opinions concerning activities in the Progress Schedule and related documents shall not control CONTRACTOR's independent judgment concerning means, methods, techniques, sequences and procedures of construction, unless the associated means, method, technique, sequence, or procedure is directed by the Contract Documents. CONTRACTOR is solely responsible for complying with the Contract Times.

B. Use of Float:
   1. Float belongs to the Project and may be used by OWNER or CONTRACTOR to accommodate changes in the Work, or to mitigate the effect of events that delay performance or conformance with the Contract Times.
   2. Changes or delays that influence Activities that have float and that do not extend the Critical Path are not justification for an extension of the Contract Times.

C. Factors Affecting the Progress Schedule:
   1. In preparing the Progress Schedule, take into consideration submittal requirements and submittal review times, time for fabricating and delivering materials and equipment, Subcontractors' work, availability and abilities of workers, availability of construction equipment, weather conditions, restrictions in operations at the Site and coordination with OWNER's operations, and other factors that have the potential to affect completion of the Work within the Contract Times.
   2. Comply with sequencing requirements indicated in the following:
      a. Section 01 11 13, Summary of Work.

1.2 DEFINITIONS

A. The following terms are defined for this Section and supplement the terms defined in the General Conditions and Supplementary Conditions:
   1. Activity: An element of the construction work that has the following specific characteristics: consumes time, consumes resources, has a definable start and finish, is assignable, and is measurable.
   2. Constraint: An imposed date on the Progress Schedule or an imposed tie between Activities. The Contract Times are Constraints.
   3. CPM Progress Schedule: Computerized Progress Schedule in Critical Path Method (CPM) format which accounts for the entire Work, defines the interrelationships between elements of the Work, reflects the uncompleted Work, and indicates the sequence with which the Work has been completed, indicates the sequence in which uncompleted Work will be completed, and indicates the duration of each Activity.
   4. Critical Path: The continuous chain of Activities with the longest duration for completion within the Contract Times.
   5. Early Start: The earliest possible date an Activity can start according to the assigned relationships among Activities.
   6. Early Finish: The earliest date an Activity can finish according to the assigned relationships among the Activities.
   7. Late Finish: The latest date an Activity can finish without extending the Contract Times.
   8. Late Start: The latest date an Activity can start without extending the Contract Times.
   9. Float: The time difference between the calculated duration of the Activity chain and the Critical Path.
   10. Total Float: The total number of days that an Activity (or chain of Activities) can be delayed without affecting the Contract Times.
   11. Network Diagram: A time-scaled logic diagram depicting the durations and relationships of the Activities.
   12. Work Areas, Area, or System: A logical breakdown of the Project elements or a group of Activities which, when collectively assembled, are readily identifiable on the Project (for example, yard piping, a structure or building, a treatment process, or other logical grouping).

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Progress Schedule Preparer:
      a. CONTRACTOR shall retain services of a scheduling consultant or shall self-prepare and maintain the Progress Schedule using qualified employee with experience in scheduling, and experienced with the scheduling software required for this Project, and experience serving as Progress Schedule preparer on construction projects of similar type, size,

and scope to this Project.

b. Progress Schedule preparer shall have not less than five years experience using the schedule software required on construction projects of similar type, size, and scope as this Project.

c. Prior to engaging a scheduling consultant or using a qualified employee, submit to ENGINEER the following:
   1) Name and address of proposed Progress Schedule preparer and the names of personnel who will be assigned to scheduling the Project.
   2) Information sufficient to demonstrate that proposed Progress Schedule preparer and scheduling personnel to be assigned to the Project possess qualifications complying with requirements of this Section. For each person assigned, submit list of similar type, size, contract value of projects, names and contact information of engineer or architect and owner.

d. Engineer's Review of Qualifications:
   1) ENGINEER will respond to CONTRACTOR whether proposed scheduling personnel are acceptable within 14 days after ENGINEER's receipt of complete qualifications.
   2) If qualifications are not acceptable, submit qualifications of acceptable personnel within 14 days of receipt of ENGINEER's non-acceptance.
   3) ENGINEER's acceptance or non-acceptance of qualifications does not release CONTRACTOR from its obligations under the Contract Documents.

1.4 SUBMITTALS

A. Quantity of each submittal required and timing of submittals are in this Section.

B. Informational Submittals: Submit the following:
   1. Initial Progress Schedules:
      a. Preliminary Progress Schedule with associated Network Diagrams, and narrative report.
      b. Acceptable Progress Schedule with associated Network Diagrams, and narrative report.
      c. Preliminary resource-loaded Progress Schedule and associated reports.
      d. Acceptable resource-loaded Progress Schedule and associated reports.
      e. Submit each Progress Schedule submittal with letter of transmittal complying with requirements of Section 01 33 00, Submittal Procedures.
   2. Progress Schedule Updates.
      a. Progress Schedule updates shall comply with requirements of this Section, and shall include updated Progress Schedule, narrative report, and updated Network Diagram when relationships among Activities are changed.
      b. Submit updated Progress Schedule at each progress meeting. If a

Progress Schedule remains unchanged from one progress meeting to the next, submit a written statement to that effect. For monthly Progress Schedule submittals, bring to progress meeting the number of copies of the updated Progress Schedule specified in Section 01 31 19.23, Progress Meetings.

3. Look-Ahead Schedules
   a. Submit 30-day look-ahead schedule at each progress meeting.
4. Time Impact Analyses: Submit in accordance with this Section.
5. Recovery Schedule: Submit in accordance with this Section.
6. Qualifications:
   a. Progress Schedule preparer, and other personnel that will assist Progress Schedule preparer in preparing and maintaining the Progress Schedule.

1.5 INITIAL PROGRESS SCHEDULES

A. Type and Organization of Progress Schedules:
   1. Prepare Progress Schedule using Primavera P6 software, unless other scheduling software is acceptable to ENGINEER.
   2. Sheet Size: 22 inches by 34 inches, unless otherwise accepted by ENGINEER.
   3. Time Scale: Indicate first date of each work week.
   4. Activity Designations: Indicate title and related Specification Section number.
   5. Progress Schedules shall be CPM Progress Schedules.
   6. Organization:
      a. Indicate on the separate Schedule of Submittals dates for submitting and reviewing Shop Drawings, Samples, and other submittals.
      b. Group deliveries of materials and equipment into a separate sub-schedule that is part of the Progress Schedule.
      c. Group construction into Work Area sub-schedules (that are part of the Progress Schedule) by Activity.
      d. Clearly indicate the Critical Path on the Progress Schedule.
      e. Organize each Work Area sub-schedule by Specification Section number.

B. Preliminary Progress Schedule:
   1. Within 30 days after the Contract Times commence running, CONTRACTOR shall submit to ENGINEER the preliminary Progress Schedule covering the entire Project, with associated Network Diagrams.
   2. Submit four copies of preliminary Progress Schedule and associated reports and schedule-related documents to accompany the preliminary Progress Schedule, in accordance with the Submittals Article of this Section. Submit in accordance with Section 01 33 00, Submittal Procedures.
   3. ENGINEER will conduct a timely review of the preliminary Progress Schedule.
   4. Preliminary Progress Schedule shall comply with the Contract Documents relative to Progress Schedules, but need not be resource-loaded.

C. Initial Acceptance of Progress Schedule:
   1. At least 45 days after the Contract Times commence running, a scheduling conference attended by CONTRACTOR, Progress Schedule preparer, ENGINEER, and others as appropriate will be held at the Site to review for acceptability to ENGINEER the preliminary Progress Schedule and associated Network Diagram and other reports and schedule-related documents required. CONTRACTOR shall have an additional 15 days to make corrections and adjustments and to complete and resubmit the Progress Schedule and associated Network Diagram. Other than bonds and insurance, mobilization, and approved Shop Drawings (and acceptance of other submittals, as applicable) required for fabricating or purchasing materials and equipment to be incorporated into the Work, no progress payment will be made to CONTRACTOR until acceptable Progress Schedule, Network Diagram, and other reports and schedule-related documents required are submitted to ENGINEER.
   2. Submit four copies each of acceptable Progress Schedule with Network Diagram, reports, and other schedule-related documents required to accompany the initial acceptable Progress Schedule, in accordance with the Submittals Article of this Section. Submit in accordance with Section 01 33 00, Submittal Procedures.
   3. The Progress Schedule will be acceptable to ENGINEER if it provides an orderly progression of the Work to completion within the Contract Times, in accordance with the Contract Documents. 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.
   4. Initially-accepted Progress Schedule shall be identified as the baseline Progress Schedule.

1.6 PROGRESS SCHEDULE UPDATES

A. Updates:
   1. Update the Progress Schedule each month. If during progress of the Work events develop that necessitate changes in the initially accepted Progress Schedule (e.g., baseline Progress Schedule), identify updated Progress Schedules sequentially as Progress Schedule Revision 1, 2, 3, and continuing in sequence as required. Number the Progress Schedule submittals in accordance with Section 01 33 00, Submittal Procedures.
   2. CONTRACTOR's Progress Schedule update shall include a narrative report in accordance with this Section. Narrative report shall include description of current progress and status of each Area of the Project, a description of progress for the period, a description of the Critical Path, a discussion of current or potential delays, Change Orders (pending and approved in since the previous Progress Schedule update), and other problems associated with maintaining the Work on schedule.

3. The update to the Progress Schedule shall be based on retained logic. Progress override logic is not allowed.
4. Required scheduling software, and schedule organization, format, and content for updated Progress Schedules are identical to that required in this Section for initial Progress Schedules.
5. Submit to ENGINEER four hard copies of the updated Progress Schedule, Network Diagram, narrative report, and other schedule-related reports and documents required, and two compact discs (CD) each with a complete software backup copy of the Progress Schedule.
6. Submit updated Network Diagrams when revisions are proposed to the logic. Indicate in the narrative report delays that have occurred since the previous updated Progress Schedule. ENGINEER will not recommend payment by OWNER of progress payments until updated Progress Schedule is received, reviewed, and accepted by ENGINEER. Payment for out-of-sequence Work is not allowed.

B. Monthly Schedule Meeting:
1. During the month, utilizing the previous month's 30-day look-ahead schedule. CONTRACTOR shall record the percent complete, start and finish dates of each scheduled Activity with the remaining duration for each Activity started but not completed, including Activities associated with procurement of materials and equipment.
2. On the same day each month, at least one week prior to a progress meeting, CONTRACTOR, Progress Schedule preparer, ENGINEER, and others as appropriate shall meet at the Site and tour the Work to review and update the schedule and progress information gathered by CONTRACTOR during the month. After acceptance of CONTRACTOR's updated data, Progress Schedule preparer shall use this information to update the Progress Schedule.

1.7 TIME IMPACT ANALYSIS

A. Evaluation by Engineer and Acceptance:
1. ENGINEER's evaluation of each time impact analysis comprised of complete information will be completed in timely manner after ENGINEER's receipt. Changes in the Contract Times will be made only by Change Order.
2. When mutual agreement is reached between the parties on effect of the change or delay in the Project, incorporate into the next Progress Schedule update the associated fragnets illustrating the influence of changes and delays.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide submittals in accordance with the General Conditions as modified by the Supplementary Conditions, and this Section.
   2. Provide submittals well in advance of need for the material or equipment, or procedure (as applicable), in the Work and with ample time required for delivery of material or equipment and to implement procedures following ENGINEER's approval or acceptance of the associated submittal. Work covered by a submittal will not be included in progress payments until approval or acceptance of related submittals has been obtained in accordance with the Contract Documents.
   3. CONTRACTOR is responsible for dimensions to be confirmed and corrected at the Site, for information pertaining solely to the fabrication processes and to techniques of construction, and for coordinating the work of all trades. CONTRACTOR's signature of submittal's stamp and letter of transmittal shall be CONTRACTOR's representation that CONTRACTOR has met his obligations under the Contract Documents relative to that submittal.

B. Samples:
   1. Conform submittal of Samples to the General Conditions as modified by the Supplementary Conditions, this Section, and the Specification Section in which the Sample is specified.
   2. Furnish at the same time Samples and submittals that are related to the same unit of Work or Specification Section. ENGINEER will not review submittals without associated Samples, and will not review Samples without associated submittals.
   3. Samples shall clearly illustrate functional characteristics of product, all related parts and attachments, and full range of color, texture, pattern, and material.

1.2 TYPES OF SUBMITTALS

A. Submittal types are classified as follows: 1) Action Submittals, 2) Informational Submittals, 3) Closeout Submittals, and 4) Maintenance Material submittals. Type of each required submittal is designated in the respective Specification Sections; when type of submittal is not specified in the associated Specification Section, submittal will be classified as follows:
   1. Action Submittals include:

a. Shop Drawings.
b. Product data.
c. Delegated design submittals, which include documents prepared, sealed, and signed by a design professional retained by CONTRACTOR, Subcontractor, or Supplier for materials and equipment to be incorporated into the completed Work. Delegated design submittals do not include submittals related to temporary construction unless specified otherwise in the related Specification Section. Delegated design submittals include: design drawings, design data including calculations, specifications, certifications, and other submittals prepared by such design professional.
d. Samples.
e. Testing plans, procedures, and testing limitations.

2. Informational Submittals include:
   a. Certificates.
   b. Design data not sealed and signed by a design professional retained by CONTRACTOR, Subcontractor, or Supplier.
   c. Pre-construction test and evaluation reports, such as reports on pilot testing, subsurface investigations, potential Hazardous Environmental Condition, and similar reports.
   d. Supplier instructions, including installation data, and instructions for handling, starting-up, and troubleshooting.
   e. Source quality control submittals (other than testing plans, procedures, and testing limitations), including results of shop testing.
   f. Field or Site quality control submittals (other than testing plans, procedures, and testing limitations), including results of operating and acceptability tests at the Site.
   g. Supplier reports.
   h. Sustainable design submittals (other than sustainable design closeout documentation).
   i. Special procedure submittals, including health and safety plans and other procedural submittals.
   j. Qualifications statements.
3. Closeout Submittals include:
   a. Maintenance contracts.
   b. Operations and maintenance data.
   c. Bonds, such as maintenance bonds and bonds for a specific product or system.
   d. Warranty documentation.
   e. Record documentation.
   f. Sustainable design closeout documentation.
   g. Software.
4. Maintenance Material Submittals include:
   a. Spare parts.
   b. Extra stock materials.

c. Tools.

5. When type of submittal is not specified and is not included in the list above, ENGINEER will determine the type of submittal.

B. Not Included in this Section: Administrative and procedural requirements for following are covered elsewhere in the Contract Documents:
1. Requests for interpretations of the Contract Documents.
2. Change Orders, Work Change Directives, and Field Orders.
3. Applications for Payment
4. Progress Schedules.
5. Photographic documentation.
6. Reports and documentation required in accordance with applicable permits
7. Site survey data.

1.3 SUBMITTALS REQUIRED IN THIS SECTION

A. Informational Submittals: Provide the following:
1. Schedule of Submittals:
a. Timing:
1) Provide submittal within time frames specified in the Contract Documents.
2) Provide updated Schedule of Submittals with each submittal of the updated Progress Schedule.
b. Content: In accordance with the General Conditions as modified by the Supplementary Conditions, and this Section. Requirements for content of preliminary Schedule of Submittals and subsequent submittals of the Schedule of Submittals are identical. Identify on Schedule of Submittals all submittals required in the Contract Documents. Updates of Schedule of Submittals shall show scheduled dates and actual dates for completed tasks. Indicate submittals that are on the Project's critical path. Indicate the following for each submittal:
1) Date by which submittal will be provided to ENGINEER.
2) Whether submittal will be for a substitution or "equal". Procedures for substitutions and "or equals" are specified in the General Conditions and the Division 01 Specifications.
3) Date by which ENGINEER's response is required. At least 14 days shall be allowed from ENGINEER's receipt of each submittal. Allow increased time for large or complex submittals.
4) For submittals for materials or equipment, date by which material or equipment must be at the Site to avoid delaying the Work and to avoid delaying the work of other contractors.
c. Prepare Schedule of Submittals using same software, and in same format, specified for Progress Schedules.
d. Coordinate Schedule of Submittals with the Progress Schedule.

e. Schedule of Submittals that is not compatible with the Progress Schedule, or that does not indicate submittals on the Project's critical path, or that that places extraordinary demands on ENGINEER for time and resources, is unacceptable. Do not include submittals not required by the Contract Documents.

f. In preparing Schedule of Submittals:

1) Considering the nature and complexity of each submittal, allow sufficient time for review and revision.

2) Reasonable time shall be allowed for: ENGINEER's review and processing of submittals, for submittals to be revised and resubmitted, and for returning submittals to CONTRACTOR.

3) Identify and accordingly schedule submittals that are expected to have long anticipated review times.

1.4 PROCEDURE FOR SUBMITTALS

A. Submittal Identification System: Use the following submittal identification system, consisting of submittal number and review cycle number.

1. Submittal Number: Shall be separate and unique number correlating to each individual submittal required. CONTRACTOR shall assign submittal number as follows:
   a. First part of submittal number shall be the applicable Specification Section number, followed by a hyphen.
   b. Second part of submittal number shall be a three-digit number (sequentially numbered from 001 through 999) assigned to each separate and unique submittal provided under the associated Specification Section.
   c. Typical submittal number for the third submittal provided for Section 40 05 19, Ductile Iron Process Pipe, would be "40 05 19-003".
2. Review Cycle Number: Shall be a letter designation indicating the initial submittal or re-submittal associated with each submittal number:
   a. "A" = Initial (first) submittal.
   b. "B" = Second submittal (e.g., first re-submittal).
   c. "C" = Third submittal (e.g., second re-submittal).
3. Examples:

Example Description	Submittal Identification	
	Submittal No.	**Review Cycle**
Initial (first) review cycle of the third submittal provided under Section 40 05 19, Ductile Iron Process Pipe	40 05 19-003-	A
Second review cycle (first re-submittal) of third submittal provided under Section 40 05 19, Ductile Iron Process Pipe	40 05 19-003-	B

B. Letter of Transmittal for Submittals:

1. Provide separate letter of transmittal with each submittal. Each submittal shall be for one Specification Section.
2. At beginning of each letter of transmittal, provide a reference heading indicating: CONTRACTOR's name, OWNER's name, Project name, Contract name and number, transmittal number, and submittal number.
3. For submittals with proposed deviations from requirements of the Contract Documents, letter of transmittal shall specifically describe each proposed variation.

C. Contractor's Review and Stamp:
   1. Contractor's Review: Before transmitting submittals to ENGINEER, review submittals to:
      a. assure proper coordination of the Work;
      b. determine that each submittal is in accordance with CONTRACTOR's desires;
      c. verify that submittal contains sufficient information for ENGINEER to determine compliance with the Contract Documents.
   2. Incomplete or inadequate submittals will be returned without review.
   3. Contractor's Stamp and Signature:
      a. Each submittal provided shall bear CONTRACTOR's stamp of approval and signature, as evidence that submittal has been reviewed by CONTRACTOR and verified as complete and in accordance with the Contract Documents.
      b. Submittals without CONTRACTOR's stamp and signature will be returned without review. Signatures that appear to be computer-generated will be regarded as unsigned and the associated submittal will be returned without review.
      c. CONTRACTOR's stamp shall contain the following:

"Project Name: _____

Contractor's Name: _____

Date: _____

---------- *Reference* ----------

Item/Submittal Title: _____

Specifications:

Section: _____

Page No.: _____

Paragraph No.: _____

Drawing No.: _____ of _____

Location of Work: _____

Submittal No. and Review Cycle: _____

Coordinated by Contractor with Submittal Nos.: _____

_____

I hereby certify that the Contractor has satisfied Contractor's obligations under the Contract Documents relative to Contractor's review and approval of this submittal.

Approved By (for Contractor): _____"

D. Submittal Marking and Organization:
   1. Mark on each page of submittal and each individual component submitted with submittal number and applicable Specification paragraph.
   2. Arrange submittal information in same order as requirements are written in the associated Specification Section.
   3. Each Shop Drawing sheet shall have title block with complete identifying information satisfactory to ENGINEER.
   4. Package together submittals for the same Specification Section. Do not provide required information piecemeal.

E. Format of Submittal and Recipients:
   1. Action Submittals and Informational Submittals: Furnish in accordance with Table 01 33 00-A, except that submittals of Samples shall be as specified elsewhere in this Section:

TABLE 01 33 00-A: SUBMITTAL CONTACTS AND REQUIRED COPIES

	Address for Deliveries	Contact Person	E-mail Address	No. of Hard-copies*	Remarks
a.	Engineer: ARCADIS-US, Inc. 3109 W. Dr. Martin Luther King Jr Boulevard, Suite 350, Tampa, FL 33607	Sean Chaparro	Sean.chaparro@arcadis.com	One	One Electronic Version (PDF)
b.	Columbia County Utilities 607 Quinten Street, Lake City, FL 33205	Chad Williams	chad_williams@columbiacountyfla.com	Two	One Electronic Version (PDF)

**Hard copies are required for final approved submittals only. Interim submittals for review can be submitted electronically.*

   2. Samples:
      a. Securely label or tag Samples with submittal identification number. Label or tag shall include clear space at least three inches by three inches in size for affixing ENGINEER's review stamp. Label or tag shall not cover, conceal, or alter appearance or features of Sample. Label or tag shall not be separated from the Sample.
      b. Submit number of Samples required in Specifications. If number of Samples is not specified in the associated Specification Section, provide

at least three identical Samples of each item required for ENGINEER's approval. Samples will not be returned to CONTRACTOR. If CONTRACTOR requires Sample(s) for CONTRACTOR's use, notify ENGINEER in writing and provide additional Sample(s). CONTRACTOR is responsible for furnishing, shipping, and transporting additional Samples.

c Deliver one Sample to ENGINEER's field office at the Site. Deliver balance of Samples to ENGINEER at address listed in Table 01 33 00-A, unless otherwise directed by ENGINEER.

3. Closeout Submittals:
   a. Provide the following Closeout Submittals in accordance with Table 01 33 00-A: maintenance contracts; bonds for specific products or systems; warranty documentation; and sustainable design closeout documentation. On documents such as maintenance contracts and bonds, include on each document furnished original signature of entity issuing the document.
   b. Operations and Maintenance Data: Submit in accordance with Section 01 78 23, Operations and Maintenance Data.
   c. Record Documentation: Submit in accordance with Section 01 78 39, Project Record Documentation.
   d. Software: Submit number of copies required in Specification Section where the software is specified. If number of copies is not specified, provide two copies on compact disc in addition to software loaded on to OWNER's computer(s) or microprocessor(s).
4. Maintenance Material Submittals: For spare parts, extra stock materials, and tools, submit quantity of items specified in associated Specification Section. Furnish in accordance with Section 01 78 43, Spare Parts and Extra Materials.

F. Distribution:
   1. Distribution of Hardcopies: ENGINEER will distribute each reviewed submittal requiring ENGINEER's written response as follows:
      a. CONTRACTOR: two copies (except closeout submittals and maintenance material submittals).
      b. Resident Project Representative: One copy (except closeout submittals and maintenance material submittals).
      c. ENGINEER's File: Two hard copies and one electronic version.

G. Resubmittals: Refer to the General Conditions for requirements regarding resubmitting required submittals.

1.5 ENGINEER'S REVIEW

A. Timing: ENGINEER's review will conform to timing accepted by ENGINEER in the accepted Schedule of Submittals.

B. Submittals not required in the Contract Documents will not be reviewed by ENGINEER and will not be recorded in ENGINEER's submittal log. All hardcopies of such submittals will be returned to CONTRACTOR.

C. Action Submittals, Results of ENGINEER's Review: Each submittal will be given one of the following dispositions:
   1. Approved: Upon return of submittal marked "Approved", order, ship, or fabricate materials and equipment included in the submittal (pending ENGINEER's approval or acceptance, as applicable, of source quality control submittals) or otherwise proceed with the Work in accordance with the submittal and the Contract Documents.
   2. Approved as Corrected: Upon return of submittal marked "Approved as Corrected", order, ship, or fabricate materials and equipment included in the submittal (pending ENGINEER's approval or acceptance, as applicable, of source quality control submittals) or otherwise proceed with the Work in accordance with the submittal and the Contract Documents, provided it is in accordance with corrections indicated.
   3. Approved as Corrected – Resubmit: Upon return of submittal marked "Approved as Corrected – Resubmit", order, ship, or fabricate materials and equipment included in the submittal (pending ENGINEER's approval or acceptance, as applicable, of source quality control submittals) or otherwise proceed with the Work in accordance with the submittal and the Contract Documents, provided it is in accordance with corrections indicated. Provide to ENGINEER record re-submittal with all corrections made. Receipt of corrected re-submittal is required before materials or equipment covered in the submittal will be eligible for payment.
   4. Revise and Resubmit: Upon return of submittal marked "Revise and Resubmit", make the corrections indicated and re-submit to ENGINEER for approval.
   5. Not Approved: This disposition indicates material or equipment that cannot be approved. Upon return of submittal marked "Not Approved", repeat initial submittal procedure utilizing approvable material or equipment.

D. Informational Submittals, Results of ENGINEER's Review:
   1. Each submittal will be given one of the following dispositions:
      a. Accepted: Information included in submittal conforms to the applicable requirements of the Contract Documents, and is acceptable. No further action by CONTRACTOR is required relative to this submittal, and the Work covered by the submittal may proceed, and products with submittals with this disposition may be shipped or operated, as applicable.
      b. Not Accepted: Submittal does not conform to applicable requirements of the Contract Documents and is not acceptable. Revise submittal and re-submit to indicate acceptability and conformance with the Contract Documents.

E. Closeout Submittals, Results of ENGINEER's Review: Dispositions and meanings are the same as specified for Informational Submittals. When acceptable, Closeout Submittals will not receive a written response from ENGINEER. Disposition as "accepted" will be recorded in ENGINEER's submittal log. When Closeout Submittal is not acceptable, ENGINEER will provide written response to CONTRACTOR.

F. Maintenance Material Submittals, Results of ENGINEER's Review: Dispositions and meanings are the same as specified for Informational Submittals. When acceptable, Maintenance Material Submittals will not receive a written response from ENGINEER. Disposition as "accepted" will be recorded in ENGINEER's submittal log. When Maintenance Material Submittal is not acceptable, ENGINEER will provide written response to CONTRACTOR, and CONTRACTOR is responsible for costs associated with transporting and handling of maintenance materials until compliance with the Contract Documents is achieved.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 45 29

TESTING LABORATORY SERVICES FURNISHED BY CONTRACTOR

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall employ and pay for services of independent testing laboratory to perform specified services.
   2. Inspection, sampling, and testing shall be as specified in the Specifications including but not limited to:
      a. Section 03 00 05, Concrete.
      b. Section 31 20 00, Earth Moving.
      c. Other tests in the Contract Documents that are not specifically assigned to others.
   3. CONTRACTOR shall pay for:
      a. Tests not specifically indicated in the Contract Documents as being OWNER's responsibility.
      b. Tests made for CONTRACTOR's convenience.
      c. Repeat tests required because of CONTRACTOR's negligence or defective Work, and retesting after failure of test for the same item to comply with the Contract Documents.
   4. Testing laboratory is not authorized to approve or accept any portion of the Work or defective Work; rescind, alter, or augment requirements of Contract Documents; and perform duties of CONTRACTOR.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.
   2. ISO/IEC 17025, General Requirements for the Competence of Testing and Calibration Laboratories.
   3. NIST SRM, Standard Reference Materials.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Testing Laboratory:
      a. Comply with applicable requirements of ASTM E329.

b. Testing laboratory shall be licensed to operate in the same state as the Site. Where applicable, laboratory shall be certified by the authority having jurisdiction for the types of testing required.
c. Testing equipment used by laboratory shall be calibrated at maximum intervals of twelve months by devices of accuracy traceable to one of the following: NIST SRM, ISO/IEC 17025, certified by state or local bureau of weights and measures, or values of natural physical constants generally accepted in the engineering and scientific community.

1.4 SUBMITTALS

A. Informational Submittals: Submit the following:
1. Quality Control Submittals and Test Reports: Testing laboratory shall promptly submit to CONTRACTOR results of testing and inspections, including:
a. Date issued.
b. Project title, number, and name of the Site.
c. Testing laboratory name and address.
d. Name and signature of inspector or person obtaining samples.
e. Date of inspection or sampling.
f. Record of temperature and weather.
g. Date of test.
h. Identification of material or product tested, and associated Specification Section.
i. Location in the Project.
j. Type of inspection or test.
k. Results of tests and observations regarding compliance with the Contract Documents.
2. Qualifications Statements:
a. Testing Laboratory:
1) Qualifications statement indicating experience and facilities for tests required under the Contract Documents.
2) Copy of report of inspection of facilities during most recent NIST inspection tour. Include memorandum of remedies of deficiencies reported during inspection.
3) Copy of certificate of calibration for each instrument or measuring device proposed for use, by accredited calibration agency.

1.5 TESTING LABORATORY DUTIES

A. Testing laboratory shall:
1. Cooperate with CONTRACTOR and provide qualified personnel promptly on notice.

2. Perform required inspections, sampling, and testing of materials and methods of construction; comply with applicable reference standards and the Contract Documents; and ascertain compliance with requirements of the Contract Documents.
3. Promptly notify ENGINEER and CONTRACTOR of irregularities or deficiencies in the Work that are observed during performance of services.
4. Promptly submit to CONTRACTOR copies of reports of inspections and tests.
5. Perform additional tests and services, as required by CONTRACTOR.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. CONTRACTOR shall:
1. Cooperate with testing laboratory personnel.
2. Provide to testing laboratory preliminary representative samples of materials and products to be tested, in required quantities.
3. Promptly submit to ENGINEER copies of results of tests and inspections received from testing laboratory.
4. Provide to laboratory the preliminary design mix proposed for concrete and other material mixes to be tested by testing laboratory.
5. Provide labor and facilities:
   a. For access to the Work to be tested, and where required, to Suppliers' operations.
   b. For obtaining and handling samples at the Site.
   c. For facilitating inspections and tests.
   d. For testing laboratory's exclusive use for storing and curing of test samples.
   e. Forms for preparing concrete test beams and cylinders.
6. Notify laboratory and ENGINEER sufficiently in advance of operations to allow assignment of personnel and scheduling of tests.
7. Arrange with laboratory and pay for additional services, sampling, and testing required for CONTRACTOR's convenience.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 51 05

TEMPORARY UTILITIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall provide all temporary utilities required for the Project.
   1. Make all arrangements with utility service companies for temporary services and obtain required permits and approvals for temporary utilities.
   2. Pay all utility service costs, including cost of electricity, water, fuel, and other utility services required for the Work.
   3. Continuously maintain adequate utilities for all purposes during the Project, until removal of temporary utilities and temporary facilities. At minimum, provide and maintain temporary utilities through Substantial Completion and removal of temporary field offices and sheds.
   4. Should OWNER occupy part of the Project prior to Substantial Completion of the entire Work, cost of utilities consumed via temporary utilities serving the portion occupied by OWNER will be shared proportionately between OWNER and CONTRACTOR as mutually agreed to by the parties.
   5. Maintain, including cleaning, temporary utilities and continuously provide consumables as required.
   6. Temporary utilities and temporary facilities shall be adequate for personnel using the Site and requirements of Project.
   7. Provide temporary utilities and temporary facilities in compliance with Laws and Regulations and, when applicable, requirements of utility owners.

B. Provide the following temporary utilities:
   1. Electricity
   2. Lighting.
   3. Telephone and communications.
   4. Heating, ventilating, and temporary enclosures.
   5. Water.
   6. Sanitary facilities.
   7. First-aid facilities.
   8. Fire protection.

1.2 REQUIREMENTS FOR TEMPORARY UTILITIES AND TEMPORARY FACILITIES

A. Electrical:

1. Provide temporary electrical service required for the Work, including continuous power for temporary field offices and sheds. Provide temporary outlets with circuit breaker protection and ground fault protection.

B. Lighting.
   1. Minimum lighting shall be five foot-candles for open areas and ten foot-candles for stairs and shops. Provide minimum of one, 300-watt lamp every 15 feet in indoor Work areas. Provide night security lighting of five foot-candles, minimum, within 50 feet of all parts of the Site during hours of darkness, controlled by photocell.

C. Telephone and Communications.
   1. Provide temporary telephone and communications required for CONTRACTOR's operations at the Site and for summoning emergency medical assistance.

D. Heating, Ventilating, and Enclosures.
   1. Provide sufficient temporary heating, ventilating, and enclosures to ensure safe working conditions and prevent damage to existing facilities and the Work.
   2. Except where otherwise specified, temporary heating shall maintain temperature of the area served between 50 degrees F and maximum design temperature of building or facility and its contents.
   3. Maintain temperature of areas occupied by OWNER's personnel or electronic equipment, including offices, lunch rooms, locker rooms, toilet rooms, and rooms containing computers, microprocessors, and control equipment, between 65 degrees F and 80 degrees F with relative humidity less than 75 percent.
   4. Required temperature range for storage areas and certain elements of the Work, including preparation of materials and surfaces, installation or application, and curing as applicable, shall be in accordance with the Contract Documents for the associated Work and the Supplier's recommended temperature range for storage, application, or installation, as appropriate.
   5. Provide temporary ventilation sufficient to prevent accumulation in construction areas and areas occupied by OWNER of hazardous and nuisance levels or concentrations of dust and particulates, mist, fumes or vapors, odors, and gases, associated with construction.
   6. Provide temporary enclosures and partitions required to maintain required temperature and humidity.

E. Water.
   1. Provide temporary water facilities including piping, valves, meters if not provided by owner of existing waterline, backflow preventers, pressure regulators, and other appurtenances. Provide freeze-protection as required.
   2. Provide water for temporary sanitary facilities, field offices, Site maintenance and cleaning and, when applicable, disinfecting and testing of systems.
   3. Continuously maintain adequate water flow and pressure for all purposes

during the Project, until removal of temporary water system.

F. Sanitary Facilities.
   1. Provide suitably-enclosed chemical or self-contained toilets for CONTRACTOR's employees and visitors to the Site. Location of temporary toilets shall be acceptable to OWNER.
   2. Provide supply of potable drinking water and related facilities and consumables for all personnel using the Site.
   3. Provide suitable temporary washing facilities for employees and visitors.

G. First-aid Facilities.
   1. Provide temporary first-aid stations at or immediately adjacent to the Site's major work areas, and inside CONTRACTOR's temporary field office. Locations of first-aid stations shall be determined by CONTRACTOR's safety representative.
   2. Provide list of emergency telephone numbers at each hardwired telephone at the Site. List shall be in accordance with the list of emergency contact information required in Section 01 31 19.13, Pre-Construction Conference.

H. Fire Protection.
   1. Provide temporary fire protection, including portable fire extinguishers rated not less than 2A or 5B in accordance with NFPA 10, Portable Fire Extinguishers, for each temporary building and for every 3,000 square feet of floor area under construction.
   2. Comply with NFPA 241, Safeguarding Building Construction, Alternation, and Demolition Operations, and requirements of fire marshals and authorities having jurisdiction at the Site.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for temporary systems may be new or used, but shall be adequate for purposes intended and shall not create unsafe conditions, and shall comply with Laws and Regulations.

B. Provide required materials, equipment, and facilities, including piping, wiring, and controls.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install temporary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.

B. Location of Temporary Utilities and Temporary Facilities:
   1. Locate temporary systems for proper function and service.
   2. Temporary systems shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility companies.
   3. Do not install temporary utilities on the ground, with the exception of temporary extension cords, hoses, and similar systems in place for short durations.

C. Modify and extend temporary systems as required by progress of the Work.

3.2 USE

A. Maintain temporary systems to provide safe, continuous service as required.

B. Properly supervise operation of temporary systems:
   1. Enforce compliance with Laws and Regulations.
   2. Enforce safe practices.
   3. Prevent abuse of services.
   4. Prevent nuisances and hazards caused by temporary systems and their use.
   5. Prevent damage to finishes.
   6. Ensure that temporary systems and equipment do not interrupt continuous progress of construction.

C. At end of each work day, check temporary systems and verify that sufficient consumables are available to maintain operation until work is resumed at the Site. Provide additional consumables if the supply on hand is insufficient.

3.3 REMOVAL

A. Completely remove temporary utilities, facilities, equipment, and materials when no longer required. Repair damage caused by temporary systems and their removal and restore to preconstruction condition.

B. Where temporary utilities are disconnected from existing utility, provide suitable, watertight or gastight (as applicable) cap or blind flange, as applicable, on service line, in accordance with requirements of utility owner.

C. When permanent utilities and systems that were used for temporary utilities, upon Substantial Completion replace all consumables such as filters and light bulbs and parts used during the Work.

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SECTION 01 51 41

TEMPORARY PUMPING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide labor, materials, tools, equipment, and incidentals shown, specified and required for temporary pumping and handling of fluids during the Work.
   2. Design and provide temporary pumping systems, including plugs, bulkheads, and line stops as required; pumps; piping, supports, and valves; temporary instrumentation and control system; fuel and electricity; personnel; and appurtenances. Conform to Laws and Regulations and requirements of authorities having jurisdiction. System shall be suitable for its service and operating environment.
   3. Required capacity of temporary pumping systems is specified in Section 01 14 16, Coordination with Owner's Operations. Provide temporary pumping system of required capacity with at least one of the largest pumps out of service.
   4. Location of the temporary pumping system shall not affect OWNER's operations and access at the Site, and public access to streets and drives, unless approved by ENGINEER and authorities having jurisdiction.
   5. Provide electricity and fuel as required for temporary pumping system. Secondary containment for fuel tanks shall be in accordance with Laws and Regulations. Include temporary fuel tanks in spill prevention control and countermeasures evaluation and plan required in Section 01 35 44, Spill Prevention Control and Countermeasures Plan.
   6. Leakage from temporary pumping system or improper discharge is not allowed.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate Work that must be performed with or before Work specified in this Section.

C. Related Sections:
   1. Section 01 14 16, Coordination with Owner's Operations.

1.2 QUALITYASSURANCE

A. Qualifications:

1. Temporary pumping system Supplier shall have at least five years of experience providing temporary pumping systems, and shall submit evidence of furnishing five temporary pumping systems on other projects similar in size and service to temporary pumping system required for the Project.

B. Component Supply and Compatibility: Obtain each temporary pumping system from a single Supplier who shall be responsible for providing a complete system.

1.3 SUBMITTALS

A. Timing: Furnish submittals for temporary pumping system to ENGINEER at least 30 days prior to delivery of temporary pumping system to the Site.

B. Action Submittals: Submit the following:
   1. Temporary Pumping System Submittal: Submit the following for each temporary pumping system:
      a. Manufacturer's data and specifications on each type and size of pump proposed and its capacity, including pump curves. Provide manufacturer's data and specifications for generators and other equipment required for temporary pumping system.
      b. Technical information and specifications on noise controls for noise-generating equipment.
      c. Technical data on temporary piping, pipe joints, valves, pipe supports, controls, flow meter, secondary containment for fuel tanks, and other information pertinent to the temporary pumping system.
      d. Layout Drawings:
         1) Sketches showing proposed layout of temporary pumping system, including locations of temporary plugs, bulkheads, and line stops; suction and discharge locations; location of pumps and associated piping and valves; and source of power for temporary pumping system. Sketches shall be scale drawings acceptable to ENGINEER, and shall include site plans similar to those in the Contract Documents.
         2) Details of system suction and discharge locations. Discharge details shall include measures to protect the receiving structure and dissipate energy.
         3) Where temporary lines will be buried, submit trench details. Submit sketches and information on other types of protection proposed for temporary piping.
      e. System curve of flow plotted against total dynamic head, and calculations that substantiate the proposed temporary pumping system, including comparison of net positive suction head required and net positive suction head available.

f. Temporary Plugs, Bulkheads, and Line Stops: Manufacturer's literature and fabrication drawings showing type of plug, bulkhead or line stop as applicable, materials, and hydrostatic head the plug, bulkhead, or line stop is designed to withstand. Submit complete technical information for CONTRACTOR-proposed line stops, installation procedures, name of proposed line stop installer, and documentation of experience on at least five similar projects.

g. Narrative on temporary pumping system operation, including who will operate the system, staffing, planned frequency of fueling, contingency plan in event of pump failure, and statement of existing systems that may be affected during operation of temporary pumping system.

h. Schedule for temporary pumping system set-up, testing, use, and removal from the Site.

C. Informational Submittals: Submit the following:

1. Qualifications Statements:

a. Qualifications of temporary pumping system Supplier.

PART 2 – PRODUCTS

2.1 TEMPORARY PUMPING SYSTEM

A. General:

1. System components shall be suitable for continuous operation with the fluid pumped.

2. Provide noise controls for temporary pumping system. Noise emissions from temporary pumping system shall conform to Laws and Regulations and shall not exceed 70 db at a distance of thirty feet from noise source.

3 Fuel consuming temporary pumping system components intended for use when CONTRACTOR is not present shall include fuel tanks sized for at least twenty-four hours of uninterrupted operation at system's operating capacity, and means to automatically notify CONTRACTOR upon high and low suction water level and low fuel level.

B. Instrumentation and Controls:

1. Controls: Provide controls for temporary pumping system in accordance with Section 01 14 16, Coordination with Owner's Operations.

C. Temporary Piping System:

1. Piping shall be steel, ductile iron, high density polyethylene, or other material accepted by ENGINEER, and suitable for system operating pressures. Aluminum piping and PVC piping not mechanically restrained are not allowed. Hoses can be used only for short sections and with acceptance by ENGINEER.

2. Piping system shall have watertight joints of the following types: fused joints, restrained couplings, flanged coupling adapters, quick-connects by Camlok or equal, flanged joints, grooved and shouldered end-type couplings, and other watertight joints accepted by ENGINEER.
3. Size discharge piping for maximum velocity of 10 feet per second.
4. Provide check valves or approved pump control valves as required.
5. Provide air valves on discharge piping as required. Air valves shall expel air upon pipe filling and admit air upon pipe dewatering, and release small amounts of entrained air during operation. Air valves shall be suitable for service with the pumped fluid.
6. Discharge from temporary pumping system shall not adversely affect the existing process or facilities. Provide energy dissipating measures at discharge point as required.

D. Temporary Plugs, Bulkheads, and Line Stops:
1. Acceptable temporary plugs and bulkheads include inflatable dams specifically designed for such service, brick bulkheads, timber bulkheads, sandbags, and other bulkhead methods suitable for the service. Line stops, where required, are specified in Division 40 of the Contract Documents.
2. Each plug, temporary bulkhead, and line stop shall be suitable for the maximum pressure encountered.
3. Where temporary plugs and bulkheads are under pressure or surcharged, provide either two plugs or a plug and temporary bulkhead.

PART 3 – EXECUTION

3.1 PREPARATION

A. General:
1. Temporary piping shall be located off of roads, driveways, and sidewalks. Piping shall not be located in environmentally sensitive areas such as wetlands.
2. Where required for OWNER's access to and operation of existing facilities, bury temporary piping that would otherwise inhibit access to processes, buildings, streets, and driveways. In paved areas, provide temporary surfacing, sufficient for AASHTO H-20 wheel loads over buried temporary piping.
3. Perform successful hydrostatic testing of temporary piping system using clean water at pressure equal to 1.2 times highest expected system operating pressure, for one hour while maintaining test pressure within 3.0 psi of required test pressure. ENGINEER will witness hydrostatic test. Hydrostatic test criteria for acceptance: No leakage.
4. Verify that entire temporary pumping system is ready for operation before commencing shutdown of OWNER's operations, facility, or systems.

Verify that temporary pumping system controls and flow meter are properly connected and functional.

3.2 TEMPORARY PUMPING

A. During Operation of the Temporary Pumping System:
   1. Temporary pumping system shall operate continuously. In the event of equipment failure, immediately make repairs or replace equipment. Provide spare parts and redundant units as necessary for continuous operation. The maximum amount of time the temporary pumping system can be out of service is 30 minutes.
   2. Provide personnel to monitor, operate, and maintain temporary pumping system twenty-four hours per day when system is in service.

3.3 DEMOBILIZATION

A. Upon Conclusion of Temporary Pumping:
   1. Remove plugs, bulkheads, and line stops in manner that allows flow to slowly return to normal, without surging, surcharging, and adverse effects on existing system.
   2. Flush out temporary pumping system with clean water discharged to an appropriate location.
   3. Remove temporary pumping system and appurtenances from the Site.

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SECTION 01 52 13

CONTRACTOR'S FIELD OFFICE AND SHEDS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide field office for CONTRACTOR's use with at least the minimum facilities specified.
   2. Provide required storage and work sheds.
   3. Pay for required permits and utilities. Field offices and sheds shall comply with Laws and Regulations.

B. Location:
   1. Locate field offices and sheds in accordance with the Contract Documents and in accordance with the Site mobilization discussions at the preconstruction conference.

C. Furnish in field office one complete set of the Contract Documents for ready reference by interested parties. In addition to the reference set, comply with Section 01 78 39, Project Record Documents.

PART 2 – PRODUCTS

2.1 FIELD OFFICE AND SHEDS, FURNISHINGS, AND EQUIPMENT

A. Field Office and Furnishings:
   1. Construction: As required by CONTRACTOR and sufficient for Project meetings.
   2. Utilities and Services: Provide the following:
      a. Water (may be bottled).
      b. Facilities as required for CONTRACTOR needs.
      c. Utilities and related facilities for lighting and maintaining temperature.
   3. Furnishings:
      a. Conference Facilities: Provide conference area with conference table and chairs sufficient for six people. Conference facilities and furnishings shall be provided with suitable utilities, lighting, and temperature controls prior to the first progress meeting, unless otherwise approved by ENGINEER.
      b. Other furnishings required by CONTRACTOR.

4. Provide on field office an exterior identification sign displaying CONTRACTOR's company name. Maximum size of sign shall be four feet by eight feet. Sign shall be suitable for outdoor use for the duration of the Project.
5. Furnish and maintain at CONTRACTOR's field office four protective helmets for use by visitors to the Site.

B. Storage and Work Sheds:
1. Provide storage and work sheds sized, furnished, and equipped to accommodate personnel, materials, and equipment involved in the Work, including temporary utility services and facilities required for environmental controls sufficient for personnel, materials, and equipment.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation:
1. Install field offices, sheds, and related facilities in accordance with Laws and Regulations.
2. Install materials and equipment, including prefabricated structures, in accordance with manufacturer's instructions.

3.2 MAINTENANCE AND REMOVAL

A. Maintenance:
1. Clean and maintain field offices and sheds as required.
2. Provide consumables as required.

B. Removal:
1. Do not remove field offices and sheds until after Substantial Completion of the entire Work, unless otherwise approved by ENGINEER.
2. Remove field offices and sheds and restore areas prior to final inspection.

+ + END OF SECTION + +

SECTION 01 57 05

TEMPORARY CONTROLS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide and maintain methods, equipment, and temporary construction as required to control environmental conditions at the Site and adjacent areas.
   2. Maintain controls until no longer required.
   3. Temporary controls include, but are not limited to, the following:
      a. Erosion and sediment controls.
      b. Noise controls.
      c. Dust control.
      d. Pest and rodent control.
      e. Control of water, including storm water runoff.
      f. Pollution control.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable provisions and recommendations of jurisdictions having authority, including, but not limited to:
   1. Florida Department of Environmental Protection.
   2. Florida Department of Transportation.

PART 2 – PRODUCTS

2.1 MATERIALS FOR TEMPORARY EROSION AND SEDIMENT CONTROLS

A. Materials for temporary erosion and sediment controls shall be as shown or indicated on the Drawings.

B. Silt Fencing:
   1. Filter Cloth:
      a. Mirafi Envirofence, or equal.
      b. Height: 18 inches, minimum.
      c. Securely fasten filter cloth to wire mesh using ties spaced at maximum intervals of two feet on centers at top and mid-height of wire mesh, as required and shown.
   2. Wire Mesh: Support filter cloth with wire mesh complying with the following:

a. Woven wire mesh, 14-gauge steel wire, maximum mesh size six-inch by six-inch.
b. Height: To match filter cloth height.
c. Fasten wire mesh to fence supports with wire ties or staples.

3. Fence Support Posts:
a. Length: Three feet, minimum.
b. Material: Metal or other acceptable material with "U" or "I" cross section, or minimum 1.25-inch by 1.25-inch hardwood.

C. Straw Bale Dike.
1. Bales shall be firmly-packed, unrotted straw bound firmly with baling wire. Cross-sectional area on the small end of each bale shall be approximately 12 inches by 12 inches or larger.
2. Posts shall comply with requirements for silt fencing support posts, or may be suitable reinforcing steel.

D. Mulch Materials and Soil Stabilization.
1. Mulch shall be unrotted straw or salt hay.
2. Soil stabilization emulsions, when used, shall be an inert, eco-friendly chemical manufactured for the specific purpose of erosion control and soil stabilization, applied with mulch or stabilization fibers.
3. Wood-fiber or paper-fiber, when used, shall be 100 percent natural and biodegradable.
4. Erosion control mat or netting shall be biodegradable. Acceptable materials include jute, excelsior, straw or coconut fiber, and cotton.

E. Protection of Storm Water Drainage Inlets and Catch Basins:
1. Inlet Filter Bag:
a. Product and Manufacturer: Provide one of the following for each drainage inlet or catch basin to be protected:
1) Silt Sack, by Atlantic Construction Fabrics (ACF) Environmental
2) Or equal.
b. Inlet filter bag permeability shall be not less than 40 gallons per square foot of bag area exposed to the flow. Fabric shall be woven polypropylene with double stitching to prevent bursting.
c. Inlet filter bags shall fit inside the drainage inlet or catch basin and shall be secured by the structure's grate or by other acceptable means.
d. Inlet filter bags shall have means of removing inlet filter bag and the silt and sediment collected in the bag, without dumping filter bag's contents into the drainage inlet or catch basin.
2. Silt fence barrier, as shown.

F. Temporary Settlement Basin.
1. Embankment Material: Comply with requirements for general fill in Section 31 20 00, Earth Moving.

2. Provide outfall structure consisting of overflow weir and discharge pipe, and provide emergency spillway.
3. Overflow Weir and Discharge Pipe: Suitably-sized piping of corrugated metal, high-density polyethylene, or other suitable material. Pipe may be new or used; if used, pipe shall be in good condition.

G. Filter Bag on Dewatering Pump Discharge:
1. Provide filter bag on discharge of each dewatering pump drawing from an excavation. Filter bag is not required on pumps associated with dewatering wells.
2. Products and Manufacturers: Provide one of the following:
   a. UltraTech Dewatering Bag, by Interstate Products.
   b. Filter Bag, by US Fabrics.
   c. Dewatering (Filter) Bag, Indian Valley Industries.
   d. DirtBag, by Atlantic Construction Fabrics (ACF) Environmental
   e. Or equal.
3. Size filter bags for maximum flow of the pump. Filter bags shall be specifically fabricated for use as a dewatering pump filter bag.
4. Provide sufficient spare filter bags for continuous dewatering operations.

H. Temporary Stone Construction Entrance:
1. Stone: Tough, hard, durable stone complying with the following gradation requirements:

Sieve Size	Total Percent Passing
Four-inch (100 mm)	100
3.5-inch (90 mm)	90 to 100
2.5-inch (65 mm)	25 to 60
1.5-inch (37.5 mm)	Zero to 15

.
2. Geotextile: As recommended by geotextile manufacturer for separating stone from subgrade, for the vehicle weight and traffic frequency required.

PART 3 – EXECUTION

3.1 NOISE CONTROL

A. Noise Control – General:
1. CONTRACTOR's vehicles and equipment shall minimize noise emissions to greatest degree practicable. Provide mufflers, silencers, and sound barriers when necessary.
2. Noise levels shall comply with Laws and Regulations, including OSHA requirements and local ordinances.
3. Noise emissions shall not interfere with the work of OWNER or others.

3.2 DUST CONTROL

A. Dust Control – General:
   1. Control objectionable dust caused by CONTRACTOR's operation of vehicles and equipment, clearing, and other actions. To minimize airborne dust, apply water or use other methods subject to acceptance of ENGINEER and approval of authorities having jurisdiction.
   2. CONTRACTOR shall prevent blowing and movement of dust from exposed soil surfaces and access roads to reduce on- and off-Site damage, nuisances, and health hazards associated with dust emissions. Control may be achieved by irrigation in which the Site shall be sprinkled with water until the surface is moist. Apply dust controls as frequently as required without creating nuisances such as excessive mud and ponding of water at the Site.
   3. Remove dust from roadways and access roads at maximum intervals of seven days by mechanical brooming or other method acceptable to ENGINEER.

3.3 PEST AND RODENT CONTROL

A. Pest and Rodent Control – General:
   1. Provide rodent and pest control as required to prevent infestation of the Site and storage areas.
   2. Employ methods and use materials that do not adversely affect conditions at the Site or on adjoining properties.
   3. In accordance with Laws and Regulations, promptly and properly dispose of pests and rodents trapped or otherwise controlled.

3.4 WATER CONTROL

A. Water Control – General:
   1. Provide methods to control surface water and water from excavations and structures to prevent damage to the Work, the Site, and adjoining properties.
   2. Control fill, grading, and ditching to direct water away from excavations, pits, tunnels and other construction areas and to direct drainage to proper runoff courses to prevent erosion, damage, or nuisance.

B. Equipment and Facilities for Water Control: Provide, operate, and maintain equipment and facilities of adequate size to control surface water.

C. Discharge and Disposal: Dispose of drainage water in manner to prevent flooding, erosion, and other damage to any and all parts of the Site and adjoining areas, and that complies with Laws and Regulations.

3.5 POLLUTION CONTROL

A. Pollution Control – General:
   1. Provide means, methods, and facilities required to prevent contamination of soil, water, and atmosphere caused by discharge of noxious substances from construction operations.
   2. Equipment used during construction shall comply with Laws and Regulations.

B. Spills and Contamination:
   1. Provide equipment and personnel to perform emergency measures required to contain spills and to remove contaminated soils and liquids.
   2. Excavate contaminated material and properly dispose of off-Site, and replace with suitable compacted fill and topsoil.

C. Protection of Surface Waters: Implement special measures to prevent harmful substances from entering surface waters. Prevent disposal of wastes, effluents, chemicals, and other such substances in or adjacent to surface waters and open drainage routes, in sanitary sewers, or in storm sewers.

D. Atmospheric Pollutants:
   1. Provide systems for controlling atmospheric pollutants related to the Work.
   2. Prevent toxic concentrations of chemicals and vapors.
   3. Prevent harmful dispersal of pollutants into atmosphere.

E. Solid Waste:
   1. Provide systems for controlling and managing solid waste related to the Work.
   2. Prevent solid waste from becoming airborne, and from discharging to surface waters and drainage routes.
   3. Properly handle and dispose of solid waste.

3.6 EROSION AND SEDIMENT CONTROL

A. Installation and Maintenance of Erosion and Sediment Controls – General:
   1. General:
      a. Provide erosion and sediment controls as shown and indicated on the Drawings and elsewhere in the Contract Documents. Provide erosion and sediment controls as the Work progresses into previously undisturbed areas.
      b. Installation of erosion and sediment controls shall be in accordance with the applicable regulatory requirements indicated in Article 1.2 of this Section, unless otherwise shown or indicated in the Contract Documents.
      c. Use necessary methods to successfully control erosion and sedimentation, including ecology-oriented construction practices, vegetative measures, and mechanical controls. Use best management practices (BMP) in accordance with Laws and Regulations, and regulatory requirements indicated in Article 1.2 of this Section, to control erosion and sedimentation during the Project.

d. Plan and execute construction, disturbances of soils and soil cover, and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation. Provide temporary measures for controlling erosion and sedimentation, as indicated in the Contract Documents and as required for the Project.
e. Where areas must be cleared for storage of materials or equipment, or for temporary facilities, provisions shall be made for regulating drainage and controlling erosion and sedimentation, subject to the ENGINEER'S approval.
f. Provide erosion and sediment controls, including stabilization of soils, at the end of each workday.

2. Coordination:
   a. Coordinate temporary erosion and sediment controls with construction of permanent drainage facilities and other Work to the extent necessary for economical, effective, and continuous erosion and sediment control.
3. Before commencing activities that will disturb soil or soil cover at the Site, provide all erosion and sediment control measures required by the Contract Documents for the areas where soil or soil cover will be disturbed.
4. In general, implement construction procedures associated with, or that may affect, erosion and sediment control to ensure minimum damage to the environment during construction. CONTRACTOR shall implement any and all additional measures required to comply with Laws and Regulations.
5. Vegetation Removal: Remove only those shrubs, grasses, and other vegetation that must be removed for construction. Protect remaining vegetation.
6. Access Roads and Parking Areas: When possible, access roads and temporary roads shall be located and constructed to avoid adverse effects on the environment. Provisions shall be made to regulate drainage, avoid erosion and sedimentation, and minimize damage to vegetation.
7. Earthwork and Temporary Controls:
   a. Perform excavation, fill, and related operations in accordance with Section 31 20 00, Earth Moving.
   b. Control erosion to minimize transport of silt from the Site into existing waterways and surface waters. Such measures shall include, but are not limited to, using berms, silt fencing, baled straw silt barriers, gravel or crushed stone, mulching and soil stabilization, slope drains, and other methods. Apply such temporary measures to erodible materials exposed by activities associated with the construction of the Project.
   c. Hold to a minimum the areas of bare soil exposed at one time.
   d. Construct fills and waste areas by selectively placing fill and waste materials to eliminate surface silts and clays that will erode.
   e. In performing earthwork, eliminate depressions that could serve as mosquito pools.

f. CONTRACTOR shall provide special care in areas with steep slopes, where disturbance of vegetation shall be minimized to maintain soil stability.

8. Inspection and Maintenance:
   a. Periodically inspect areas of earthwork and areas where soil or soil cover are disturbed to detect evidence of the start of erosion and sedimentation; apply corrective measures as required to control erosion and sedimentation. Continue inspections and corrective measures until soils are permanently stabilized and permanent vegetation has been established
   b. Repair or replace damaged erosion and sediment controls within 24 hours of CONTRACTOR becoming aware of such damage.
   c. Periodically remove silt and sediment that has accumulated in or behind sediment and erosion controls. Properly dispose of silt and sediment.
9. Duration of Erosion and Sediment Controls:
   a. Maintain erosion and sediment controls in effective working condition until the associated drainage area has been permanently stabilized.
   b. Maintain erosion and sediment controls until the Site is restored and site improvements including landscaping, if any, are complete with underlying soils permanently stabilized.
10. Work Stoppage: If the Work is temporarily stopped or suspended for any reason, CONTRACTOR shall provide additional temporary controls necessary to prevent environmental damage to the Site and adjacent areas while the Work is stopped or suspended.
11. Failure to Provide Adequate Controls: In the event CONTRACTOR repeatedly fails to satisfactorily control erosion and siltation, OWNER reserves the right to employ outside assistance or to use OWNER's own forces for erosion and sediment control. Cost of such work, plus engineering and inspection costs, will be deducted from monies due CONTRACTOR.

B. Silt Fencing:
   1. Install and maintain silt fencing in a vertical plane, at the location(s) shown or indicated on the Drawings.
   2. Locations of Silt Fencing:
      a. Where possible, install silt fencing along contour lines so that each given run fencing is at the same elevation.
      b. On slopes install silt fencing at intervals that do not exceed the maximum intervals indicated in the following table:

Slope (percent)	Maximum Length of Slope Above Each Silt Fence (feet)
2 and less	150
2.1 to 5	100
5.1 to 10	50
10.1 to 20	25
20.1 to 25	20

25.1 to 40	15
40.1 to 50	10

c. Provide silt fencing around perimeter of each stockpile of topsoil, general fill material, and excavated material. Install silt fencing before expected precipitation and maintain until stockpile is removed.
d. Do not install silt fencing at the following types of locations:
   1) Area of concentrated storm water flows such as ditches, swales, or channels.
   2) Where rock or rocky soils prevent full and uniform anchoring of silt fencing.
   3) Across upstream or discharge ends of storm water piping or culverts.

3. Installation:
   a. Securely fasten wire mesh to posts, and securely fasten filter cloth to wire mesh.
   b. When two sections of filter cloth abut each other, fold over edges and overlap by minimum of six inches and securely fasten to wire mesh.
   c. Embed posts in the ground to the depth necessary for proper controls; embed posts to at least 16 inches below ground.
   d. Filter cloth and wire mesh shall extend a minimum of eight inches below ground and a minimum of 16 inches above ground.
   e. Remove sediment accumulated at silt fencing as required. Repair and reinstall silt fencing as required.
4. Maintenance:
   a. Do not allow formation of concentrated storm water flows on slopes above silt fencing unless so shown or indicated in the Contract Documents. If unauthorized concentrated storm water flows occur, stabilize the slope via earthmoving and other stabilization measures as required to prevent flow of concentrated storm water flows toward silt fencing.

C. Straw Bale Dike.
1. Install straw bale dikes where shown or indicated, including in swales, along contours, and along toe of slopes.
2. Install bales in shallow excavation as wide as the bale and approximately four to six inches below surrounding grade.
3. Ends of bale shall tightly abut ends of adjacent bales.
4. Securely install straw bales using two support posts per bale, driven into the ground a minimum of 1.5 to two feet below bottom of bale. Top of post shall be flush with top of bale. Angle first post for each bale toward the previously-installed bale.
5. Frequently inspect bales and repair or replace as required. Remove accumulated silt and debris from behind straw bales.

D. Mulching and Soil Stabilization:

1. Use mulching to temporarily stabilize exposed soil and fill material.
    a. Immediately following final grading, provide mulch and stabilize with mats or netting, or sprayed soil stabilization emulsion with fiber additive.
    b. Application of mulching for soil stabilization shall be as follows.
        1) Unrotted Straw or Salt Hay: 1.5 to two tons per acre.
        2) Soil stabilization emulsions, when used, shall be applied in accordance with manufacturer's instructions, and shall be applied with mulch or stabilization fibers.
        3) Wood-fiber or Paper-fiber Application: 1,500 lbs. per acre, installed by hydroseeding.
    c. Where mats or netting are used:
        1) Cover entire area to be stabilized with mats or netting.
        2) Provide anchoring trenches at the top and bottom of slopes to receive mats or netting. Bury at least the top and bottom ends of mat or netting, four inches or more wide, at top and bottom of slope. Tamp trench full of soil. Four inches from trench, secure mat or netting with appropriate staples spaced at intervals of 10 inches.
        3) Overlap adjacent strips of mat or netting by at least four inches.

E. Protection of Storm Water Drainage Inlets and Catch Basins:
    1. Protect each drainage inlet and catch basin that has the potential to receive storm water runoff from exposed soils, and does not discharge into a storm water settlement basin.
    2. Install either, inlet filter bags inside of drainage inlet or catch basin, or a silt fence barrier around drainage inlets and catch basins. Secure inlet filter bag with the structure's grate or by other acceptable means.
    3. Inlet filter bags shall not pose any obstruction above the elevation of the drainage inlet or catch basin grate requiring barricades or flashers.
    4. When removing silt and sediment from inlet filter bag, do not dump filter bag's contents into the drainage inlet or catch basin.
    5. Remove silt and sediment from inlet filter bag, or replace inlet filter bag, when inlet filter bag is not more than half full.

F. Temporary Settlement Basin.
    1. For constructing embankments comply with requirements in Section 31 20 00, Earth Moving. .
    2. Overflow Weir and Discharge Pipe:
        a. Install piping in accordance with manufacturer's instructions.
        b. Install overflow weirs at elevations on shown or indicated on the Drawings or approved Shop Drawings, as applicable, to avoid overtopping and overfilling of settlement basin without short-circuiting the settlement basin's hydraulics.
        c. Wrap geotextile material specified for silt fencing around discharge structures of temporary settlement basins

3. Crushed Stone and Riprap: Install in accordance with Division 31. Provide in areas of temporary settlement basin subject to erosion, and at upstream and downstream ends of discharge piping.
4. Remove sediment when required based on accumulation of material.
5. When temporary settlement basin is no longer required, remove the temporary settlement basin discharge weir, discharge pipe, and spillway, fill the temporary sediment basin to required grade in accordance with requirements of Division 31 Section on excavation and fill..

G. Filter Bag on Dewatering Pump Discharge:
1. Provide dewatering of excavations in compliance with Section 31 20 00, Earth Moving.
2. Locate filter bags and temporary pump discharge lines to avoid interfering with the public, use of private property, and OWNER's operations. Relocate filter bags and appurtenances when required.
3. Filter bag discharge shall be directed to appropriate storm water drainage route. Do not discharge into roadways, driveways, or access roads. When temporary settlement basin is used, locate filter bags to discharge to temporary settlement basin when practicable.
4. Provide filter bag on discharge of each dewatering pump drawing from an excavation.
5. Securely attach filter bag to pump discharge pipe or hose.
6. Maintain, clean out, and replace filter bags as required.

H. Temporary Stone Construction Entrance:
1. Where shown on the Drawings, and where construction vehicles will regularly transit to paved surfaces from unstabilized surfaces, provide a temporary stone construction entrance. Contractor vehicles shall use temporary construction entrances.
2. Provide temporary stone construction entrances of the width, length, and thickness shown or indicated on the Drawings. When not shown or indicated on the Drawings, temporary stone construction entrance shall be not less than 50 feet long, by 20 feet wide, by eight inches deep.
3. Installation:
   a. Ensure that subgrade under temporary stone construction entrance is suitably dense for the intended purpose. Suitably prepare subgrade as required for temporary construction entrance.
   b. Provide on subgrade a layer of geotextile fabric, installed in accordance with geotextile manufacturer's recommendations for separation.
   c. Provide stone on installed geotextile. Grade stone for passage of vehicles.
4. Maintenance:
   a. Maintain temporary stone construction entrance at not less than the minimum required thickness. Add stone as required to maintain thickness.

b. When upper layer of temporary stone construction entrance becomes contaminated with soil, remove the contaminated material and replace with clean stone.
c. Using water to wash down temporary construction entrance or paved areas onto which soil material has been tracked is not allowed.

3.7 REMOVAL OF TEMPORARY CONTROLS

A. Removals – General:
1. Upon completion of the Work, remove temporary controls and restore Site to pre-construction condition.
2. After soils are permanently stabilized, remove from the Site temporary erosion and sediment controls.

+ + END OF SECTION + +

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SECTION 01 65 00

PRODUCT DELIVERY REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes the general requirements for preparing for shipping, delivering, and handling materials and equipment.
   2. CONTRACTOR shall make all arrangements for transporting, delivering, and handling of materials and equipment required for prosecution and completion of the Work.
   3. When required, move stored materials and equipment without additional compensation and without changes to the Contract Times.

1.2 SUBMITTALS

A. Refer to individual Specification Sections for submittal requirements relative to delivering and handling materials and equipment.

1.3 PREPARING FOR SHIPMENT

A. When practical, factory-assemble materials and equipment. Match mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable, protective coating.

B. Package materials and equipment to facilitate handling, and protect materials and equipment from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate the associated purchase order number, bill of lading number, contents by name, OWNER's contract name and number, CONTRACTOR name, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.

C. Protect materials and equipment from exposure to the elements and keep thoroughly dry and dust-free at all times. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Lubricate bearings and other items requiring lubrication in accordance with manufacturer's instructions.

D. Advance Notice of Shipments:
   1. Keep ENGINEER informed of delivery of all materials and equipment to be incorporated in the Work.
   2. Upon receipt of Supplier's advance notice of shipment, at least seven days prior to delivery of materials and equipment, provide ENGINEER written notification of anticipated date and place of arrival of the following:
      a. Packaged Lift Station.
      b. Packaged Wastewater Treatment Plant.

E. Do not ship materials and equipment until:
   1. Related Shop Drawings and other submittals have been approved or accepted (as applicable) by ENGINEER, including, but not necessarily limited to, all Action Submittals associated with the materials and equipment being delivered.
   2. Manufacturer's instructions for handling, storing, and installing the associated materials and equipment have been submitted to and accepted by ENGINEER in accordance with the Specifications.
   3. Results of source quality control testing (factory testing), when required by the Contract Documents for the associated materials or equipment, have been reviewed and accepted by ENGINEER.
   4. Facilities required for handling materials and equipment in accordance with manufacturer's instructions are in place and available.
   5. Required storage facilities have been provided.

1.4 DELIVERY

A. Scheduling and Timing of Deliveries:
   1. Arrange deliveries of materials and equipment in accordance with the accepted Progress Schedule and in ample time to facilitate inspection prior to installation.
   2. Schedule deliveries to minimize space required for and duration of storage of materials and equipment at the Site or delivery location, as applicable.
   3. Coordinate deliveries to avoid conflicting with the Work and conditions at Site, and to accommodate the following:
      a. Work of other contractors and OWNER.
      b. Storage space limitations.
      c. Availability of equipment and personnel for handling materials and equipment.
      d. OWNER's use of premises.
   4. Deliver materials and equipment to the Site during regular working hours.
   5. Deliver materials and equipment to avoid delaying the Work and the Project, including work of other contractors, as applicable. Deliver anchor system materials, including anchor bolts to be embedded in concrete or masonry, in ample time to avoid delaying the Work.

B. Deliveries:
   1. Shipments shall be delivered with CONTRACTOR's name, Subcontractor's name (if applicable), Site name, Project name, and contract designation (example: "ABC Construction Co., City of Somewhere, Idaho, Wastewater Treatment Plant Primary Clarifier Improvements, Contract 25, General Construction") clearly marked.
   2. Site may be listed as the "ship to" or "delivery" address; but OWNER shall not be listed as recipient of shipment unless otherwise directed in writing by ENGINEER.
   3. Provide CONTRACTOR's telephone number to shipper; do not provide OWNER's telephone number.
   4. Arrange for deliveries while CONTRACTOR's personnel are at the Site. CONTRACTOR shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when CONTRACTOR is not present will be refused by OWNER, and CONTRACTOR shall be responsible for the associated delays and additional costs, if incurred.

C. Containers and Marking:
   1. Have materials and equipment delivered in manufacturer's original, unopened, labeled containers.
   2. Clearly mark partial deliveries of component parts of materials and equipment to identify materials and equipment, to allow easy accumulation of parts, and to facilitate assembly.

D. Inspection of Deliveries:
   1. Immediately upon delivery, inspect shipment to verify that:
      a. Materials and equipment comply with the Contract Documents and approved or accepted (as applicable) submittals.
      b. Quantities are correct.
      c. Materials and equipment are undamaged.
      d. Containers and packages are intact and labels are legible.
      e. Materials and equipment are properly protected.
   2. Promptly remove damaged materials and equipment from the Site and expedite delivery of new, undamaged materials and equipment, and remedy incomplete or lost materials and equipment to furnish materials and equipment in accordance with the Contract Documents, to avoid delaying progress of the Work.
   3. Advise ENGINEER in writing when damaged, incomplete, or defective materials and equipment are delivered, and advise ENGINEER of the associated impact on the Progress Schedule.

1.5 HANDLING OF MATERIALS AND EQUIPMENT

A. Provide equipment and personnel necessary to handle materials and equipment, including those furnished by OWNER, by methods that prevent soiling or damaging materials and equipment and packaging.

B. Provide additional protection during handling as necessary to prevent scraping, marring, and otherwise damaging materials and equipment and surrounding surfaces.

C. Handle materials and equipment by methods that prevent bending and overstressing.

D. Lift heavy components only at designated lifting points.

E. Handle materials and equipment in safe manner and as recommended by the manufacturer to prevent damage. Do not drop, roll, or skid materials and equipment off delivery vehicles or at other times during handling. Hand-carry or use suitable handling equipment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 66 00

PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section includes general requirements for storing and protecting materials and equipment.

1.2 STORAGE

A. Store and protect materials and equipment in accordance with manufacturer's recommendations and the Contract Documents.

B. CONTRACTOR shall make all arrangements and provisions necessary for, and pay all costs for, storing materials and equipment. Excavated materials, construction equipment, and materials and equipment to be incorporated into the Work shall be placed to avoid injuring the Work and existing facilities and property, and so that free access is maintained at all times to all parts of the Work and to public utility installations in vicinity of the Work. Store materials and equipment neatly and compactly in locations that cause minimum inconvenience to OWNER, other contractors, public travel, and owners, tenants, and occupants of adjoining property. Arrange storage in manner to allow easy access for inspection.

C. Store materials and equipment to become OWNER's property to facilitate their inspection and ensure preservation of quality and fitness of the Work, including proper protection against damage by freezing, moisture, and high temperatures with ambient temperatures as high as 100 degrees F. Store in indoor, climate-controlled storage areas all materials and equipment subject to damage by moisture, humidity, heat, cold, and other elements, unless otherwise acceptable to OWNER. When placing orders to Suppliers for equipment and controls containing computer chips, electronics, and solid-state devices, CONTRACTOR shall obtain, coordinate, and comply with specific temperature and humidity limitations on materials and equipment, because temperature inside cabinets and components stored in warm temperatures can approach 200 degrees F.

D. CONTRACTOR shall be fully responsible for loss or damage (including theft) to stored materials and equipment.

E. Do not open manufacturer's containers until time of installation, unless recommended by the manufacturer or otherwise specified in the Contract Documents.

F. Do not store materials or equipment in structures being constructed unless approved by ENGINEER in writing.

G. Do not use lawns or other private property for storage without written permission of the owner or other person in possession or control of such premises.

1.3 PROTECTION

A. Equipment to be incorporated into the Work shall be boxed, crated, or otherwise completely enclosed and protected during shipping, handling, and storage, in accordance with Section 01 65 00, Product Delivery Requirements.

B. Store all materials and equipment off the ground (or floor) on raised supports such as skids or pallets.

C. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Painted equipment surfaces that are damaged or marred shall be repainted in their entirety in accordance with equipment manufacturer and paint manufacturer requirements, to the satisfaction of ENGINEER.

D. Protect electrical equipment, controls, and instrumentation against moisture, water damage, heat, cold, and dust. Space heaters provided in equipment shall be connected and operating at all times until equipment is placed in operation and permanently connected.

1.4 UNCOVERED STORAGE

A. The following types of materials may be stored outdoors without cover on supports so there is no contact with the ground:
   1. Reinforcing steel.
   2. Precast concrete materials.
   3. Structural steel.
   4. Metal stairs.
   5. Handrails and railings.
   6 Grating.
   7. Checker plate.
   8. Metal access hatches.
   9. Castings.
   10. Rigid electrical conduit.
   11. Piping, except polyvinyl chloride (PVC) pipe.

1.5 COVERED STORAGE

A. The following materials and equipment may be stored outdoors on supports and completely covered with covering impervious to water:
   1. Grout and mortar materials.
   2. Masonry units.
   3. Rough lumber.
   4. Soil materials and granular materials such as aggregate.
   5. PVC pipe.

B. Tie down covers with rope, and slope covering to prevent accumulation of water.

C. Store loose granular materials, with covering impervious to water, in well-drained area or on solid surfaces to prevent mixing with foreign matter.

1.6 FULLY PROTECTED STORAGE

A. Store all material and equipment not named in Articles 1.4 and 1.5 of this Section on supports in buildings or trailers that have concrete or wooden flooring, roof, and fully closed walls on all sides. Covering with visquine plastic sheeting or similar material in space without floor, roof, and walls is not acceptable. Comply with the following:
   1. Provide heated storage for materials and equipment that could be damaged by low temperatures or freezing.
   2. Provide air-conditioned storage for materials and equipment that could be damaged by high temperatures.
   3. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.
   4. Maintain humidity at levels recommended by manufacturers for electrical and electronic equipment.

1.7 HAZARDOUS PRODUCTS

A. Prevent contamination of personnel, storage area, and the Site. Comply with all applicable Laws and Regulations.

1.8 MAINTENANCE OF STORAGE

A. On scheduled basis, periodically inspect stored materials and equipment to ensure that:
   1. Condition and status of storage facilities is adequate to provide required storage conditions.
   2. Required environmental conditions are maintained on continuing basis.
   3. Materials and equipment exposed to elements are not adversely affected.

B. Mechanical and electrical equipment requiring long-term storage shall have complete manufacturer's instructions for servicing each item, with notice of enclosed instructions shown on exterior of container or package.
   1. Comply with manufacturer's instructions on scheduled basis.
   2. Space heaters that are part of electrical equipment shall be connected and operated continuously until equipment is placed in service and permanently connected.

1.9 MICROPROCESSORS, PANELS, AND INSTRUMENTATION STORAGE

A. Store panels, microprocessor-based equipment, electronics, and other devices subject to damage or decreased useful life because of temperatures below 40 degrees F or above 100 degrees F, relative humidity above 90 percent, or exposure to rain or exposure to blowing dust in climate-controlled storage space.

B. Requirements:
   1. Storage shall be in third-party owned, bonded, insured, climate-controlled warehouse in Suwannee County.
   2. OWNER and ENGINEER have the right to inspect materials and equipment during normal working hours.
   3. Placed inside each panel or device a desiccant, volatile corrosion inhibitor blocks (VCI), moisture indicator, and maximum-minimum indicating thermometer.
   4. Check panels and equipment at least once per month. Replace desiccant, VCI, and moisture indicator as often as required, or every six months, whichever occurs first.

C. Costs for storing climate-sensitive materials and equipment shall be paid by CONTRACTOR. Replace panels and devices damaged during storage, or for which storage temperatures or humidity range has been exceeded, at no additional cost to OWNER. Delays resulting from such replacement are causes within CONTRACTOR's control.

D. Do not ship panels and equipment to the Site until conditions at the Site are suitable for installation, including slabs and floors, walls, roofs, and environmental controls. Failure to have the Site ready for installation shall not relieve CONTRACTOR from complying with the Contract Documents.

1.10 RECORDS

A. Keep up-to-date account of materials and equipment in storage to facilitate preparation of Applications for Payment, if the Contract Documents provide for payment for materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 75 11

CHECKOUT AND STARTUP PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall initially start up and place equipment installed under the Contract into successful operation, in accordance with the equipment manufacturer's written instructions and as instructed by Supplier at the Site.
   2. Provide all material, labor, tools, and equipment required to complete equipment checkout and start-up.
   3. Provide chemicals, lubricants, and other required operating fluids.
   4. Provide fuel, electricity, water, filters, and other expendables required for start-up of equipment, unless otherwise specified.
   5. General Activities Include:
      a. Cleaning, as required under other provisions of the Contract Documents.
      b. Removing temporary protective coatings.
      c. Flushing and replacing lubricants, where required by manufacturer.
      d. Lubrication.
      e. Checking shaft and coupling alignments and resetting where required.
      f. Checking and setting motor, pump, and other equipment rotation, safety interlocks, and belt tensions.
      g. Checking and correcting (if necessary) leveling plates, grout, bearing plates, anchorage devices, fasteners, and alignment of piping, conduits, and ducts that may place stress on the connected equipment.
      h. All adjustments required.

B. Coordination:
   1. Coordinate checkout and start-up with other contractors, as necessary.
   2. Do not start up system or subsystem for continuous operation until all components of that system or subsystem, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.
   3. OWNER will provide sufficient personnel to assist CONTRACTOR in starting up equipment, but responsibility for proper operation is CONTRACTOR's.
   4. Supplier shall be present during checkout, start-up, and initial operation, unless otherwise acceptable to ENGINEER.
   5. Start-up of heating and air conditioning equipment and systems is dependent upon the time of year. Return to the Site at beginning of next heating or air conditioning season (as applicable) to recheck and start the appropriate systems.

6. Do not start up system, unit process, or equipment without submitting acceptable preliminary operations and maintenance manuals by CONTRACTOR, in accordance with Section 01 78 23, Operations and Maintenance Data.

C. OWNER's Assumption of Responsibility for Equipment and Systems:
   1. OWNER will assume responsibility for the equipment upon Substantial Completion.
   2. Prior to turning over to OWNER responsibility for operating and maintaining system or equipment:
      a. Provide training of operations and maintenance personnel in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
      b. Complete system field quality control testing in accordance with the Contract Documents.
      c. Submit acceptable final operations and maintenance manuals in accordance with Section 01 78 23, Operations and Maintenance Data.
      d. Obtain from ENGINEER final certificate of Substantial Completion for either entire Work or the portion being turned over to OWNER.

1.2 SUBMITTALS

A. Closeout Submittals: Submit the following:
   1. Certifications:
      a. Supplier's certification of installation in accordance with Paragraph 3.1.B of this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SERVICES OF SUPPLIER

A. When specified, furnish services of competent, qualified representatives of material and equipment manufacturers as specified, including supervising installation, adjusting, checkout, start-up, and testing of materials and equipment.

B. Certification:
   1. When services by Supplier are required at the Site, within 14 days after first test operation of equipment, submit to ENGINEER a letter from Supplier, on Supplier's letterhead, stating that materials and equipment are installed in accordance with Supplier's requirements and installation instructions, and in accordance with the Contract Documents.
   2. In lieu of Supplier letter, submit completed form attached to this Section.

3. Include in the final operations and maintenance manual for the associated equipment a copy of the letter or completed form, as applicable.

3.2 MINIMUM START-UP REQUIREMENTS

A. Bearings and Shafting:
   1. Inspect for cleanliness, and clean and remove foreign matter.
   2. Verify alignment.
   3. Replace defective bearings and those that operate in a rough or noisy manner.
   4. Grease as necessary, in accordance with manufacturer's recommendations.

B. Drives:
   1. Adjust tension in V-belt drives and adjust vari-pitch sheaves and drives for proper equipment speed.
   2. Adjust drives for alignment of sheaves and V-belts.
   3. Clean and remove foreign matter before starting operation.

C. Motors:
   1. Check each motor for comparison to amperage nameplate value.
   2. Correct conditions that produce excessive current flow and conditions that exist due to equipment malfunction.

D. Pumps:
   1. Check glands and seals for cleanliness and adjustment before running pump.
   2. Inspect shaft sleeves for scoring.
   3. Inspect mechanical faces, chambers, and seal rings, and replace if defective.
   4. Verify that piping system is free of dirt and scale before circulating liquid through pump.

E. Valves:
   1. Inspect manual and automatic control valves, and clean bonnets and stems.
   2. Tighten packing glands to ensure no leakage, but allow valve stems to operate without galling.
   3. Replace packing in valves to retain maximum adjustment after system is determined to be complete.
   4. Replace packing on valves that continue to leak.
   5. Remove and repair bonnets that leak.
   6. After cleaning, coat packing gland threads and valve stems with surface preparation of "Molycote" or "Fel-Pro".

F. Verify that control valve seats are free of foreign matter and are properly positioned for intended service.

G. Tighten flanges and other pipe joints after system has been placed in operation. Replace gaskets that show signs of leakage after tightening.

H. Inspect all joints for leakage:
   1. Promptly remake each joint that appears to be faulty; do not wait for rust other corrosion to form.
   2. Clean threads on both parts, and apply compound and remake joints.

I. After system has been placed in operation, clean strainers, drives, pockets, orifices, valve seats, and headers in fluid system to ensure freedom from foreign matter.

J. Open air vents, where used, and remove operating elements. Clean thoroughly, replace internal parts, and place back into operation.

K. Remove rust, scale, and foreign matter from equipment and renew defaced surfaces.

L. Set and calibrate equipment as required.

M. Inspect fan wheels for clearance and balance. Provide factory-authorized personnel for adjustment when needed.

N. Check each electrical control circuit to verify that operation complies with the Contract Documents.

O. Inspect each pressure gauge, thermometer, and other instruments for calibration. Replace items that are defaced, broken, or that read incorrectly.

P. Repair damaged insulation.

Q. Excess Gasses and Fluids:
   1. Vent gasses trapped in systems.
   2. Verify that liquids are drained from all parts of air systems.

3.3 ATTACHMENTS

A. The attachment listed below, following the "End of Section" designation, is a part of this Specification Section.
   1. Supplier's Installation Certification Form (one page).

+ + END OF SECTION + +

SUPPLIER'S INSTALLATION CERTIFICATION

Contract No. and Name: _____

Equipment Specification Section: _____

Equipment Name: _____

Contractor: _____

Manufacturer of Equipment: _____

The undersigned Supplier of the equipment described above hereby certifies that Supplier has checked the equipment installation and that the equipment, as specified in the Contract Documents, has been provided in accordance with the manufacturer's recommendations and the Contract Documents, and that the trial operation of the equipment has been satisfactory.

Comments: _____

_____ _____

Date Supplier Name (print)

_____

Signature of Supplier

_____ _____

Date Contractor Name (print)

_____

Signature of Contractor

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SECTION 01 77 19

CLOSEOUT REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

A. Definitions: Closeout is defined to include the general requirements near the end of the Contract Time, in preparation for final acceptance, final payment, normal termination of the Contract, occupancy by the OWNER and similar actions evidencing completion of the WORK.

1.2 PREREQUISITES FOR FINAL ACCEPTANCE

A. General: Prior to requesting the OWNER's final inspection for certifications of final acceptance and final payment, as required by the General Conditions, complete the following and list known exceptions (if any) in request:
   1. Submit final payment request with final releases and supports not previously submitted and accepted. Include certificates of insurance for products and completed operations.
   2. Submit updated final statement, accounting for additional changes to the Contract Sum.
   3. Submit certified copy of the OWNER's final punch-list of itemized WORK to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, endorsed and dated by the OWNER.

1.3 CLOSEOUT PROCEDURES

A. General Operating/Maintenance Instructions: Arrange for each installer of WORK requiring continuing maintenance (by the OWNER) or operation, to meet with the OWNER's personnel, at the project site, to provide basic instructions needed for proper operation and maintenance of the entire WORK. Include instructions by manufacturer's representatives where installers are not expert in the required procedures. Review maintenance manuals, record documentation, tools, spare parts and materials, identification system, hazards, cleaning and similar procedures and facilities. For operational equipment, demonstrates start-up, shut-down, emergency operations, noise and vibration adjustments, safety, economy/efficiency adjustments, and similar operations. Review maintenance and operations in relation with applicable guarantees, warranties, agreements to maintain, bonds and similar continuing commitments.

1.4 FINAL CLEANING

A. General: As specified herein, provide final cleaning of the WORK. The following are examples, but not by way of limitation, of the cleaning levels required.
   1. Clean project site (yard and grounds), including landscaping, development areas, of litter and foreign substances. Sweep paved areas to a broom-clean condition; remove stains, petrochemical spills and other foreign deposits. Rake grounds, which are neither planted nor paved, to a smooth evenly textured
      surface.
   2. Restore the grass and landscaping to original condition. Repair ruts caused by equipment.
   3. Remove discharge piping and restore discharge pipeline trends to original condition. Sod where needed. Mow grass where needed.
   4. Remove discharge piping and restore outfall area to original condition.

1.5 REMOVAL OF PROTECTION

A. Except as otherwise indicated or requested by the OWNER, remove temporary protection devices and facilities which were installed during the course of the WORK to protect previously completed WORK during the remainder of the construction period.

1.6 COMPLIANCY

A. Comply with safety standards and governing regulations for cleaning operations. Do not burn waste materials at the site, or bury debris or excess materials on the OWNER's property, or discharge volatile or other harmful or dangerous materials into drainage systems; remove waste materials from the site and dispose of in a lawful manner.

B. Where extra materials of value remaining after completion of the associated WORK have become the OWNER's property, dispose or store at the site as directed by the OWNER.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 78 23

OPERATIONS AND MAINTENANCE DATA

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Submit operation and maintenance data, in accordance with this Section and in accordance with requirements elsewhere in the Contract Documents, as instructional and reference manuals by operations and maintenance personnel at the Site.
   2. Required operation and maintenance data are presented in the individual Specification Sections. At minimum, submit operation and maintenance data for:
      a. All equipment and systems, including manufacturer's operation and maintenance manual.
      b. Valves, gates, actuators, and related accessories.
      c. Instrumentation and control devices.
      d. Electrical gear.
   3. For each operation and maintenance manual, submit the following:
      a. Preliminary Submittal: Electronic copy of entire operation and maintenance manual, except for test data, service reports by Supplier, and electronic copies.
      b. Final Submittal: Printed and bound copy of complete operations and maintenance manual, including test data and service reports by Supplier, with electronic copies.

B. Quantity Required and Timing of Submittals:
   1. Preliminary Submittal:
      a. Electronic Copies: Two copies, exclusive of any printed copies required by CONTRACTOR.
      b. Submit to ENGINEER by the earlier of: ninety days following approval of Shop Drawings and product data submittals, or ten days prior to starting training of operations and maintenance personnel, or ten days prior to field quality control testing at the Site.
   2. Final Submittal: Provide final submittal prior to Substantial Completion, unless submittal is specified as required prior to an interim Milestone.
      a. Printed Copies: Three copies.
      b. Electronic Copies: Three copies.

1.2 FORMAT OF PRINTED COPIES

A. Binding and Cover:
   1. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy as required. Binders shall be minimum one-inch wide and maximum of three-inch wide. Binders for each copy of each volume shall be identical.
   2. Binders shall be locking three-ring/"D"-ring type, or three-post type. Three-ring binders shall be riveted to back cover and include plastic sheet lifter (page guard) at front of each volume.
   3. Do not overfill binders.
   4. Covers shall be oil-, moisture-, and wear-resistant, including identifying information on cover and spine of each volume.
   5. Provide the following information on cover of each volume:
      a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
      b. Name or type of material or equipment covered in the manual.
      c. Volume number, if more than one volume is required, listed as "Volume __ of __", with appropriate volume-designating numbers filled in.
      d. Name of Project and, if applicable, Contract name and number.
      e. Name of building or structure, as applicable.
   6. Provide the following information on spine of each volume:
      a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
      b. Name or type of material or equipment covered in the manual.
      c. Volume number, if more than one volume is required, listed as "Volume __ of __", with appropriate volume-designating numbers filled in.
      d. Project name and building or structure name.

B. Pages:
   1. Print pages in manual on 30-pound (minimum) paper, 8.5 inches by 11 inches in size.
   2. Reinforce binding holes in each individual sheet with plastic, cloth, or metal. When published, separately-bound booklets or pamphlets are part of the manual, reinforcing of pages within booklet or pamphlet is not required.
   3. Provide each page with binding margin at least one inch wide. Punch each page with holes suitable for the associated binding.

C. Drawings:
   1. Bind into the manual drawings, diagrams, and illustrations up to and including 11 inches by 17 inches in size, with reinforcing specified for pages.
   2. Documents larger than 11 inches by 17 inches shall be folded and inserted into clear plastic pockets bound into the manual. Mark pockets with printed text indicating content and drawing numbers. Include no more than three drawing sheets per pocket.

D. Copy Quality and Document Clarity:

1. Contents shall be original-quality copies. Documents in the manual shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color. Manuals that contain copies that are unclear, not completely legible, off-center, skewed, or where text or drawings are cut by binding holes, are unacceptable. Pages that contain approval or date stamps, comments, or other markings that cover text or drawing are unacceptable. Faxed copies are unacceptable.
2. Clearly mark in ink to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished or cross out inapplicable content. Using highlighters to so indicate options furnished is unacceptable.

E. Organization:
   1. Coordinate with ENGINEER and OWNER to develop comprehensive, practical, and consistent indexing system for operations and maintenance data. ENGINEER will review indexing system before operations and maintenance data is submitted.
   2. Table of Contents:
      a. Provide table of contents in each volume of each operations and maintenance manual.
      b. In table of contents and at least once in each chapter or section, identify materials and equipment by their functional names. Thereafter, abbreviations and acronyms may be used if their meaning is clearly indicated in a table bound at or near beginning of each volume. Using material or equipment model or catalog designations for identification is unacceptable.
   3. Use dividers and indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

1.3 FORMAT OF ELECTRONIC COPIES

A. Electronic Copies of Operation and Maintenance Manuals:
   1. Each electronic copy shall include all information included in the corresponding printed copy.
   2. Submit each electronic copy on a separate compact disc (CD), unless another electronic data transfer method or format is acceptable to ENGINEER.
   3. File Format:
      a. Files shall be in "portable document format" (PDF). Files shall be electronically searchable.
      b. Submit separate file for each separate document in the printed copy.

c. Within each file, provide bookmarks for the following:
    1) Each chapter and subsection listed in the corresponding printed copy document's table of contents.
    2) Each figure.
    3) Each table.
    4) Each appendix.

4. At the request of the OWNER, also submit drawings and figures in one of the following formats: ".bmp", ".tif", ".jpg", or ".gif". Submit files in a separate directory on the CD.

1.4 CONTENT

A. General:
1. Prepare each operations and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-built drawings as applicable, bills of materials, technical bulletins, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.
2. Completeness and Accuracy:
    a. Operation and maintenance manuals that include language stating or implying that the manual's content may be insufficient or stating that the manual's content is not guaranteed to be complete and accurate are unacceptable.
    b. Operations and maintenance manuals shall be complete and accurate.
    c. Operation and maintenance manuals shall indicate the specific alternatives and features furnished, and the specific operation and maintenance provisions for the material or equipment furnished.
3. Submit complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; operating instructions for start-up, normal and emergency conditions; regulation and control; operational troubleshooting; and shutdown. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.

B. Submit written explanations of all safety considerations relating to operation and maintenance procedures.

C. Submit complete, detailed, written preventive maintenance instructions including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems function economically throughout their expected service life. Instructions shall

include:

1. Written explanations with illustrations for each preventive maintenance task such as inspection, adjustment, lubrication, calibration, and cleaning. Include pre-startup checklists for each equipment item and maintenance requirements for long-term shutdowns.
2. Recommended schedule for each preventive maintenance task.
3. Lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.
4. Table of alternative lubricants.
5. Troubleshooting instructions.
6. List of required maintenance tools and equipment.

D. Submit complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:

1. Manufacturer's name, address, telephone number, fax number, and Internet website address.
2. Manufacturer's local service representative's or local parts supplier's name, address, telephone number, fax number, Internet website address, and e-mail addresses, when applicable.
3. Manufacturer's shop order and serial number(s) for materials, equipment or assembly furnished.
4. For each part or piece include the following information:
    a. Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.
    b. Part name or description.
    c. Manufacturer's part number.
    d. Quantity of each part used in each assembly.
    e. Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.

E. Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number) that will expedite the ordering process.

F. Submit manufacturer's recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.

G. Submit manufacturer's installation and operation bulletins, diagrams, schematics,

and equipment cutaways. Avoid submitting catalog excerpts unless they are the only document available showing identification or description of particular component of the equipment. Where materials pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.

H. Submit original-quality copies of each approved and accepted Shop Drawing, product data, and other submittal, updated to indicate as-installed condition. Reduced drawings are acceptable only if reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.

I. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.

J. Submit copy of warranty bond and service contract as applicable.

K. When copyrighted material is used in operations and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall maintain and submit to ENGINEER with record documents as specified below, except where otherwise specified or modified in Divisions 2 through 46.

B. Maintenance of Record Documents:
   1. Maintain in CONTRACTOR's field office, in clean, dry, legible condition, complete sets of the following record documents: Drawings, Specifications, and Addenda; Shop Drawings, and other CONTRACTOR submittals, including records of test results, approved or accepted as applicable, by ENGINEER; Change Orders, Work Change Directives, Field Orders, photographic documentation, survey data, and all other documents pertinent to the Work.
   2. Make record documents available for inspection upon request of ENGINEER or OWNER.
   3. Do not use record documents for purpose other than serving as Project record. Do not remove record documents from CONTRACTOR's field office without ENGINEER's approval.

C. Submittal of Record Documents:
   1. Submit to ENGINEER the following record documents:
      a. Drawings.
      b. Project Manual including Specifications and Addenda (bound).
   2. Prior to readiness for final payment, submit to ENGINEER one copy of final record documents. Submit complete record documents; do not make partial submittals.
   3. Submit record documents with transmittal letter on CONTRACTOR letterhead complying with letter of transmittal requirements in Section 01 33 00, Submittal Procedures.
   4. Record documents submittal shall include certification, with original signature of official authorized to execute legal agreements on behalf of CONTRACTOR, reading as follows:
      "[*Insert Contractor's corporate name*] has maintained and submitted record documentation in accordance with the General Conditions and Supplementary Conditions, Section 01 78 39, Project Record Documents, and other elements of Contract Documents, for the Suwannee County Water Treatment Plant, Suwannee County, Florida. We certify that each record document submitted is

complete, accurate, and legible relative to the Work performed under our Contract, and that the record documents comply with the requirements of the Contract Documents.

[*Provide signature, print name, print signing party's corporate title, and date*]".

1.2 RECORDING CHANGES

A. General:
   1. At the start of the Project, label each record document to be submitted as, "PROJECT RECORD" using legible, printed letters. Letters on record copy of the Drawings shall be two inches high.
   2. Keep record documents current. Make entries on record documents within two working days of receipt of information required to record the change.
   3. Do not permanently conceal the Work until required information has been recorded.
   4. Accuracy of record documents shall be such that future searches for items shown on the record documents may rely reasonably on information obtained from ENGINEER-accepted record documents.
   5. Marking of Entries:
      a. Use erasable, colored pencils (not ink or indelible pencil) for marking changes, revisions, additions, and deletions to record documents.
      b. Clearly describe the change by graphic line and make notations as required. Use straight-edge to mark straight lines. Writing shall be legible and sufficiently dark to allow scanning of record documents into legible electronic files.
      c. Date all entries on record documents.
      d. Call attention to changes by drawing a "cloud" around the change(s) indicated.
      e. Mark initial revisions in red. In the event of overlapping changes, use different colors for subsequent changes.

B. Drawings:
   1. Record changes on copy of the Drawings. Submittal of CONTRACTOR-originated or -produced drawings as a substitute for recording changes on the Drawings is unacceptable.
   2. Record changes on plans, sections, schematics, and details as required for clarity, making reference dimensions and elevations (to Project datum) for complete record documentation.
   3. Record actual construction including:
      a. Depths of various elements of foundation relative to Project datum.
      b. Horizontal and vertical location of Underground Facilities referenced to permanent surface improvements. For each Underground Facility,

including pipe fittings, provide dimensions to at least two permanent, visible surface improvements.

c. Location of exposed utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.

d. Changes in structural and architectural elements of the Work, including changes in reinforcing.

e. Field changes of dimensions, arrangements, and details.

f. Changes made in accordance with Change Orders, Work Change Directives, and Field Orders.

g. Changes in details on the Drawings. Submit additional details prepared by CONTRACTOR when required to document changes.

4. Recording Changes for Schematic Layouts:

a. In some cases on the Drawings, arrangements of conduits, circuits, piping, ducts, and similar items are shown schematically and are not intended to portray physical layout. For such cases, the final physical arrangement shall be determined by CONTRACTOR subject to acceptance by ENGINEER.

b. Record on record documents all revisions to schematics on Drawings, including: piping schematics, ducting schematics, process and instrumentation diagrams, control and circuitry diagrams, electrical one-line diagrams, motor control center layouts, and other schematics when included in the Contract. Record actual locations of equipment, lighting fixtures, in-place grounding system, and other pertinent data.

c. When dimensioned plans and dimensioned sections on the Drawings show the Work schematically, indicate on the record documents, by dimensions accurate to within one inch in the field, centerline location of items of Work such as conduit, piping, ducts, and similar items

1) Clearly identify the Work item by accurate notations such as “cast iron drain”, “rigid electrical conduit”, “copper waterline”, and similar descriptions.

2) Show by symbol or note the vertical location of Work item; for example, “embedded in slab”, “under slab”, “in ceiling plenum”, “exposed”, and similar designations. For piping not embedded, also provide elevation dimension relative to Project datum.

3) Descriptions shall be sufficiently detailed to be related to Specifications.

d. ENGINEER may furnish written waiver of requirements relative to schematic layouts shown on plans and sections when, in ENGINEER’s judgment, dimensioned layouts of Work shown schematically will serve no useful purpose. Do not rely on waiver(s) being issued.

5. Supplemental Drawings:

a. In some cases, drawings produced during construction by ENGINEER or CONTRACTOR supplement the Drawings and shall be included with record documents submitted by CONTRACTOR. Supplemental record drawings shall include drawings provided with Change Orders, Work

Change Directives, and Field Orders and that cannot be incorporated into the Drawings due to space limitations.

b. Supplemental drawings provided with record drawings shall be integrated with the Drawings and include necessary cross-references between drawings. Supplemental record drawings shall be on sheets the same size as the Drawings.

c. When supplemental drawings developed by CONTRACTOR using computer-aided drafting/design (CADD) software are to be included in record drawings, submit electronic files for such drawings in AutoCAD as part of record drawing submittal. Submit electronic files on compact disc labeled, "Supplemental Record Drawings", together with CONTRACTOR name, Project name, and Contract name and number.

C. Specifications and Addenda:

1. Mark each Section to record:

a. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually provided.

b. Changes made by Addendum, Change Orders, Work Change Directives, and Field Orders.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 78 43

SPARE PARTS AND EXTRA MATERIALS

PART 1 – GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall furnish spare parts data and extra materials for materials and equipment in accordance with the Contract Documents.

B. List of Spare Parts and Extra Materials: With the Shop Drawings and product data for each Specification Section, submit a complete list of spare parts, extra stock materials, maintenance supplies, and special tools required for maintenance ("spare parts and extra materials") for two years of operation, with unit prices in current United States funds, and source(s) of supply for each.

C. Packaging and Labeling: Furnish spare parts and extra materials in manufacturer's unopened cartons, boxes, crates, or other original, protective covering suitable for preventing corrosion and deterioration for maximum length of storage normally anticipated by manufacturer. Packaging of spare parts and extra materials shall be clearly marked and identified with name of manufacturer, applicable equipment, part number, part description, and part location in the equipment. Protect and package spare parts and extra materials for maximum shelf life normally anticipated by manufacturer.

D. Storage Prior to Delivery to Owner: Prior to furnishing spare parts and extra materials to OWNER, store spare parts and extra materials in accordance with the Contract Documents and manufacturers' recommendations.

E. Delivery Time and Eligibility for Payment:
   1. Deliver to OWNER spare parts and extra materials upon Substantial Completion for equipment or system associated with the spare parts and extra materials. Do not deliver spare parts and extra materials before commencing start-up for associated equipment or system.
   2. Spare parts and extra materials are not eligible for payment until delivered to OWNER and CONTRACTOR's receipt of OWNER's countersignature on letter of transmittal.

F. Procedure for Delivery to Owner: Deliver spare parts and extra materials to OWNER's storage room at the Site at a Site designated by OWNER. When spare parts and extra materials are delivered, CONTRACTOR and ENGINEER will mutually inventory the spare parts and extra materials delivered to verify compliance with the Contract Documents regarding quantity and part numbers. Additional

procedures for delivering spare parts and extra materials to OWNER, if required, will be developed by ENGINEER and complied with by CONTRACTOR.

G. Transfer Documentation:
   1. Furnish on CONTRACTOR letterhead a letter of transmittal for spare parts and extra materials furnished under each Specification Section. Letter of transmittal shall accompany spare parts and extra materials. Do not furnish letter of transmittal separate from associated spare parts and extra materials.
   2. Furnish an original signed letter of transmittal for each Specification Section. Upon delivery of specified quantities and types of spare parts and extra materials to OWNER, designated person from OWNER will countersign each original letter of transmittal indicating OWNER's receipt of spare parts and extra materials.
   3. Letter of transmittal shall include the following:
      a. Information required for letters of transmittal in Section 01 33 00, Submittal Procedures.
      b. Transmittal shall list spare parts and extra materials furnished under each Specification Section. List each individual part or product and quantity furnished.
      e. Provide space for countersignature by OWNER as follows: space for signature, space for printed name, and date.

H. CONTRACTOR shall be fully responsible for loss or damage to spare parts and extra materials until spare parts and extra materials are received by OWNER.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 79 13

SYSTEM AND FACILITY PERFORMANCE TESTING PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, services, equipment, and incidentals required for performance testing as indicated in the Contract Documents.
   2. Conduct performance testing for each item of process; mechanical; instrumentation and control; plumbing; heating, ventilating, and air conditioning (HVAC); electrical systems and equipment; and other systems and equipment; as listed in Table 01 79 13-A of this Section, to demonstrate compliance with the performance requirements of the Contract Documents.
   3 Objectives of performance testing are to:
      a. Demonstrate to satisfaction of OWNER and ENGINEER that structures, systems, and equipment tested comply with all functional and performance requirements in the Contract Documents.
      b. Demonstrate that facility is Substantially Complete
      c. Establish baseline operating conditions for OWNER's use in establishing standard operating procedures and preventative maintenance programs.
   4. Utilities and Consumables:
      a. CONTRACTOR shall provide the following: electricity, fuel, compressed air, chemicals, temporary piping and appurtenances, and all other items and Work required for completing performance testing.
      b. OWNER will provide the following: water for initial performance testing. CONTRACTOR shall provide temporary piping and appurtenances required to convey to the testing location utilities and consumables furnished by OWNER. If re-testing is required, cost of utilities and consumables furnished by OWNER for initial testing shall be paid by CONTRACTOR at OWNER's cost or standard rates, as applicable.
   5. Sequence: The following general sequence applies to performance testing:
      a. Furnish submittals required prior to performance testing, in accordance with this Section.
      b. Complete the Work associated with starting and placing equipment in operation.
      c. To the extent practicable, complete Site quality control Work specified in Specification Sections for individual equipment items and systems.

d. Proceed with performance testing in accordance with this Section, simulating the range of actual operating conditions to the greatest extent possible.
e. Successful completion of performance testing is required to achieve Substantial Completion.

B. Coordination:
1. Review procedures under this and other Sections and coordinate installation and testing of items that must be started up and tested with or before performance testing Work.
2. Notify other contractors in advance of performance testing Work to provide them with sufficient time for installing and testing items included in their contracts that must be installed and tested with or before performance testing Work.

1.2 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning:
1. A "system" includes all required items of equipment, devices, and appurtenances connected so that their operation or function complements, protects, or controls the operation or function of the others.

1.3 QUALITY ASSURANCE

A. Qualifications:
1. Contractor's Performance Testing Manager (may be Contractor):
a. Appoint a performance testing manager, who shall:
1) Manage, coordinate, and supervise CONTRACTOR's performance testing.
2) Assist in coordinating and documenting Site quality control Work specified in individual Specifications Sections.
3) Prepare, or review and approve, all submittals for the Work under this Section
4) Coordinate activities of Subcontractors and Suppliers relative to performance testing.
5) Make frequent visits to the Site during performance testing.
b. Experience:
1) Performance testing manager shall have at least five years of experience in work similar to that required, or experience on at least five separate projects, in managing performance testing of process, mechanical, instrumentation and control, HVAC, and electrical systems.

B. Pre-performance Testing Conference:
   1. After initial submittal of documentation plan and performance testing plan and prior to starting performance testing, arrange a meeting at Site with CONTRACTOR's performance testing manager, CONTRACTOR's other key personnel, equipment Suppliers' technical representatives, authority having jurisdiction over operating permit(s), ENGINEER, OWNER, and other representatives directly concerned with performance testing Work. Record discussions of conference and decisions and agreements and disagreements and furnish a copy of record to each party attending. Review foreseeable methods and procedures relating to performance testing Work including:
      a. Review Project requirements including Contract Documents, submittals related to performance testing, requests for interpretations relative to performance testing, and other pertinent documents.
      b. Review required submittals, both completed and to be completed.
      c. Review status of the equipment and systems to be performance tested and work to be completed prior to performance testing.
      d. Review Progress Schedule and testing schedule.
      e. Review status of utilities and consumables required for performance testing.
      f. Review required inspections, testing, certifying, and quality control procedures.
      g. Review methods for complying with Laws and Regulations and requirements of authorities having jurisdiction, such as compliance with facility operating permit requirements, insurance requirements, environmental protection, health, safety, fire, and similar regulations.
   2. Reconvene meeting at earliest opportunity if additional information must be developed to conclude the required topics of the meeting.
   3. Record revisions or changes agreed upon, reasons therefor, and parties agreeing or disagreeing with them.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Documentation plan, in accordance with Article 1.5 of this Section.
   2. Performance testing plans, in accordance with Article 1.5 of this Section.

B. Informational Submittals: Submit the following:
   1. Records of pre-performance testing conference.
   2. Testing schedules, in accordance with Article 1.5 of this Section.
   3. Notices: Written notice to ENGINEER and OWNER at least 72 hours prior to beginning each test.
   4. Site Quality Control Submittals: All records produced during, and results of, performance testing.
   5. Qualifications Statements:

a. Testing laboratory qualifications and certifications, if not previously submitted under other Sections.
b. Qualifications of CONTRACTOR's performance testing manager and other required performance testing personnel, including copies of valid operators' licenses issued by authority having jurisdiction.

1.5 DOCUMENTATION PLAN, PERFORMANCE TESTING PLAN, AND TESTING SCHEDULE

A. Documentation Plans: Develop recordkeeping system to document compliance with requirements of this Section and authorities having jurisdiction.
   1. Calibration documentation including identification (by make, manufacturer, model, and serial number) of all test equipment, date of original calibration, date(s) of subsequent calibrations, calibration method, and test laboratory verifying calibration.
   2. Documentation to be provided for each equipment item and system to be tested shall include date of test, equipment tag number or system name, nature of test, test objectives, test results, test instruments employed, and signature spaces for CONTRACTOR's performance testing manager and OWNER's and ENGINEER's witnesses. Establish separate file for each system and equipment item to be tested. Files shall include the following information, as applicable, when associated tests, source quality control, or Site quality control measures are required in the Contract Documents:
      a. Metallurgical tests, when required.
      b. Source quality control (factory) tests.
      c. Accelerometer recordings made during shipment, when such recordings are required.
      d. Field calibration tests, in accordance with the Contract Documents.
      e. Field hydrostatic tests for equipment and systems that operate under pressure, in accordance with the Contract Documents.
      f. Site quality control testing, in accordance with the Contract Documents
   3. Forms:
      a. Develop forms specific to each item of equipment and system being tested, to document results of testing.
      b. Provide forms approved by ENGINEER in sufficient quantity to document all testing Work.

B. Performance Testing Plans:
   1. Develop performance testing plans describing in detail coordinated, sequential performance testing of each system and equipment item to be tested. Each performance testing plan shall be specific to the system or equipment item to be performance-tested, and shall identify by specific equipment or tag number each device or control station to be manipulated or observed during performance testing, and specific results to be observed or obtained.

Performance testing plans shall also be specific regarding support systems required to complete the performance testing Work, temporary devices and systems required (if any) during performance testing, Subcontractors and Suppliers to be present during performance testing, and planned performance testing duration. Performance testing plans shall include:

a. Summary of start-up, check-out, and Site quality control testing required for each system or equipment item prior to starting performance testing.
b. Calibration of all field instruments and control devices.
c. Description of and information on temporary systems, equipment, and devices proposed for performance testing, including calibration data for temporary instrumentation and controls.
d. Plan and procedures for implementing performance testing of systems and equipment. Performance tests shall duplicate the operating conditions described in the Contract Documents.
e. Description of data reduction required, if any, and proposed time between collection of data and submittal of results to ENGINEER.
f. Summary of criteria for acceptance of test results. Summary shall include performance tolerances (if any) included in the Contract Documents. Where performance tolerances are not included in the Contract Documents, testing plan shall include proposed performance tolerances.

2. Performance testing plans shall contain complete description of proposed procedures to achieve desired testing environment.
3. Following ENGINEER's approval of performance testing plans, CONTRACTOR shall reproduce performance testing plans in sufficient quantity for CONTRACTOR'S purposes plus five copies to ENGINEER and five copies to OWNER. Do not start performance testing until required quantity of approved performance testing plans is provided.

C. Testing Schedule:
1. Provide a testing schedule that sets forth the planned sequence for performance testing Work.
2. Testing schedule shall be part of the Progress Schedule and shall conform to requirements for Progress Schedule, except as specified in this Section.
3. Test schedule shall:
a. Detail the equipment and systems to be performance-tested, and the testing duration required for each.
b. Show planned start date, duration, and completion of each performance test.
c. Submitted no later than four weeks in advance of the date performance testing is to begin. ENGINEER will not witness performance testing Work until test schedule is accepted by ENGINEER.
d. Be updated weekly and resubmitted to ENGINEER. Updates shall indicate actual dates of performance testing Work, indicating systems and

equipment for which performance testing is in progress, and that are satisfactorily completed in accordance with the Contract Documents.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PREPARATION

A. Before starting the performance testing, complete the following:
   1. Prepare and align equipment in accordance with equipment Specifications and Section 01 73 19, Installation.
   2. To the extent practicable, complete equipment tests and check-out in accordance with the Contract Documents and manufacturers' recommendations.
   3. Complete other tests required by the Contract Documents, including instrumentation and controls calibration and testing, piping tests, electrical tests, and other tests required prior to full operation of the system or facility.
   4. Complete the Work required in Section 01 75 11, Checkout and Startup Procedures.

B. Temporary Systems and Devices Required for Performance Testing:
   1. Minimize the need for temporary systems and devices required for performance testing.
   2. Provide temporary connections and bulkheads as required, and make other provisions to re-circulate process fluids and gasses as required or otherwise simulate the range of anticipated operating conditions for the systems and equipment being performance-tested. During performance testing, CONTRACTOR's performance testing manager and team shall monitor the characteristics of each equipment item and system and report unusual conditions to ENGINEER.
   3. Properly install temporary systems. Test temporary equipment and devices in accordance with manufacturer's instructions to verify suitability for use in performance testing. Test temporary piping using in accordance with requirements for associated permanent piping.
   4. Calibration and Loop Testing of Temporary Instruments and Controls: Calibrate and test all loops and associated instruments and control devices, in accordance with instrumentation and controls Sections of Division 40, Process Integration.

3.2 PERFORMANCE TESTING

A. CONTRACTOR's performance testing manager shall organize teams comprising qualified representatives of Suppliers, Subcontractors, CONTRACTOR's independent testing laboratory (if applicable), and others as appropriate, to efficiently and complete performance testing Work within the Contract Times and in accordance with the accepted Progress Schedule.

B. Performance testing shall be done in accordance with the approved performance testing plan, approved documentation plan, and accepted testing schedule. Performance-test the systems and equipment items listed in Table 01 79 13-A of this Section.

C. System Performance Tests:
   1. Testing:
      a. Duration:
         1) Operate and performance-test the system (or each portion thereof, as applicable) and equipment for sufficient period of time to determine: operating characteristics of system and equipment, including noise, temperatures, and vibration; observe its performance characteristics; and for initial adjustment of controls and appurtenances.
         2) The minimum duration of performance testing for each system or equipment item shall be the number of continuous and consecutive days specified in Table 01 79 13-A in this Section. List the proposed performance testing duration in the testing plan and testing schedule.
         3) Duration of performance testing shall be in accordance with the approved testing plan and accepted testing schedule.
      b. When testing requires availability of temporary systems such as temporarily "looped" piping, temporary or standby electrical power, temporary compressed air, or temporary instrumentation and controls, provide acceptable alternate sources that meet the requirements of system and equipment being tested.
      c. Disposal site for test media that have the potential, upon disposal, to create a Hazardous Environmental Condition, are subject to review and acceptance by OWNER and ENGINEER.
      d. During performance testing, CONTRACTOR shall obtain baseline operating data on equipment with motors greater than one horsepower. Baseline data shall include amperage, bearing temperatures, and vibration data obtained at intervals in the approved testing plan. Methods of measurement shall be in accordance with industry standards applicable for the motors being tested.
   2. Test Interruption: Should testing be halted for any reason, repeat the operational testing until specified continuous testing period is completed for

the system or equipment item without interruption, in accordance with the Contract Documents.

3. Test Results and Re-testing: The following applies to the entire system tested and to portions thereof:
   a. Successful test results shall indicate conformance in accordance with the Contract Documents. If performance tolerances are not specified in the Contract Documents, test results shall conform to tolerances established in approved testing plan submittal.
   b. When results of performance testing fail to comply with the Contract Documents regarding such test, CONTRACTOR shall make adjustments and repairs as required and shall repeat the tests as required until conform with the Contract Documents is achieved.
   c. Re-testing Because of Disputed Testing Results or Procedures: In the case of an otherwise satisfactory performance test, when there is doubt, dispute, or difference between ENGINEER and CONTRACTOR regarding testing results, methods, or equipment used in performance testing, ENGINEER may order CONTRACTOR to repeat the testing. If repeat testing using such modified methods or equipment required by ENGINEER confirms the previous test, all costs of repeat test will be paid by OWNER. Otherwise all costs, including costs of engineering, labor, testing agencies, and inspections, shall be paid by CONTRACTOR.

3.3 REQUIRED PERFORMANCE TESTING

A. The schedules listed below, following the "End of Section" designation, are a part of this Specification Section.
   1. Table 01 79 13-A, Required Performance Testing.

+ + END OF SECTION + +

TABLE 01 79 13-A, REQUIRED PERFORMANCE TESTING

Name of System or Principal Equipment to be Performance-Tested	Appurtenant or Associated Systems or Equipment (1)	Performance Testing Minimum Duration (days)	Systems or Equipment to be Tested Concurrently with this System (2)	Remarks
1. Lift Station	-	1	-	
2. Wastewater Treatment Plant	-	45	-	
3. Generator	-	1	-	
4.				

Notes:

(1) The appurtenant or associated systems or equipment listed in this column may not completely name all systems or equipment associated with the operation of the principal system or equipment being tested. Performance-test all appurtenant systems and equipment associated with the principal system or equipment, when the appurtenant system or equipment is required for operation fo the principal system or equipment being performance tested.

(2) Performance-test all appurtenant systems and equipment associated with the principal system or equipment being performance-tested. And the additional systems or equipment listed in this column.

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SECTION 01 79 23

INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall furnish services of Manufacturer's operation and maintenance training specialists to instruct OWNER's personnel in recommended operation and maintenance procedures for materials and equipment furnished, in accordance with the Contract Documents.
   2. Manufacturer shall provide field training at the Site, unless otherwise required elsewhere in the Contract Documents.
   3. OWNER reserves the right to record training sessions on video for OWNER's later use in instructing OWNER's personnel.
   4. All materials shall be submitted to the Engineer in PDF format for review and approved at least 60 days prior to scheduled training.

B. Scheduling of Training Sessions:
   1. General:
      a. CONTRACTOR shall coordinate training services with start-up and initial operation of materials and equipment on days and times, and in manner, acceptable to OWNER, in accordance with the Contract Documents.
      b. Training may be required outside of normal business hours to accommodate schedules of operations and maintenance personnel. Furnish training services at the required days and times at no additional cost to OWNER.
   2. Prerequisites to Training:
      a. Training of OWNER'S personnel shall commence after acceptable preliminary operation and maintenance data has been submitted and work required in Section 01 75 11, Checkout and Startup Procedures, and Section 01 79 13, Equipment and System Startup and Performance Testing Procedures is complete.
      b. At option of OWNER or ENGINEER, training may be allowed to take place before, during, or after equipment start-up.
   3. Training Schedule Submittal:
      a. Training Schedule Required: CONTRACTOR shall prepare and submit proposed training schedule for review and acceptance by ENGINEER and OWNER. Proposed training schedule shall show all training required in the Contract Documents, and shall demonstrate compliance

with specified training requirements relative to number of hours of training, number of training sessions, and scheduling.

b. Timing of Training Schedule Submittal: Submit initial training schedule at least thirty days before scheduled start of first training session. Submit final training schedule, incorporating revisions in accordance with ENGINEER's comments, no later than fourteen days prior to starting the first training session.

c. OWNER reserves the right to modify personnel availability for training in accordance with process or emergency needs at the Site.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer's instructors shall be factory-trained by manufacturer of material or equipment.
   2. Manufacturer's instructors shall be proficient and experienced in conducting training of type required.
   3. Qualifications of instructors are subject to acceptance by ENGINEER. If ENGINEER does not accept qualifications of proposed instructor, furnish services of replacement instructor with acceptable qualifications.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Training Schedule: Detailed schedule of training sessions, demonstrating compliance with number of training sessions, hours required in the Contract Documents, and complying with the Contract Times. Submit training schedule submittals in accordance with time frames specified in this Section.

B. Informational Submittals: Submit the following:
   1. Lesson Plan: Acceptable lesson plan for training on each material or equipment item, in accordance with the Contract Documents. Lesson plan shall comply with requirements of this Section. Include with lesson plan copy of handouts that will be used during training sessions. Provide lesson plan submittals in accordance with time frames specified in this Section.
   2. Qualifications: Credentials of manufacturer's proposed operations and maintenance instructor(s). Credentials shall demonstrate compliance with requirements of this Section and shall include brief resume' and specific details of instructor's operating, maintenance, and training experience relative to the specific material and equipment for which instructor will provide training.

C. Closeout Submittals: Submit the following:
   1. Trainee sign-in sheet for each training session. Submit to OWNER.

1.4 LESSON PLAN

A. Supplier's lesson plan shall describe specific instruction topics, system components for which training will be furnished, and training procedures. Handouts, if any, to be used in training shall be included with the lesson plan. Describe in lesson plan "hands-on" demonstrations planned for training sessions.

B. Submit acceptable lesson plan seven days prior to starting associated training.

C. Lesson plan shall include estimated duration of each training segment.

D. Lesson plan shall include the following:
   1. Equipment Overview (required for all types of operations and maintenance training):
      a. Describe equipment's operating (process) function and performance objectives.
      b. Describe equipment's fundamental operating principles and dynamics.
      c. Identify equipment's mechanical, electrical, and electronic components and features. Group related components into subsystems and describe function of subsystem and subsystem's interaction with other subsystems.
      d. Identify all support equipment associated with operation of subject equipment, such as air intake filters, valve actuators, motors, and other appurtenant items and equipment.
      e. Identify and describe safety precautions and potential hazards related to operation.
      f. Identify and describe in detail safety and control interlocks.
   2. Operations Personnel Training:
      a. Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.
      b. Operation:
         1) Describe operating principles and practices.
         2) Describe routine operating, start-up, and shutdown procedures.
         3) Describe abnormal or emergency start-up, operating, and shutdown procedures that may apply.
         4) Describe alarm conditions and responses to alarms.
         5) Describe routine monitoring and recordkeeping procedures.
         6) Describe recommended housekeeping procedures.
      c. Troubleshooting:
         1) Describe how to determine if corrective maintenance or an operating parameter adjustment is required.
   3. Mechanical Maintenance Training:
      a. Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.
      b. Equipment Preventive Maintenance:
         1) Describe preventative maintenance inspection procedures required to:

a) Inspect equipment in operation.
b) Identify potential trouble symptoms and anticipate breakdowns.
c) Forecast maintenance requirements (predictive maintenance).

2) Define recommended preventative maintenance intervals for each component.
3) Describe lubricant and replacement part recommendations and limitations.
4) Describe appropriate cleaning practices and recommend intervals.
5) Identify and describe use of special tools required for maintenance of equipment.
6) Describe component removal, installation, and disassembly and assembly procedures.
7) Perform "hands-on" demonstrations of preventive maintenance procedures.
8) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
9) Define recommended torquing, mounting, calibrating, and aligning procedures and settings, as appropriate.
10) Describe recommended procedures to check and test equipment following corrective maintenance.

c. Equipment Troubleshooting:
1) Define recommended systematic troubleshooting procedures.
2) Provide component-specific troubleshooting checklists.
3) Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.
4) Describe common corrective maintenance procedures with "hands on" demonstrations.

4. Instrumentation/Controls Maintenance Training:
a. Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.

1.5 TRAINING AIDS

A. Manufacturer's instructor shall incorporate training aids as appropriate to assist in the instruction. Provide handouts of text, tables, graphs, and illustrations as required. Other appropriate training aids include:
1. Audio-visual aids, such as videos, Microsoft Powerpoint presentations, overhead transparencies, posters, drawings, diagrams, catalog sheets, or other items.
2. Equipment cutaways and samples, such as spare parts and damaged equipment.
3. Tools, such as repair tools, customized tools, and measuring and calibrating instruments.

B. Handouts:

1. Manufacturer's instructor shall distribute and use descriptive handouts during training. Customized handouts developed especially for training for the Project are encouraged.
2. Photocopied handouts shall be good quality and completely legible.
3. Handouts should be coordinated with the instruction, with frequent references made to the handouts.
4. Provide at least five copies of handouts for each training session.

C. Audio-visual Equipment: Training provider shall provide audio-visual equipment required for training sessions. OWNER is not responsible for providing audio-visual equipment. Audio-visual equipment that training provider shall provide, as required, includes:
   1. Laptop computer, presentation software, and suitable projector.
   2. As required, extension cords and spare bulb for projector.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 02 41 00

DEMOLITION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified and required for demolition, removal, and disposal Work.
   2. The Work under this Section includes, but is not necessarily limited to:
      a. Demolition and removal of existing materials and equipment as shown or indicated in the Contract Documents. The Work includes demolition of structural concrete, foundations, walls, structural steel, tanks, metals, attachments, appurtenances, piping, electrical and mechanical systems and equipment, paving, curbs, sidewalks, gutters, fencing and similar existing facilities.
      b. Demolition and removal of all Underground Facilities underneath, and above-grade piping and utilities in, the building(s) and structures shown or indicated for demolition, unless the Underground Facilities or above-grade facilities are shown or indicated as to remain.
      c. Remove from slabs, foundations, walls, and footings that are to be demolished all utilities and appurtenances embedded in such construction.
   3. Demolitions and removals specified under other Sections shall comply with requirements of this Section.
   4. Perform demolition Work within areas shown or indicated.
   5. Pay all costs associated with transporting and, as applicable, disposing of materials and equipment resulting from demolition.

B. Coordination:
   1. Comply with Section 01 14 16, Coordination with Owner's Operations.
   2. Review procedures under this and other Sections and coordinate the Work that will be performed with or before demolition and removals.

C. Related Sections:
   1. Section 33 11 00, Clearing and Grubbing.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Electrical Removals: Entity and personnel performing electrical removals shall be electrician legally qualified to perform electrical construction and electrical work in the jurisdiction where the Site is located.

2. Plumbing Removals: Entity and personnel performing plumbing removals shall be plumber legally qualified to perform plumbing construction and plumbing work in the jurisdiction where the Site is located.

B. Regulatory Requirements:
   1. Demolition, removal, and disposal Work shall be in accordance with 29 CFR 1926.850 through 29 CFR 1926.860 (Subpart T - Demolition), and all other Laws and Regulations.
   2. Comply with requirements of authorities having jurisdiction.

1.3 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Procedure Submittals:
      a. Demolition and Removal Plan: Not less than ten days prior to starting demolition Work, submit acceptable plan for demolition and removal Work, including:
         1) Plan for coordinating shut-offs, capping, temporary services, and continuing utility services.
         2) Other proposed procedures as applicable.
         3) Equipment proposed for use in demolition operations.
         4) Recycling/disposal facility(ies) proposed, including facility owner, facility name, location, and processes. Include copy of appropriate permits and licenses, and compliance status.
         5) Planned demolition operating sequences.
         6) Detailed schedule of demolition Work in accordance with the accepted Process Schedule.
   2. Notification of Intended Demolition Start: Submit in accordance with Paragraph 3.1.A of this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PREPARATION

A. Notification:
   1. At least 48 hours prior to commencing demolition or removal, notify ENGINEER in writing of planned start of demolition Work. Do not start removals without permission of ENGINEER.

B. Protection of Surrounding Areas and Facilities:
   1. Perform demolition and removal Work in manner that prevents damage and injury to property, structures, occupants, the public, and facilities. Do not

interfere with use of, and free and safe access to and from, structures and properties.

2. Closing or obstructing of roads, drives, sidewalks, and passageways adjacent to the Work is not allowed unless indicated otherwise in the Contract Documents. Conduct the Work with minimum interference to vehicular and pedestrian traffic.
3. Provide temporary barriers, lighting, sidewalk sheds, and other necessary protection.
4. Repair damage to facilities that are to remain.

C. Existing Utilities: In addition to requirements of the General Conditions, Supplementary Conditions, and Division 01 Specifications, do the following:
   1. Should uncharted or incorrectly charted Underground Facilities be encountered, CONTRACTOR responsibilities shall be in accordance with the General Conditions as may be modified by the Supplementary Conditions. Cooperate with utility owners in keeping adjacent services and facilities in operation.
   2. Sanitary Sewer: Before proceeding with demolition, locate and cap all sewer lines and service laterals discharging from the structure being demolished.
   3. Other Utilities: Before proceeding with demolition, locate and cap as required all other utilities, such as fuel and gas; heating, ventilating, and air conditioning; electric; and communications; and service laterals serving the building or structure being demolished.
   4. Shutdown of utility services shall be coordinated by CONTRACTOR, assisted by OWNER as required relative to contacting utility owners.

3.2 DEMOLITION – GENERAL

A. Locate construction equipment used for demolition Work and remove demolished materials and equipment to avoid imposing excessive loading on supporting and adjacent walls, floors, framing, facilities, and Underground Facilities.

B. Pollution Controls:
   1. Use water sprinkling, temporary enclosures, and other suitable methods to limit emissions of dust and dirt to lowest practical level. Comply with Section 01 57 05, Temporary Controls, and Laws and Regulations.
   2. Do not use water when water may create hazardous or objectionable conditions such as icing, flooding, or pollution.
   3. Clean adjacent structures, facilities, properties, and improvements of dust, dirt, and debris caused by demolition Work, in accordance with the General Conditions.

C. Explosives:
   1. Use of explosives is prohibited.

D. Building or Structure Demolition:

1. Unless otherwise approved by ENGINEER, proceed with demolition from top of building or structure to the ground. Complete demolition Work above each floor or tier before disturbing supporting members of lower levels.
2. Demolish concrete and masonry in small sections.
3. Remove structural framing members and lower to ground using hoists, cranes, or other suitable methods. Do not throw or drop to the ground.
4. Break up and remove foundations and slabs-on-grade unless otherwise shown or indicated as remaining in place.

E. Demolition of Site Improvements:
1. Pavement, Sidewalks, Curbs, and Gutters: Demolition of asphalt or concrete pavement, sidewalks, curbs, and gutters, as applicable, shall terminate at cut edges. Edges shall be linear and have a vertical cut face.
2. Fencing, Guardrails, and Bollards: Remove to the limits shown or indicated on the Drawings. Completely remove below-grade posts and concrete.
3. Manholes, Vaults, Chambers, and Handholes: Remove to the limits shown or indicated on the Drawings.
4. Underground Facilities Other than Manholes, Vaults, Chambers, and Handholes: Remove to the extent shown or indicated on the Drawings. Unless otherwise shown or indicated, cap ends of piping to remain in place in accordance with the "Mechanical Removals" Article in this Section.
5. Landscaping: Comply with Section 33 11 00, Clearing and Grubbing.

F. Salvage and Ownership:
1. Refer to Section 01 11 13, Summary of Work, for requirements on salvage, ownership, and handling of equipment and materials removed during demolition and removal Work.
2. Materials and equipment to remain OWNER's property shall be carefully removed and appropriately handled by CONTRACTOR to avoid damage and invalidation of warranties in effect, and shall be cleaned and stored at the Site (or other site specified in the Contract Documents) at place designated by ENGINEER or OWNER.

3.3 STRUCTURAL REMOVALS

A. Remove structures to lines and grades shown or indicated, unless otherwise directed by ENGINEER. Where limits are not shown or indicated, limits shall be four inches outside item to be installed. Removals beyond limits shown or indicated shall be at CONTRACTOR's expense and such excess removals shall be reconstructed to satisfaction of ENGINEER without additional cost to OWNER.

B. Recycling and Reuse of Demolition Materials:
1. All concrete, brick, tile, masonry, roofing materials, reinforcing steel, structural metals, miscellaneous metals, plaster, wire mesh, and other items contained in or upon building or structure to be demolished shall be removed, transported,

and disposed of away from the Site, unless otherwise approved by ENGINEER.

2. Do not use demolished materials as fill or backfill adjacent to structures, in pipeline trenches, or as subbase under structures or pavement.

C. After removing concrete and masonry walls or portions thereof, slabs, and similar construction that ties in to the Work or to existing construction, neatly repair the junction point to leave exposed only finished edges and finished surfaces.

D. Where parts of existing structures are to remain in service following demolition, remove the portions shown or indicated for removal, repair damage, and leave the building or structure in proper condition for the intended use.

1. Remove concrete and masonry to the lines shown or indicated by sawing, drilling, chipping, and other suitable methods. Leave the resulting surfaces true and even, with sharp, straight corners that will result in neat joints with new construction and be satisfactory for the purpose intended.
2. Do not damage reinforcing bars beyond the area of concrete and masonry removal. Do not saw-cut beyond the area to be removed.
3. Reinforcing bars that are exposed at surfaces of removed concrete and masonry that will not be covered with new concrete or masonry shall be removed to 1.5 inches below the final surface. Repair the resulting hole, with repair mortar for concrete and grout for masonry, to be flush with the surface.
4. Where existing reinforcing bars are shown or indicated to extend into new construction, remove existing concrete so that reinforcing bars are clean and undamaged.

E. Where equipment or material anchored to concrete or masonry are removed and anchors are not to be re-used, remove the anchors to not less than 1.5 inches beneath surface of concrete or masonry member. Repair the resulting hole, using repair mortar for concrete and grout for masonry, to be flush with the surface. Alternately, when the anchor is stainless steel, the anchor may be cut flush with the surface of the concrete or masonry, when so approved by ENGINEER.

F. Where anchoring materials, including bolts, nuts, hangers, welds, and reinforcing steel, are required to attach the Work to existing construction, provide such materials under this Section, unless specified elsewhere in the Contract Documents.

3.4 MECHANICAL REMOVALS

A. Mechanical demolition and removal Work includes dismantling and removing existing piping, ductwork, pumps, equipment, tanks, and appurtenances as shown, indicated, and required for completion of the Work. Mechanical removals include cutting and capping as required.

B. Demolition and Removals of Piping, Ductwork, and Similar Items:

1. Purge piping and tanks (as applicable) of chemicals or fuel (as applicable) and make safe for removal and capping. Remove to the extent shown or indicated existing process, water, waste and vent, chemical, gas, fuel, and other piping. Remove piping to the nearest solid piping support, and provide caps on ends of remaining piping. Where piping to be demolished passes through existing walls to remain, cut off and cap pipe on each side of the wall.
2. Caps, Closures, Blind Flanges, and Plugs:
    a. Provide closure pieces, such as blind flanges and caps, where shown or required to complete the Work.
    b. Where used in this Section, the term "cap" means the appropriate type closure for the piping or ductwork being closed, including caps, blind flanges, and other closures.
    c. Caps shall be compatible with the piping or ductwork to which the cap is attached, fluid-tight and gastight, and appropriate for the fluid or gas conveyed in the pipe or duct.
    d. Unless otherwise shown or indicated, caps shall be mechanically fastened, fused, or welded to pipe or duct. Plug piping with means other than specified in this Section only when so shown or indicated in the Contractor Documents or when allowed by ENGINEER.
3. When Underground Facilities are altered or removed, properly cut and cap piping left in place, unless otherwise shown or indicated.
4. Remove waste and vent piping, and ductwork to extent shown and cap as required. Where demolished vent piping, stacks, and ductwork passes through existing roofing, patch the roof with the same or similar materials. Completed patch shall be watertight and comply with roofing manufacturer's recommendations.
5. Modifications to potable water piping and other plumbing and heating system work shall comply with Laws and Regulations. All portions of potable water system that have been modified or opened shall be hydrostatically tested and disinfected in accordance with the Contract Documents, and Laws and Regulations. Hydrostatically test other, normally-pressurized, plumbing piping and heating piping.

C. Equipment Demolition and Removals:
1. To the extent shown or indicated, remove existing process equipment; pumps; storage tanks; hoisting and conveying equipment; heating, ventilating, and air conditioning equipment; generators; and other equipment.
2. Where required, disassemble equipment to avoid imposing excessive loading on supporting walls, floors, framing, facilities, and Underground Facilities. Disassemble equipment as required for access through and egress from building or structure. Disassembly shall comply with Laws and Regulations. Provide required means to remove equipment from building or structure.
3. Remove control panels, operator stations, and instruments associated with equipment being removed, unless shown or indicated otherwise.
4. Remove fuel appurtenances as applicable, including fuel storage tanks. Dispose of tank contents in accordance with Laws and Regulations.

5. Remove equipment supports as applicable, anchorages, base, grout, and piping. Remove anchorage systems in accordance with the "Structural Removals" Article in this Section. Remove small-diameter piping back to header unless otherwise indicated.
6. Remove access platforms, ladders, and stairs related to equipment being removed, unless otherwise shown or indicated.

3.5 ELECTRICAL REMOVALS

A. Electrical demolition Work includes removing existing transformers, distribution switchboards, control panels, motors, starters, conduit and raceways, cabling, poles and overhead cabling, panelboards, lighting fixtures, switches, and miscellaneous electrical equipment, as shown, specified, or required.

B. Remove existing electrical equipment and fixtures to avoid damaging systems to remain, to keep existing systems in operation, and to maintain integrity of grounding systems.

C. Remove or modify motor control centers and switchgear as shown or indicated. Modified openings shall be cut square and dressed smooth to dimensions required for installation of equipment.

D. Disconnect and remove motors, control panels, and other electrical gear where shown or indicated. Motors, microprocessors and electronics, other electrical gear to be reused shall be stored in accordance with Section 01 66 00, Product Storage and Handling Requirements.

E. Cables in conduits to be removed shall be removed back to the power source or control panel, unless otherwise shown or indicated. Verify the function of each cable before disconnecting and removing.

F. Conduits, raceways, and cabling shall be removed where shown or indicated. Abandoned conduits concealed in floor, ceiling slabs, or in walls shall be cut flush with the slab or wall (as applicable) at point of entrance, suitably capped, and the area repaired in a flush, smooth manner acceptable to ENGINEER. Exposed conduits, junction boxes, other electrical appurtenances, and their supports shall be disassembled and removed. Repair all areas of the Work to prevent rusting on exposed surfaces.

G. Conduits in Underground Facilities not scheduled for reuse shall be suitably capped watertight where each enters building or structure to remain.

H. Where shown or indicated, remove direct burial cable. Openings in buildings for entrance of direct burial cable shall be patched with repair mortar or other material approved by ENGINEER for this purpose, and made watertight.

I. Existing poles and overhead cables shall be removed or abandoned as shown and specified. Existing substation(s) and poles owned by electric utility will be removed by the electric utility. Completely remove from the Site poles not owned by electric utility and shown or indicated for removal. Make necessary arrangements with electric utility for removal of utility company's transformers and metering equipment after new electrical system has been installed and energized.

J. Lighting fixtures, wall switches, receptacles, starters, and other miscellaneous electrical equipment, not designated as remaining as OWNER's property, shall be removed and properly disposed off-Site as required.

3.6 DISPOSAL OF DEMOLITION DEBRIS

A. Remove from the Site all debris, waste, rubbish, and material resulting from demolition operations and equipment used in demolition Work. Comply with the General Conditions, Supplementary Conditions.

B. Transportation and Disposal:
   1. Non-hazardous Material: Properly transport and dispose of non-hazardous demolition debris at appropriate landfill or other suitable location, in accordance with Laws and Regulations. Non-hazardous material does not contain Asbestos, PCBs, Petroleum, Hazardous Waste, Radioactive Material, or other material designated as hazardous in Laws and Regulations.
   2. Hazardous Material: When handling and disposal of hazardous materials is included in the Work, properly transport and dispose of hazardous materials in accordance with the Contract Documents and Laws and Regulations.

C. Submit to ENGINEER information required in this Section on proposed facility(ies) where demolition material will be recycled. Upon request, ENGINEER or OWNER, shall be allowed to visit recycling facility(ies) to verify adequacy and compliance status. During such visits, recycling facility operator shall cooperate and assist ENGINEER and OWNER.

+ + END OF SECTION + +

SECTION 03 00 05

CONCRETE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete, reinforcing, and related materials.
   2. The Work includes:
      a. Providing concrete consisting of portland cement, fine and coarse aggregates, water, and approved admixtures; combined, mixed, transported, placed, finished, and cured.
      b. Fabricating and placing reinforcing, including ties and supports.
      c. Design, erection, and removal of formwork.
      d. Building into the concrete all sleeves, frames, anchorage devices, inserts, and other items required to be embedded in concrete.
      e. Providing openings in concrete as required to accommodate Work under this and other Sections.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate installation of items to be installed in the concrete Work.

C. Classifications of Concrete:
   1. Class "A" concrete shall be steel-reinforced and includes all concrete in contact with earth unless otherwise shown or indicated.

D. Related Sections:
   1. Section 05 05 33, Anchor Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ACI 224R, Control of Cracking in Concrete Structures.
   2. ACI 301, Specifications for Structural Concrete for Buildings.
   3. ACI 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
   4. ACI 305R, Specification for Hot Weather Concreting.
   5. ACI 306R, Cold Weather Concreting.
   6. ACI 309R, Guide for Consolidation of Concrete.

7. ACI 318, Building Code Requirements for Structural Concrete and Commentary.
8. ACI 347, Guide to Formwork for Concrete.
9. ACI SP-66, ACI Detailing Manual.
10. ASTM A82/A82M, Specification for Steel Wire, Plain, for Concrete Reinforcement.
11. ASTM A185/A185M, Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
12. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
13. ASTM C31/C31M, Practice for Making and Curing Concrete Test Specimens in the Field.
14. ASTM C33/C33M, Specification for Concrete Aggregates.
15. ASTM C39/C39M, Test Method for Compressive Strength of Cylindrical Concrete Specimens.
16. ASTM C42/C42M, Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
17. ASTM C94/C94M, Specification for Ready-Mixed Concrete.
18. ASTM C138/C138M, Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
19. ASTM C143/C143M, Test Method for Slump of Hydraulic-Cement Concrete.
20. ASTM C150/C150M, Specification for Portland Cement.
21. ASTM C172, Practice for Sampling Freshly Mixed Concrete.
22. ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
23. ASTM C260, Specification for Air-Entraining Admixtures for Concrete.
24. ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
25. ASTM C494/C494M, Specification for Chemical Admixtures for Concrete.
26. ASTM C579, Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
27. ASTM C1064/C1064M, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
28. ASTM D1752, Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
29. ASTM E96/E96M, Test Methods for Water Vapor Transmission of Materials
30. ASTM E1745, Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
31. CRD-C 572, U. S. Army Corps of Engineers Specification for Polyvinylchloride Waterstops.
32. CRSI 1MSP, Manual of Standard Practice.
33. NSF/ANSI 61, Drinking Water System Components - Health Effects.

1.3 QUALITY ASSURANCE

A. Laboratory Trial Batch:
   1. Employ independent testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes.
   2. Each concrete mix design specified shall be verified by laboratory trial batch, unless indicated otherwise.
   3. Perform the following testing on each trial batch:
      a. Aggregate gradation for fine and coarse aggregates.
      b. Slump.
      c. Air content.
      d. Compressive strength based on three cylinders each tested at seven days and at 28 days.
   4. Submit for each trial batch the following information:
      a. Project identification name and number (if applicable).
      b. Date of test report.
      c. Complete identification of aggregate source of supply.
      d. Tests of aggregates for compliance with the Contract Documents.
      e. Scale weight of each aggregate.
      f. Absorbed water in each aggregate.
      g. Brand, type, and composition of cementitious materials.
      h. Brand, type, and amount of each admixture.
      i. Amounts of water used in trial mixes.
      j. Proportions of each material per cubic yard.
      k. Gross weight and yield per cubic yard of trial mixtures.
      l. Measured slump.
      m. Measured air content.
      n. Compressive strength developed at seven days and 28 days, from not less than three test cylinders cast for each seven day and 28-day test, and for each design mix.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. List of concrete materials and concrete mix designs proposed for use. Include results of tests performed to qualify the materials and to establish the mix designs. Do not start laboratory trial batch testing until this submittal is approved by ENGINEER.
      b. Laboratory Trial Batch Reports: Submit laboratory test reports for concrete cylinders, materials, and mix design tests.
      c. Concrete placement drawings showing the location and type of all joints.
      d. Drawings for fabricating, bending, and placing concrete reinforcing. Comply with ACI SP-66. For walls and masonry construction, provide

elevations to a minimum scale of 1/4-inch to one foot. Show bar schedules, stirrup spacing, adhesive dowels, splice lengths, diagrams of bent bars, arrangements, and assemblies, as required for fabricating and placing concrete reinforcing.

2. Product Data:
   a. Manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
3. Samples:
   a. Samples: Submit samples of materials as specified and as otherwise requested by ENGINEER, including names, sources, and descriptions.

B. Informational Submittals: Submit the following:
1. Delivery Tickets: Copies of all delivery tickets for each load of concrete delivered to or mixed at the Site. Each delivery tickets shall contain the information in accordance with ASTM C94/C94M along with project identification name and number (if any), date, mix type, mix time, quantity and amount of water introduced.
2. Site Quality Control Submittals:
   a. Report of testing results for testing of field concrete cylinders for each required time period. Submit within 24 hours after completion of associated test. Test report shall include results of all testing required at time of sampling.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Transportation, Delivery, and Handling:
1. Deliver concrete reinforcing products to Site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings on approved Shop Drawings.
2. Materials used for concrete shall be clean and free from foreign matter during transportation and handling, and kept separate until measured and placed into concrete mixer.
3. Implement suitable measures during hauling, piling, and handling to ensure that segregation of coarse and fine aggregate particles does not occur and grading is not affected.
4. Deliver grout materials from manufacturers in unopened containers that bear intact manufacturer labeling.
5. Comply with Section 01 65 00, Product Delivery Requirements.

B. Storage:
   1. Store formwork materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective, waterproof covering. Provide for adequate air circulation or ventilation under cover.
   2. Store concrete reinforcing materials to prevent damage and accumulation of dirt and excessive rust. Store on heavy wood blocking so that reinforcing does not come into contact with the ground. Space framework or blocking supports to prevent excessive deformation of stored materials.
   3. Store concrete joint materials on platforms or in enclosures or covered to prevent contact with ground and exposure to weather and direct sunlight.
   4. For storage of concrete materials, provide bins or platforms with hard, clean surfaces.
   5. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I/II.

B. Fly Ash Mineral Admixture:
   1. Mineral admixtures, when used, shall conform to the requirements of ASTM C618 Class F, except as follows:
      a. The loss on ignition shall be a maximum of four percent.
      b. The maximum percent of sulfur trioxide (SO3) shall be 4.0.
   2. Fly ash shall be considered to be a cementitious material.
   3. Laboratory trial batches shall be tested to determine compliance with strength requirements, times of setting, slump, slump loss, and shrinkage characteristics.

C. For concrete, when Type II Cement is used, fly ash shall be used within the following percentages by weight.
   1. Fly ash shall have minimum of 20 percent and maximum of 25 percent of total weight of cementitious material.

D. Aggregates: ASTM C33/C33M.
   1. Fine Aggregate: Clean, sharp, natural sand free of loam, clay, lumps, and other deleterious substances. Dune sand, bank run sand, and manufactured sand are unacceptable.
   2. Coarse Aggregate:
      a. Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter.
      b. Coarse aggregate shall comply with the following:
         1) Crushed stone, processed from natural rock or stone.
         2) Washed gravel, either natural or crushed. Slag, pit gravel, and bank-

run gravel are not allowed.

c. Coarse Aggregate Size: ASTM C33/C33M, Nos. 57 or 67, unless otherwise approved by ENGINEER.

E. Water: Clean, potable.

F. Admixtures:
1. Air-Entraining Admixture: ASTM C260.
2. Water-Reducing Admixture: ASTM C494/C494M, Type A.
3. Water Reducing and Set-Adjusting Admixtures: ASTM C494/C494M, Types D and E.
4. High Range Water-Reducing Admixture: ASTM C494/C494M, Type F/G.
5. Use only admixtures that have been tested and approved in the mix designs.
6. Do not use calcium chloride or admixtures containing chloride ions.

2.2 CONCRETE MIX

A. General:
1. Normal weight: 145 pounds per cubic foot.
2. Use air-entraining admixture in all concrete. Provide from three to five percent entrained air for other concrete.

B. Proportioning and Design of Class "A" Concrete Mix:
1. Minimum compressive strength at 28 days: 4,000 psi.
2. Maximum water-cement ratio by weight: 0.45.
3. Minimum cement content: 564 pounds per cubic yard.
4. Use amounts of admixtures recommended by admixture manufacturer for climatic conditions prevailing at the Site at time of placing. Adjust quantities and types of admixtures as required to maintain quality. Site soil conditions contain acidic soils.

C. Slump Limits:
1. Proportion and design mixes to result in concrete slump at point of placement of not less than one inch and not more than four inches.
2. When using high-range water reducers, slump prior to addition of admixture shall not exceed three inches. Slump after adding admixture shall not exceed eight inches at point of placement.

D. Adjustment of Concrete Mixes:
1. Concrete mix design adjustments may be requested by CONTRACTOR when warranted by characteristics of materials, Site conditions, weather, test results, or other, similar circumstances.
2. Submit for ENGINEER's approval laboratory test data for adjusted concrete mix designs, including compressive strength test results.
3. Implement adjusted mix designs only after ENGINEER's approval.

4. Adjustments to concrete mix designs shall not result in additional costs to OWNER.

2.3 FORM MATERIALS

A. Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection. CONTRACTOR shall be responsible for designing the formwork system to resist all applied loads including pressures from fluid concrete and construction loads.

B. Smooth Form Surfaces: Acceptable panel-type to provide continuous, straight, smooth, as-cast surfaces in accordance with ACI 301.

C. Unexposed Concrete Surfaces: Material to suit project conditions.

D. Provide 3/4-inch chamfer at all external corners. Chamfer is not required at re-entrant corners unless otherwise shown or indicated.

E. Form Ties:
   1. Provide factory-fabricated, removable, or snap-off metal form ties, that prevent form deflection and prevent spalling of concrete surfaces upon removal. Materials used for tying forms are subject to approval of ENGINEER.
   2. Unless otherwise shown or indicated, provide ties so that portion remaining within concrete after removal of exterior parts is at least 1.5 inches from outer surface of concrete. Unless otherwise shown or indicated, provide form ties that, upon removal, will leave a uniform, circular hole not larger than one-inch diameter in the concrete surface.
   3. Ties for exterior walls, below-grade walls, and walls subject to hydrostatic pressure shall be provided with waterstops.
   4. Wire ties are unacceptable.

2.4 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed bars.

B. Welded Wire Fabric: ASTM A185/A185M.

C. Steel Wire: ASTM A82/A82M.

D. Provide supports for reinforcing including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing in place.
   1. Use wire bar-type supports complying with CRSI MSP1 recommendations, except as specified in this Section. Do not use wood, brick, or other unacceptable materials.

2. For slabs on grade, use precast concrete blocks, four inches square minimum with compressive strength equal to or greater than the surrounding concrete, or supports with sand plates or horizontal runners where base materials will not support chair legs.
3. For all concrete surfaces where legs of supports are in contact with forms, provide supports having either hot-dip galvanized, plastic-protected, or stainless steel legs in accordance with CRSI MSP1.
4. Provide precast concrete supports over waterproof membranes.

E. Adhesive Dowels:
1. Dowels:
a. Dowel reinforcing bars shall comply with ASTM A615, Grade 60.
2. Adhesive:
a. For requirements for adhesive, refer to Section 05 05 33, Anchor Systems.

2.5 RELATED MATERIALS

A. Membrane-Forming Curing Compound: ASTM C309, Type I.

B. Epoxy Bonding Agent:
1. Two-component epoxy resin bonding agent.
2. Products and Manufacturers: Provide one of the following:
a. Sikadur 32, Hi-Mod LPL, by Sika Corporation.
b. Eucopoxy LPL, by the Euclid Chemical Company.
c. Or equal.

C. Epoxy-Cement Bonding Agent:
1. Three-component blended epoxy resin-cement bonding agent.
2. Products and Manufacturers: Provide one of the following:
a. Sika Armatec 110 EpoCem, by Sika Corporation.
b. Duralprep A.C., by Euclid Chemical Company.
c. Or equal.

D. Preformed Expansion Joint Filler:
1. Provide preformed expansion joint filler complying with ASTM D1752, Type I (sponge rubber) or Type II (cork).

E. Exterior and Interior Vertical Joint Sealant; Non-submerged:
1. Two-component Polyurethane Sealant:
a. Products and Manufacturers: Provide one of the following:
1) Sikaflex- 2c NS by Sika Corporation.
2) Dymeric 240 FC by Tremco Sealant/Waterproofing Division of RPM International, Inc.
3) Or equal.

b. Polyurethane based, two-component elastomeric sealant complying with:
   1) FS TT-S-00227E: Type II (non-sag) Class A and ASTM C920, Type M, Grade NS, Class 25.
   2) Adhesion-in-Peel, FS TT-S-00227E and ASTM C794: (Minimum five pounds per linear inch with no adhesion failure): 10 pounds.
   3) Hardness (Standard Conditions), ASTM C661: 25 to 35 (Shore A).
   4) Stain and color change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
   5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
   6) Rheological Vertical Displacement at 120 degrees F, FS TT-S-00227E: No sag.
   7) VOC Content: 100 g/L, maximum.

F. Exterior and Interior Horizontal Joint Sealant; Non-submerged:
   1. Two-component Polyurethane Sealant:
      a. Products and Manufacturers: Provide one of the following:
         1) Sikaflex- 2c SL by Sika Corporation.
         2) THC/900 by Tremco Sealant/Waterproofing Division of RPM International, Inc.
         3) Or equal.
      b. Polyurethane based, two-component elastomeric, self-leveling sealant complying with the following:
         1) FS TT-S-00227E, Type I (self-leveling) Class A. and ASTM C920, Type M, Grade P, Class 25
         2) Water Immersion Bond, FS TT-S-00227E: Elongation of 50 percent with no adhesive failure.
         3) Hardness (Standard Conditions), ASTM C661: 35 to 45.
         4) Stain and Color Change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
         5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
         6) VOC Content: 165 g/L, maximum.

G. Miscellaneous Joint Sealant Materials:
   1. Joint Cleaner: As recommended by calking and sealant manufacturer.
   2. Joint Primer and Sealer: As recommended for compatibility with calking and sealant by calking and sealant manufacturer.
   3. Bond Breaker Type: Polyethylene tape or other plastic tape as recommended for compatibility with calking and sealant by calking and sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of calking and sealant. Provide self-adhesive tape where applicable.
   4. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other

flexible, permanent, durable nonabsorptive material as recommended for compatibility with calking and sealant by calking and sealant manufacturer. Provide size and shape of rod that will control joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide highly-compressible backer to minimize possibility of sealant extrusion when joint is compressed.

2.6 GROUT

A. Non-shrink Grout:
   1. Pre-packaged, non-metallic, cementitious grout requiring only the addition of water at the Site.
   2. Minimum 28-day Compressive Strength: 7,000 psi.
   3. Products and Manufacturers: Provide one of the following:
      a. NS Grout by Euclid Chemical Company.
      b. Set Grout by Master Builders, Inc.
      c. NBEC Grout by Five Star Products, Inc.
      d. Or equal.

B. Epoxy Grout:
   1. Pre-packaged, non-shrink, non-metallic, 100 percent solids, solvent-free, moisture-insensitive, three-component epoxy grouting system.
   2. Minimum Seven-day Compressive Strength: 14,000 psi, when tested in accordance with ASTM C579.
   3. Products and Manufacturers: Provide one of the following:
      a. Euco High Strength Grout, by Euclid Chemical Company.
      b. Sikadur 42, Grout Pak, by Sika Corporation.
      c. Five Star Epoxy Grout, by Five Star Products, Inc.
      d. Or equal.

C. Grout Fill:
   1. Grout mix shall consist of cement, fine and coarse aggregates, water, and admixtures complying with requirements specified in this Section for similar materials in concrete.
   2. Proportion and mix grout fill as follows:
      a. Minimum Cement Content: 564 pounds per cubic yard.
      b. Maximum Water-Cement Ratio: 0.45.
      c. Maximum Coarse Aggregate size: 1/2-inch, unless otherwise indicated.
      d. Minimum 28-day Compressive Strength: 4,000 psi.

PART 3 – EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the substrate and the conditions under which the Work will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 FORMWORK

A. Construct formwork in accordance with ACI 347 such that concrete members and structures are of correct size, shape, alignment, elevation, and position.

B. Provide openings in formwork to accommodate the Work of other trades. Accurately place and securely support items required to be built into formwork.

C. Clean and adjust forms prior to placing concrete. Apply form release agents or wet forms as required. Re-tighten forms during and after concrete placing, when required, to eliminate cement paste leaks.

D. Removing Formwork:
   1. Comply with ACI 301 and ACI 347, except as otherwise indicated in the Contract Documents.
   2. Do not remove formwork and shoring until supported concrete members have acquired minimum of 90 percent of specified compressive strength. Results of suitable quality control tests of field-cured specimens may be submitted to ENGINEER for review as evidence that concrete has attained sufficient strength for removal of supporting formwork and shoring prior to removal times indicated in the Contract Documents.
   3. Removal time for formwork is subject to ENGINEER's acceptance.
   4. Repair form tie-holes following in accordance with ACI 301.

3.3 REINFORCING, JOINTS, AND EMBEDDED ITEMS

A. Comply with the applicable recommendations of Laws and Regulations and standards referenced in this Section, including CRSI MSP1, for details and methods of placing and supporting reinforcing.

B. Clean reinforcing to remove loose rust and mill scale, earth, ice, and other materials which act to reduce or destroy bond between reinforcing material and concrete.

C. Position, support, and secure reinforcing against displacement during formwork construction and concrete placing. Locate and support reinforcing by means of metal chairs, runners, bolsters, spacers, and hangers, as required.

1. Place reinforcing to obtain minimum concrete coverages as shown on the Drawings and as required in ACI 318. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcing accurately in position during concrete placing. Set with ties so that twisted ends are directed away from exposed concrete surfaces.
2. Do not secure reinforcing to formwork using wire, nails or other ferrous metal. Metal supports subject to corrosion shall not be in contact with formed or exposed concrete surfaces.

D. Provide sufficient quantity of supports of strength required to carry reinforcing. Do not place reinforcing more than two inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

E. Splices: Provide standard reinforcing splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown or indicated for minimum lap of spliced bars, as shown on the Drawings.

F. Install welded wire fabric in lengths as long as practical, lapping adjoining sections a minimum of one full mesh.

G. Do not place concrete until reinforcing is inspected and ENGINEER indicates that conditions are acceptable for placing concrete. Concrete placed in violation of this paragraph will be rejected. Notify ENGINEER in writing at least two working days prior to proposed concrete placement.

H. Joints:
1. Provide construction, isolation, expansion, and control joints as indicated or required. Locate construction joints so as to not impair the strength and appearance of the structure. Place isolation and control joints in slabs-on-grade to stabilize differential settlement and random cracking.
2. In walls, locate joints at a maximum spacing of 40 feet and approximately 12 feet from corners.
3. In foundation slabs and slabs-on-grade, locate joints at intervals of approximately 40 feet.
4. In mats and structural slabs and beams, locate joints in compliance with ACI 224R.
5. Locations of joints shall be in accordance with the Contract Documents and as approved by ENGINEER in the Shop Drawings.
6. Where construction joints are indicated to be roughened, intentionally roughen surfaces of previously-placed concrete to amplitude of 1/4-inch.

I. Installation of Embedded Items: Set and build into the Work anchorage devices and embedded items required for other Work that is attached to, or supported by, cast-in-place concrete. Use setting diagrams, templates, and instructions provided under

other Sections and, when applicable, other contracts for locating and setting. Refer to Paragraph 1.1.B of this Section. Do not embed in concrete uncoated aluminum items. Where aluminum items are in contact with concrete surfaces, coat aluminum to prevent direct contact with concrete.

J. Adhesive Dowels:
   1. Adhesive dowels shall be reinforcing bar dowels set in an adhesive in hole drilled into hardened concrete. Comply with adhesive system manufacturer's installation instructions regarding hole diameter, drilling method, embedment depth required to fully develop required tensile strength, and hole cleaning and preparation instructions. Unless more-stringent standards are required by adhesive system manufacturer, comply with the following.
   2. Drill holes to adhesive system manufacturer's recommended diameter and depth to develop required tensile strength. Holes shall not be more than 1/4-inch greater than nominal bar diameter, and hole depth shall not be less than twelve times nominal bar diameter. Hammer-drill holes. Cored holes are not allowed.
   3. Embedment depths shall be based on concrete compressive strength of 2,000 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.
   4. Determine location of existing reinforcing steel in vicinity of proposed holes prior to drilling. Adjust location of holes to be drilled to avoid drilling through or damaging existing reinforcing bars only when approved by ENGINEER.
   5. Before setting adhesive dowel, hole shall be free of dust and debris using method recommended by adhesive system manufacturer. Hole shall be brushed, with manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
   6. Inject adhesive into hole through injection system mixing nozzle and necessary extension tubes, placed to bottom of hole. Withdraw discharge end as adhesive is placed, but keep end of tube immersed to prevent forming air pockets. Fill hole to depth that ensures that excess material is expelled from hole during dowel placement.
   7. Twist dowels during insertion into partially-filled hole to guarantee full wetting of bar surface with adhesive. Insert bar slowly to avoid developing air pockets.

3.4 CONCRETE PLACING

A. Site Mixing: Use drum-type batch machine mixer, mixing not less than 1.5 minutes for one cubic yard or smaller capacity. Increase required mixing time by minimum of 15 seconds for each additional cubic yard or fraction thereof.

B. Ready-Mixed Concrete: Comply with ASTM C94/C94M.

C. Concrete Placing:
   1. Place concrete in a continuous operation within planned joints or sections in accordance with ACI 304R.
   2. Do not begin placing concrete until work of other trades affecting concrete is completed.
   3. Wet concrete and subgrade surfaces to saturated surface dry condition immediately prior to placing concrete.
   4. Deposit concrete as near its final location as practical to avoid segregation due to re-handling or flowing.
   5. Avoid separation of the concrete mixture during transportation and placing. Concrete shall not free-fall for distance greater than four feet during placing.
   6. Complete concrete placing within 90 minutes of addition of water to the dry ingredients.

D. Consolidate placed concrete in accordance with ACI 309R using mechanical vibrating equipment supplemented with hand rodding and tamping, such that concrete is worked around placing and other embedded items and into all parts of formwork. Insert and withdraw vibrators vertically at uniformly-spaced locations. Do not use vibrators to transport concrete within the formwork. Vibration of formwork or placing is not allowed.

E. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing.
   1. In hot weather comply with ACI 305R.
   2. In cold weather comply with ACI 306R.

3.5 QUALITY OF CONCRETE WORK

A. Make concrete solid, compact, smooth, and free of laitance, cracks, and cold joints.

B. Concrete for liquid-retaining structures and concrete in contact with earth, water, or exposed directly to the elements shall be watertight.

C. Cut out and properly replace to extent directed by ENGINEER, or repair to satisfaction of ENGINEER, surfaces that contain cracks or voids, are unduly rough, or are in defective in any way. Patches or plastering are unacceptable.

D. Repair, removal and replacement of defective concrete directed by ENGINEER shall be at no additional cost to OWNER.

3.6 CURING

A. Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue curing by using moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until formwork is removed. Provide protection, as required, to prevent damage to exposed concrete surfaces. Total curing period shall not be less than seven days. Curing methods and materials shall be compatible with scheduled finishes.

3.7 FINISHING

A. Slab Finish:
   1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently. Use a wood float only. Check and level surface plane to a tolerance not exceeding 1/4-inch in ten feet when tested with a ten foot straightedge placed on the surface at not less than two different angles. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float the surface to a uniform, smooth, granular texture. Slab surfaces shall receive a float finish. Provide additional trowel finishing as required in this Section.
   2. After floating, begin first trowel finish operation using power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over the surface.
   3. Consolidate concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in ten feet when tested with a ten-foot straightedge. Grind smooth surface defects that would telegraph through applied floor covering system.
   4. Use trowel finish for the following:
      a. Interior exposed slabs, unless otherwise shown or indicated.
      b. Apply non-slip broom finish, after troweling, to exterior concrete slab and elsewhere as shown.

B. Formed Finish:
   1. Provide smooth form concrete finish at exposed surfaces. Use largest practical form panel sizes to minimize form joints. Exposed surfaces include interior water-contacting surfaces of tanks, whether or not directly visible. All surfaces shall be considered as exposed, unless buried or covered with permanent structural or architectural material. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/8-inch in

height. Where surface will be coated or will receive further treatment, remove all fins flush with concrete surface.

2. Provide rough form finish at all unexposed surfaces. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/2-inch in height.

C. Non-Slip Broom Finish:
   1. Immediately after float finishing, slightly roughen concrete surface by brooming in direction perpendicular to main traffic route. Use fine fiber-bristle broom, unless otherwise directed by ENGINEER. Coordinate required final finish with ENGINEER before applying finish.
   2. Use non-slip broom finish for the following:
      a. Exterior exposed horizontal surfaces subject to lightweight foot traffic.
      b. Interior and exterior concrete steps and ramps.
      c. Horizontal surfaces which will receive a grout topping or a concrete equipment base slab.

3.8 GROUT PLACING

A. Place grout as shown and indicated, and in accordance with grout manufacturer's instructions and recommendations. If grout manufacturer's instructions conflict with the Contract Documents, notify ENGINEER and not proceed until obtaining ENGINEER's clarification.

B. Dry-packing is not allowed, unless otherwise indicated.

C. Manufacturers of proprietary grout materials shall make available upon 72 hours notice the services of qualified, full-time, factory-trained employee to aid in ensuring proper use of grout materials at the Site.

D. Placing grout shall comply with temperature and weather limitations described in Article 3.4 of this Section.

3.9 FIELD QUALITY CONTROL

A. Site Testing Services:
   1. CONTRACTOR shall employ independent testing laboratory to perform field quality control testing for concrete. ENGINEER will direct where samples are obtained.
   2. Testing laboratory will provide all labor, material, and equipment required for sampling and testing concrete, including: scale, glass tray, cones, rods, molds, air tester, thermometer, and other incidentals required.
   3. CONTRACTOR shall provide a large, tightly-constructed, firmly-braced, insulated, storage boxes of wood or steel, each with capacity of not less than 15 concrete cylinders under conditions described in ASTM C31/C31M. Quantity,

size, and location shall be coordinated with ENGINEER and shall be as required to provide storage for specimens for each concrete placement.

B. Quality Control Testing During Construction:
   1. Perform sampling and testing for field quality control during concrete placing, as follows:
      a. Sampling Fresh Concrete: ASTM C172.
      b. Slump: ASTM C143/C143M; one test for each concrete load at point of discharge.
      c. Concrete Temperature: ASTM C1064/C1064M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed. Test each load when time from batching to placement exceeds 75 minutes.
      d. Air Content: ASTM C231; one for every two concrete load at point of discharge, and when a change in the concrete is observed.
      e. Unit Weight: ASTM C138/C138M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed.
      f. Compression Test Specimens:
         1) In accordance with ASTM C31/C31M, make one set of compression cylinders for each 50 cubic yards of concrete, or fraction thereof, of each mix design placed each day. Each set shall be four standard cylinders, unless otherwise directed by ENGINEER.
         2) Cast, store, and cure specimens in accordance with ASTM C31/C31M.
      g. Compressive Strength Tests:
         1) In accordance with ASTM C39/C39M; one specimen tested at seven days, and three specimens tested at 28 days.
         2) Concrete that does not comply with strength requirements will be considered as defective Work.
      h. Submit test results from certified by testing laboratory to ENGINEER within 24 hours of completion of test.
      i. When there is evidence that strength of in-place concrete does not comply with the Contract Documents, CONTRACTOR shall employ the services of concrete testing laboratory to obtain cores from hardened concrete for compressive strength determination. Cores and tests shall comply with ASTM C42/C42M and the following:
         1) Testing of Adhesive Dowels: CONTRACTOR will employ testing agency to perform field quality control testing of drilled dowel installations. After adhesive system manufacturer's recommended curing period and prior to placing connecting reinforcing, proof-test for pullout ten percent of adhesive dowels installed. Adhesive dowels shall be tensioned to 60 percent of specified yield strength. Where dowels are located less than six bar diameters from edge of concrete, ENGINEER will determine tensile load required for test. If one or

more dowels fail, retest all dowels installed for the Work. Dowels that fail shall be reinstalled and retested at CONTRACTOR's expense.

+ + END OF SECTION + +

SECTION 05 05 33

ANCHOR SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install anchor systems.
   2. This Section includes all anchor systems required for the Work, but not specified under other Sections.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before anchor systems Work.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ACI 318, Building Code Requirements for Structural Concrete.
   2. ACI 350, Code Requirements for Environmental Engineering Concrete Structures.
   3. ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
   4. ANSI B212.15, Cutting Tools - Carbide-tipped Masonry Drills And Blanks For Carbide-tipped Masonry Drills.
   5. ANSI/MSS SP-58, Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation.
   6. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   7. ASTM A276, Specification for Stainless Steel Bars and Shapes.
   8. ASTM A493, Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
   9. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
   10. ASTM A1011/A1011M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
   11. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
   12. ASTM C307, Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings.

13. ASTM C881/C881M, Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
14. ASTM D695, Test Method for Compressive Properties of Rigid Plastics.
15. ASTM D790, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
16. ASTM E329, Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
17. ASTM E488, Test Methods for Strength of Anchors in Concrete and Masonry Elements.
18. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
19. ASTM F594, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
20. ASTM F1554, Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
21. FS A-A-1922A, Shield, Expansion (Caulking Anchors, Single Lead).
22. FS A-A-1923A, Concrete Expansion Anchors.
23. FS A-A-1925A, Shield, Expansion (Nail Anchors).
24. FS A-A-55614, Shield, Expansion (non-drilling expansion anchors).
25. ICC-ES AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.
26. ICC-ES AC58, Acceptance Criteria for Adhesive Anchors in Masonry Elements.
27. ICC-ES AC60, Acceptance Criteria for Anchors in Unreinforced Masonry Elements.
28. ICC-ES AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
29. ICC-ES AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
30. ISO 3506-1, Mechanical Properties of Corrosion-Resistant Stainless Steel Fasteners -- Part 1: Bolts, Screws and Studs.
31. NSF/ANSI 61, Drinking Water System Components – Health Effects.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Testing Laboratory: Shall comply with ASTM E329 and shall be experienced in tension testing of post-installed anchoring systems.
   2. Post-installed Anchor Installer: Shall be experienced and trained by post-installed anchor system manufacturer in proper installation of manufacturer's products. Product installation training by distributors or manufacturer's representatives is unacceptable unless the person furnishing the training is qualified as a trainer by the anchor manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Listing of all anchor systems products intended for use in the Work including product type, intended location in the Project, and embedded lengths.
   2. Product Data:
      a. Manufacturer's specifications, load tables, dimension diagrams, acceptable base material conditions, acceptable drilling methods, and acceptable bored hole conditions.
      b. When required by ENGINEER, copies of valid ICC ES reports that presents load-carrying capacities and installation requirements for anchor systems.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. For each type of anchor bolt or threaded rod, submit copies of laboratory test reports and other data required to demonstrate compliance with the Contract Documents.
      b. Post-installed anchor system manufacturer's certification that installer received training in the proper installation of manufacturer's products required for the Work.
   2. Manufacturer's Instructions:
      a. Installation instructions for each anchor system product proposed for use, including bore hole cleaning procedures and adhesive injection, cure and gel time tables, and temperature ranges (storage, installation and in-service).
   3. Field Quality Control Submittals:
      a. Submit results of field quality control testing and inspections performed by testing laboratory.

1.5 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection:
   1. Keep materials dry during delivery and storage.
   2. Store adhesive materials within manufacturer's recommended storage temperature range.
   3. Protect anchor systems from damage at the Site. Protect products from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. General:
   1. At locations where conditions dictate that Work specified in other Sections is to be of corrosion resistant materials, provide associated anchor systems

of stainless steel materials, unless other corrosion-resistant anchor system material is specified. Provide anchor systems of stainless steel materials where stainless steel materials are required in the Contract Documents.

2. Stainless Steel Nuts:
   a. For anchor bolts and adhesive anchors, provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts for stainless steel anchors used for anchoring equipment, gates, and weirs, and other locations, if any, where the attachment will require future removal for operation or maintenance. Provide lock washer or double nuts on each anchorage device provided for equipment, as required by equipment manufacturer.
   b. For other locations, provide for each anchorage device a nut as specified or as required by anchor manufacturer. When ASTM A194/A194M, Grade 8S (Nitronic 60) nuts are not required for anchor bolts and adhesive anchors as specified in this Section, provide anti-seizing compound where stainless steel rods are used with stainless steel nuts of the same type.
3. Materials that can contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.

B. Design Criteria
   1. Size, Length, and Load-carrying Capacity: Comply with the Contract Documents. When size, length or load-carrying capacity of anchor system is not otherwise shown or indicated, provide the following:
      a. Anchor Bolts: Provide size, length, and capacity required to carry design load based on values and requirements of Paragraph 3.2.A of this Section. For conditions outside limits of critical edge distance and spacing in Paragraph 3.2.A of this Section, minimum anchor bolt embedment as shown or indicated in Paragraph 3.2.A of this Section apply and capacity shall be based on requirements of Laws and Regulations, including applicable building codes.
      b. Adhesive Anchors, Expansion Anchors, or Concrete Inserts: Provide size, length, type, and capacity required to carry design load. Anchor capacity shall be based on the procedures required by the building code in effect at the Site. Where Evaluation Service Reports issued by the ICC Evaluation Service are required in this Section, anchor capacities shall be based on design procedure required in the applicable ICC Evaluation Service Report.
         1) General: Determine capacity considering reductions due to installation and inspection procedures, embedment length, strength of base fastening materials, spacing, and edge distance, as indicated in the manufacturer's design guidelines. For capacity determination, concrete shall be assumed to be in the cracked condition, unless calculations demonstrate that the anchor system will be installed in an area that is not expected to crack under any and all conditions of design loading.

2) Concrete Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of the greater of the following: required to develop tensile strength of anchor, or a minimum embedment of 10 anchor diameters; and minimum anchor spacing and edge distance of 12 anchor diameters.
3) Concrete Masonry Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.
4) Concrete Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of six anchor diameters, and minimum anchor spacing and edge distance of seven anchor diameters.
5) Concrete Masonry Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.
6) Concrete Undercut Anchors: Unless otherwise shown or indicated in the Contract Documents, or approved by ENGINEER, provide minimum anchor spacing and edge distance as tabulated in anchor manufacturer's instructions.

2. Design Loads. Comply with the Contract Documents. When design load of supported material, equipment, or system is not otherwise shown or indicated, provide the following:
   a. Equipment Anchors: Use design load recommended by equipment manufacturer. When equipment can be filled with fluid, use loads that incorporate equipment load and load imposed by fluid.
   b. Pipe Hangers and Supports: Use full weight of pipe, and fluid contained in pipe that are tributary to the support plus the full weight of valves and accessories located between the hanger or support being anchored and the next hanger or support.
   c. Hangers and Supports for Electrical Systems, and HVAC, Plumbing, and Fire Suppression Systems and Piping: Use the full weight of supported system that is tributary to the support plus the full weight of accessories located between the hanger or support being anchored and the next hanger or support. When piping or equipment is to be filled with fluid, anchor systems shall be sized to support such loads in addition to the weight of the equipment, piping, or system, as applicable.
   d. Delegated Design: When anchor systems are used for supporting materials, equipment, or systems delegated to a design professional retained by CONTRACTOR, Subcontractor, or Supplier, provide anchor system suitable for loads indicated in delegated design documents and consistent with the design intent expressed in the Contract Documents.

C. Application:
   1. Anchor Bolts:
      a. Where anchor bolt is shown or indicated, use cast-in-place anchor bolt unless another anchor type is approved by ENGINEER.
      b. Provide anchor bolts as shown or indicated, or as required to secure structural element to appropriate anchor surface.
   2. Concrete Adhesive Anchors:
      a. Use where adhesive anchors are shown or indicated for installation in concrete.
      b. Suitable for use where subject to vibration.
      c. Suitable for use in exterior locations or locations subject to freezing.
      d. Suitable for use in submerged, intermittently submerged, or buried locations.
      e. Do not use in overhead applications, unless otherwise shown or approved by ENGINEER.
      f. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.
   3. Concrete Masonry Adhesive Anchors:
      a. Use where adhesive anchors are shown or indicated for installation in grout-filled or hollow masonry units.
      b. Suitable for use where subject to vibration.
      c. Suitable for use in exterior locations or locations subject to freezing.
      d. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.
   4. Concrete Wedge Expansion Anchors:
      a. Use where expansion anchors are shown or indicated for installation in concrete.
      b. Do not use where subject to vibration.
      c. Do not use in exterior locations or locations subject to freezing.
      d. Do not use in submerged, intermittently submerged, or buried locations.
      e. Suitable for use in overhead applications.
   5. Grout-filled Concrete Masonry Wedge Expansion Anchors:
      a. Use where expansion anchors are shown or indicated for installation on the interior face of grout-filled unit masonry.
      b. Do not use where subject to vibration.
      c. Do not use in exterior locations or locations subject to freezing.
   6. Hollow Concrete Masonry Sleeve Expansion Anchors:
      a. Use where expansion anchors are shown or indicated for installation in hollow concrete unit masonry or solid brick.
      b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
      c. Do not use where subject to vibration.
      d. Do not use in exterior locations or locations subject to freezing.

7. Drop-in Expansion Anchors:
    a. Use drop-in expansion anchors installed in concrete where light-duty anchors are required to support piping or conduit two-inch diameter or smaller.
    b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
    c. Do not use where subject to vibration.
    d. Do not use at submerged, intermittently submerged, or buried locations.
    e. Do not use in exterior locations or locations subject to freezing.
    f. Suitable for use in overhead applications.
8. Concrete Undercut Anchors:
    a. Use where undercut anchors are shown or indicated for installation in concrete.
    b. Suitable for use where subject to vibration.
    c. Do not use in submerged, intermittently submerged, or buried locations.
    d. Do not use in exterior locations or locations subject to freezing.
    e. Suitable for use in overhead applications.
9. Concrete Inserts:
    a. Use only where shown or indicated in the Contract Documents.
    b. Allowed for use to support pipe hangers and pipe supports for pipe size and loading recommended by the concrete insert manufacturer.
10. Drive-In Expansion Anchors:
    a. Use drive-in expansion anchors installed in concrete, precast concrete, grouted masonry units, or brick, where light-duty anchors are required to support piping or conduit one-inch diameter and smaller.
    b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
    c. Do not use in overhead applications.
11. For Use in Precast Concrete Planks:
    a. To support piping or conduit six-inch diameter and smaller, use low-profile drop-in anchors, hollow concrete masonry adhesive anchors, or through-bolts.
    b. For piping greater than six-inch diameter, or to support safety-related systems, use through-bolts. Each through-bolt shall consist of threaded rod, nuts, washers, and bearing plate.

2.2 MATERIALS

A. Anchor Bolts:
    1. Interior Dry Non-corrosive Locations: Provide straight threaded carbon steel rods complying with ASTM F1554, Grade 36, with heavy hex nuts

complying with ASTM A563 Grade 36, unless otherwise shown or indicated on the Drawings. Hooked anchor bolts are unacceptable.

2. Exterior, Buried, Submerged Locations, or When Exposed to Wastewater: Provide stainless steel straight threaded rods complying with ASTM F593, AISI Type 316, Condition A, with ASTM F594, AISI Type 316, stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required. Other AISI types may be used when approved by ENGINEER. Hooked bolts are unacceptable.
3. Equipment: Provide anchor bolts complying with material requirements of this Section and equipment manufacturer's requirements relative to size, embedment length, and anchor bolt projection. Anchor bolts shall be straight threaded rods with washers and nuts as specified in this Section. Hooked bolts are unacceptable.
4. Anchoring of Structural Elements: Provide anchor bolts of size, material, and strength shown or indicated in the Contract Documents.

B. Concrete Adhesive Anchors:
   1. General:
      a. Adhesive anchors shall consist of threaded rods anchored into hardened concrete using an adhesive system.
   2. Products and Manufacturers: Provide one of the following:
      a. HIT-RE 500-V3 Injection Epoxy Adhesive Anchoring System, by Hilti Fastening Systems, Inc.
      b. HIT-HY 200-A and HIT-HY 200-R Adhesive Anchoring System, by Hilti Fastening Systems, Inc
      c. SET-XP Adhesive anchoring system, by Simpson Strong-Tie Company, Inc.
      d. Or equal.
   3. Adhesive:
      a. Adhesive system shall use two-component adhesive mix.
      b. Adhesives shall have a current evaluation report by ICC Evaluation Service for use in both cracked and uncracked concrete with seismic recognition for SDC A through F as tested and assessed in accordance with ICC-ES AC308, which incorporates the requirements of ACI 355.4-11
      d. Adhesives shall have minimum bond strength and minimum design bond strength in accordance with Table 05 05 33-A:

TABLE 05 05 33-A:
ADHESIVE BOND STRENGTH [1,2]

Bond Strength (psi)					
Rod Diameter	**Uncracked Concrete**	**Cracked Concrete**	**Dowel Size**	**Uncracked Concrete**	**Cracked Concrete**
1/2-inch	1670	880	#4	1500	1080
5/8-inch	1670	750	#5	1460	1090
3/4-inch	1670	665	#6	1415	1015

7/8inch	1525	610	#7	1370	835
1-inch	1360	595	#8	1330	760
-	-	-	#9	1560	850
1.25-inch	1070	595	#10	1240	475

Table Notes:
1. Bond strengths listed for hammer-drilled, dry hole.
2. Bond strengths listed for maximum short term concrete temperature of 130 degrees F and maximum long term concrete temperature of 110 degrees F.

4. Anchor:
   a. Provide continuously-threaded, AISI Type 316 stainless steel adhesive anchor rod. Threaded rods shall comply with the concrete adhesive anchor manufacturer's specifications as included in the ICC Service Evaluation Report for the anchor submitted. Nuts shall have specified proof load stresses equal to or greater than the minimum tensile strength of the stainless steel threaded rod used. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.

C. Concrete Masonry Adhesive Anchors:
   1. General:
      a. Grout-filled concrete masonry adhesive anchors shall consist of threaded rods anchored into grout-filled concrete block masonry using an adhesive system.
      b. Hollow concrete masonry adhesive anchors shall consist of threaded rods with a cylindrical mesh steel or plastic screen tube anchored into hollow concrete block masonry using an adhesive system.
   2. Products and Manufacturers: Provide one of the following:
      a. HIT-HY 70 Hybrid Adhesive Anchor System, by Hilti Fastening Systems, Inc.
      b. Acrylic-Tie Adhesive, by Simpson Strong-Tie Company, Inc.
      c. Or equal.
   3. Adhesive:
      a. Adhesive system shall use two-component adhesive mix.

      b. Hybrid adhesives shall comply with the following:
         1) ASTM D695 compressive yield strength greater than 7,200 psi on a seven-day cure.
      c. Adhesives shall have current ICC Evaluation Service Report for use in grout-filled concrete masonry, tested and assessed in accordance with ICC-ES AC 58 and ICC-ES AC 60.
   4. Anchor:
      a. Provide stainless steel adhesive anchor rod complying with ASTM F593, AISI Type 316, Condition CW, with ASTM F594, AISI Type 316 stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.

5. Mesh Screen Tube (for hollow masonry applications):
    a. Provide with mesh size, length, and diameter as specified by adhesive anchor manufacturer.

D. Concrete Wedge Expansion Anchors:
1. General:
    a. Concrete wedge expansion anchors shall consist of stud, wedge, nut, and washer.
2. Products and Manufacturers: Provide one of the following:
    a. Kwik Bolt TZ Wedge Anchor, by Hilti Fastening Systems, Inc.
    b. Strong Bolt 2 Wedge Anchor, by Simpson Strong-Tie Company, Inc.
    c. Or equal.
3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4. Provide concrete wedge expansion anchors suitable for use in cracked and uncracked concrete in accordance with ACI 318 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete wedge anchors in accordance with ACI 355.2 prequalification tests.
4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
5. Other Locations: Provide expansion anchors complete with nuts and washers, AISI Type 304 stainless steel anchor body, in accordance with ASTM A276 or ASTM A493.
7. Concrete wedge expansion anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete with seismic recognition in seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.

G. Drop-in Expansion Anchors:
1. General:
    a. Drop-in expansion anchors shall each consist of an internally threaded, deformation-controlled expansion anchor with pre-assembled expander plug.
2. Products and Manufacturers: Provide one of the following:
    a. HDI Drop-In Anchors, by Hilti Fastening Systems, Inc.
    b. Drop-In Anchor, by Simpson Strong-Tie Company, Inc.
    c. Or equal.
3. Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633, complying with physical requirements of FS A-A-55614, Type I. Anchors shall be flush or shell type. Provide low-profile anchors for use in precast concrete planks.

I. Concrete Inserts:
1. Manufacturers: Provide products of one of the following:
    a. Unistrut Corporation.
    b. Cooper B-Line, Inc.

c. Anvil International, Inc.
d. Or equal.

2. Spot Concrete Inserts:
   a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall comply with ANSI/MSS SP-58, malleable iron, Type 18. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Provide nuts compatible with insert and to suit threaded hanger rod sizes.
3. Continuous Concrete Inserts:
   a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall be continuous type and shall be manufactured from minimum 12-gage cold-formed channel sections, complying with ASTM A1011/A1011M, stainless steel, Grade 33, complete with styrofoam inserts, end caps, and means for attaching to forms. Provide channel nuts compatible with insert suitable for threaded hanger rod sizes.
4. Provide inserts with plain finish.

J. Drive-In Expansion Anchors:
1. General:
   a. Drive-In expansion anchors shall each consist of stainless steel drive pin and expanding alloy body.
2. Products and Manufacturers: Provide one of the following:
   a. Metal HIT Anchor, by Hilti Fastening Systems, Inc.
   b. Zinc Nailon Anchor, by Simpson Strong-Tie Company, Inc.
   c. Or equal.
3. Provide Type 304 stainless steel drive pin with zinc alloy body. Anchor shall comply with physical requirements of FS A-A-1925A, Type 1.

K. Unless approved by ENGINEER, do not use power-actuated fasteners or other types of bolts and fasteners not specified in this Section.

L. Anti-Seizing Compound:
1. Products and Manufacturers: Provide one of the following:
   a. Pure Nickel Never-Seez, by Bostik.
   b. Nickel-Graf, by Anti-Seize Technology.
   c. Or equal.
2. Provide pure nickel anti-seizing compound.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which materials will be installed and advise ENGINEER in writing of conditions detrimental to proper and timely completion

of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Anchor Bolts:
1. Provide anchor bolts as shown or indicated in the Contract Documents, or as required to secure structural element to the appropriate anchor surface.
2. Locate and accurately set anchor bolts using templates or other devices as required, prior to placing concrete. Wet setting of anchor bolts is unacceptable.
3. Protect threads and shank from damage during installation and subsequent construction operations.
4. Unless otherwise shown or approved by ENGINEER anchor bolts shall comply with Table 05 05 33-B:

TABLE 05 05 33-B:
SINGLE ANCHOR ALLOWABLE LOADS ON ANCHOR BOLTS [1]

Bolt Diameter (inch)	F1554 Grade 36 F593 Type 316, Condition A				F1554 Grade 55			
	Minimum Embedment (inch)	Minimum Edge Distance and Spacing[2] (inch)	Shear[3,4] (lb)	Tension[3] (lb)	Minimum Embedment (inch)	Minimum Edge Distance and Spacing[2] (inch)	Shear[3] (lb)	Tension[3] (lb)
1/2	6	9	1,262	2,420	8.5	12.75	1,660	3,190
5/8	7.5	11.25	2,010	3,860	10.5	15.75	2,640	5,080
3/4	9	13.5	2,974	5,720	13	19.5	3,910	7,520
7/8	10.5	15.75	4,106	7,890	15	22.5	5,400	10,390
1	12	18	5,386	10,360	17	25.5	7,090	13,450
1 1/8	13.5	20.25	6,787	13,052	19	28.5	8,930	16,580
1 1/4	15	22.5	8,617	16,572	21	31.5	11,340	20,040

Table Notes:
1. Table is based on ACI 318 and ACI 350, Appendix D, f'_c = 4000 psi. Table 05 05 33-B is not applicable to anchor bolts embedded in grouted masonry.
2. Critical edge distance and spacing are indicated in the table. Capacity of anchor bolts for other combination of edge distances and spacing shall be evaluated in accordance with ACI 318 and ACI 350, Appendix D.
3. Values for shear and tension listed are not considered to act concurrently. Interaction of tension and shear will be evaluated by ENGINEER in accordance with ACI 318 and ACI 350, Appendix D.

B. Adhesive Anchors, Undercut Anchors, and Expansion Anchors – General:

1. Prior to drilling, locate existing reinforcing steel in vicinity of proposed holes. If reinforcing conflicts with proposed hole location, obtain ENGINEER's approval of alternate hole locations to avoid drilling through or damaging existing reinforcing bars.

C. Adhesive Anchors:
   1. Comply with manufacturer's written installation instructions and the following.
   2. Drill holes to adhesive system manufacturer's recommended drill bit diameter to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits that comply with the tolerances of ANSI B212.15. Core-drilled holes are unacceptable.
   3. Before setting adhesive anchor, hole shall be made free of dust and debris by method recommended by adhesive anchor system manufacturer. Hole shall be brushed with adhesive system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
   4. Before injecting adhesive, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.
   5. Prior to injecting adhesive into the drilled hole, dispense, to a location appropriate for such waste, an initial amount of adhesive from the mixing nozzle, until adhesive is uniform color.
   6. Inject adhesive into hole through injection system-mixing nozzle and necessary extension tubes, placed to bottom of hole. Discharge end shall be withdrawn as adhesive is placed but kept immersed to prevent formation of air pockets. Fill hole to depth that ensures that excess material is expelled from hole during anchor placement.
   7. Twist anchors during insertion into partially-filled hole to guarantee full wetting of rod surface with adhesive. Insert rod slowly to avoid developing air pockets.
   8. Provide adequate curing in accordance to adhesive system manufacturer's requirements prior to continuing with adjoining Work that could place load on installed adhesive anchors. Do not begin adjoining Work until adhesive anchors are successfully tested or when allowed by ENGINEER.
   9. Limitations:
      a. At time of anchor installation, concrete shall have compressive strength (f'c) of not less than 2,500 psi.
      b. At time of anchor installation, concrete shall have age of not less than 21 days.
      c. Installation Temperature: Comply with manufacturer's instructions for installation temperature requirements. Provide temporary protection and other measures, such as heated enclosures, necessary to ensure that base material temperature complies with anchor systems manufacturer's requirements during installation and curing of adhesive anchor system.

d. Oversized Holes: Advise ENGINEER immediately if size of drilled hole is larger than recommended by anchor system manufacturer. Cost of corrective measures, including but not limited to redesign of anchors due to decreased anchor capacities, shall be paid by CONTRACTOR.
e. Embedment depths shall be based on installation in normal-weight concrete with compressive strength of 2,500 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.

D. Expansion Anchors:
1. Comply with expansion anchor manufacturer's written installation instructions and the following:
2. Drill holes using anchor system manufacturer's recommended drill bit diameter and to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits complying with tolerances of ANSI B212.15. Core drilled holes are unacceptable.
3. Before installing anchor, hole shall be made free of dust and debris by method recommended by anchor system manufacturer. Hole shall be brushed with anchor system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.
4. Before installing anchor, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.
5. Protect threads from damage during anchor installation. Drive anchors not less than four threads below surface of the attachment. Set anchors to anchor manufacturer's recommended torque using a torque wrench.

E. Concrete Undercut Anchors:
1. Comply with undercut anchor manufacturer's written installation instructions and the following.
2. Protect threads from damage during anchor installation.
3. Drill hole to anchor manufacturer's specified depth and diameter using a drill bit matched to the specific anchor.
4. Before setting the undercut anchor, hole shall be free of dust and debris using method recommended by undercut anchor system manufacturer. Hole shall be blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.
5. Insert the anchor by hand until anchor reaches bottom of hole.
6. Set anchor in accordance with manufacturer's instructions using anchor manufacturer's specified setting tool.
7. Verify that the setting mark is visible on the threaded rod above the sleeve.
8. Anchor shall be set to manufacturer's recommended torque, using a torque wrench.

F. Concrete Inserts:
1. Comply with concrete insert manufacturer's installation instructions.

2. Inserts shall be flush with slab bottom surface.
3. Protect embedded items from damage during concrete placing. Ensure that embedded items are securely fastened to prevent movement during concrete placing, and ensure that embedded items do fill with concrete during concrete placing.
4. Inserts intended for piping greater than four-inch diameter shall be provided with hooked rods attached to concrete reinforcing.

G. Anti-Seizing Compound:
1. Provide anti-seizing compound in accordance with anti-seizing compound manufacturer's installation instructions, at locations indicated in Paragraph 2.1.B of this Section.
2. Do not use anti-seizing compound at locations where anchor bolt or adhesive anchor will contact potable water or water that will be treated to become potable.

3.3 CLEANING

A. After embedding concrete is placed, remove protection and clean bolts and inserts.

3.4 FIELD QUALITY CONTROL

A. Site Tests:
1. Furnish services of independent testing laboratory to perform field quality tensile testing of production adhesive anchors at the Site, unless otherwise specified.
   a. Testing shall comply with ASTM E488.
   b. Test at least ten percent of all types of adhesive anchors. If one or more adhesive anchors fail the test, CONTRACTOR shall pay cost of testing, or at ENGINEER's option CONTRACTOR may arrange for testing paid by CONTRACTOR, for all adhesive anchors of same diameter and type installed on the same day as the failed anchor. If anchors installed on the same day as the failed anchor also fail the test, ENGINEER may require retesting of all anchors of the same diameter and type installed in the Work. CONTRACTOR shall be responsible for retesting costs.
   c. ENGINEER will direct which adhesive anchors are to be tested and indicate test load to be used
   d. Apply test loads with hydraulic ram.
   e. Displacement of post-installed anchors shall not exceed D/10, where D is nominal diameter of anchor being tested.
2. Correct defective Work by removing and replacing or correcting, as directed by ENGINEER.

3. CONTRACTOR shall pay for all corrections and subsequent testing required to confirm competence in the installation of post-installed mechanical anchors.
4. Testing agency shall submit test results to CONTRACTOR and ENGINEER within 24 hours of completion of test.

B. Manufacturer's Services:
1. Provide at the Site services of qualified adhesive manufacturer's representative during initial installation of adhesive anchor systems to train CONTRACTOR's personnel in proper installation procedures. Manufacturer's representative shall observe to confirm that installer demonstrates proper installation procedures for adhesive anchors and adhesive material.

+ + END OF SECTION + +

SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish miscellaneous metal fabrications including surface preparation and shop priming.
   2. The Work also includes:
      a. Providing openings in miscellaneous metal fabrications to accom-modate the Work under this and other Sections, and attaching to miscellaneous metal fabrications all items such as sleeves, bands, studs, fasteners, and all items required for which provision is not specifically included under other Sections.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the Work to be installed with, or attached to miscellaneous metal fabrications Work.
   2. Hot-dip Galvanizing: Coordinate with steel fabricator detailing for and fabrication of assemblies to be hot-dip galvanized, to minimize distortion during galvanizing process.

C. Related Sections:
   1. Section 05 05 33, Anchor Systems.
   2. Section 09 91 00, Painting,

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI A14.3, Ladders – Fixed –Safety Requirements.
   2. ANSI Z359.1, Safety Requirements for Personal Fall Arrest Systems, Subsystems, and Components.
   3. ASTM A36/A36M, Specification for Carbon Structural Steel.
   4. ASTM A53/A53M, Specification for Pipe Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   5. ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   6. ASTM A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

7. ASTM A240/A240M, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
8. ASTM A320/A320M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.
9. ASTM A384/A384M-02 Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
10. ASTM A500, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
11. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
12. ASTM A793, Specification for Rolled Floor Plate, Stainless Steel.
13. ASTM A992/A992M, Specification for Structural Steel Shapes.
14. ASTM B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
15. ASTM B211, Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.
16. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
17. ASTM B308/B308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
18. ASTM B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
19. ASTM B632/B632M, Specification for Aluminum-Alloy Rolled Tread Plate.
20. AWS D1.1/D1.1M, Structural Welding Code – Steel.
21. AWS D1.2/D1.2M, Structural Welding Code – Aluminum.
22. AWS D1.6, Structural Welding Code – Stainless Steel.
23. NAAMM, Metal Finishes Manual.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Welding:
      a. Qualify welding processes and welding operators in accordance with AWS D1.1/D1.1M, D1.2/D1.2M, or D1.6, as applicable.
      b. When requested by ENGINEER, provide certification that each welder employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.

B. Regulatory Requirements: Conform to the following:
   1. 29 CFR 1910, Occupational Health and Safety Standards.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Fabrication and erection details for assemblies of miscellaneous metal Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Include setting drawings and templates for locating and installing miscellaneous metal items and anchorage devices.
   2. Product Data:
      a. Copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal Work.

B. Informational Submittals: Submit the following:
   1. Test and Evaluation Reports:
      a. Mill test report that indicate chemical and physical properties of each type of material, when requested by ENGINEER.
   2. Qualifications Statements:
      a. Copies of welder's certifications, when requested by ENGINEER.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in other construction in ample time to prevent delaying the Work.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Steel:
   1. W-Shapes and WT-Shapes: ASTM A992/A992M.
   2. S-Shapes and Channels: ASTM A572/A572M, Grade 50.
   3. Hollow Structural Sections: ASTM A500, Grade B.
   4. Angles, Plates, Bars: ASTM A36/A36M.
   5. Steel Pipe: ASTM A53/A53M, Grade B.

B. Aluminum:
   1. Aluminum Shapes: ASTM B308/B308M, Alloy 6061-T6, ASTM B 221, Alloy 6061-T6.
   2. Aluminum Tubes and Pipes: ASTM B429, Alloy 6061-T6.
   3. Aluminum Bars and Rod: ASTM B211, Alloy 6061-T6.

4. Aluminum Plates: ASTM B209, Alloy 6061-T6.

C. Stainless Steel:
   1. Plates and Sheets: ASTM A240/A240M, Type 304L or Type 316 stainless steel.
   2. Submerged or Intermittently Submerged: Type 316 stainless steel.
   3. Non-submerged: Type 304L stainless steel.

D. Stainless Steel Fasteners and Fittings: ASTM A 320/A 320M, Type 304L or Type 316 Stainless Steel.

E. Zinc-coated Hardware: ASTM A153/A153M.

2.2 MISCELLANEOUS METAL ITEMS

A. Shop Assembly:
   1. Pre-assemble items in the shop to the greatest extent possible to minimize field-splicing and field-assembly of units at the Site. Disassemble units only to extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Aluminum Ladders:
   1. Fabricate ladders for locations shown or indicated with dimensions, spacing, details, and anchorages as shown and specified. Comply with OSHA 29 CFR 1910 and ANSI A14.3, except as otherwise shown or specified.
      a. Unless otherwise shown, provide 1.5-inch diameter continuous side rails, spaced at least 1.5 feet apart.
      b. Provide extruded square rungs, spaced maximum of 12 inches on centers, with non-slip surface on top of each rung. Adhesive strips for non-slip surfaces are not acceptable.
   2. Fit rungs in centerline of side rails, plug weld, and grind smooth on outer rail faces.
   3. Support each ladder at top and bottom and at intermediate points spaced not more than five feet on centers.
   4. Use welded or bolted brackets, designed for adequate support and anchorage, and to hold ladder clear of wall surface with minimum of seven inches between wall and centerline of rungs.
   5. Unless otherwise shown or approved by ENGINEER, extend rails 3.5 feet above top rung, and return rails to wall or structure, unless other secure handholds are provided. If adjacent structure does not extend above top rung, goose-neck extended rails back to structure to provide secure ladder access.
   6. Use extruded aluminum conforming to alloy and temper 6061-T6.

C. Aluminum Stair Nosings:
   1. Manufacturers: Provide products of one of the following:

a. Supergrit Type 241BF by Wooster Products, Inc.
b. Or equal.

2. Fabricate extruded aluminum nosing of sizes and configurations as shown on the Drawings.
   a. Unless otherwise shown, provide ribbed abrasive filled type, using black abrasive filler.
3. Provide anchors for embedding in concrete, either integral or applied to treads, as standard with manufacturer.

D. Fall Prevention System:
1. Provide each ladder with a fall prevention system complying with 29 CFR 1910, ANSI A14.3, and ANSI Z359.1.
2. System shall consist of a carrier rail securely and permanently attached to ladder, over which travels a sleeve to which harness belt can be attached.
3. Products and Manufacturers: Provide products of one of the following:
   a. Saf-T-Climb by North Safety Products.
   b. Or equal.
4. Rail:
   a. Notched at six-inch intervals and constructed of galvanized steel.
   b. Provide ladder attachments/rail mounting brackets of same material as rail, and as required by Supplier.
   c. For all ladders, include provisions to secure safety sleeve to carrier rail at top of vertical ladder so that sleeve will not slide down rail when safety belt is unsnapped.
   d. Ladders Below Hatches: Rail for ladder shall extend from bottom of ladder to top of ladder. Provide telescoping safety post as specified in this Article.
   e. Ladders Not Below Hatches: Rail for ladder shall extend from bottom of ladder to above horizontal landing or roof at top of ladder, Provide removable extension section at top of ladder. Arrange rail to allow climber to land on landing or roof without unsnapping climber's safety harness
5. Accessories: Provide with each ladder the following, all furnished by fall prevention system Supplier:
   a. One safety sleeve compatible for use with the rail. Sleeve shall be cast bronze with five zinc-plated steel roller bearings. Sleeve shall travel smoothly on straight or curved rail.
   b. One safety harness that attaches to sleeve. Harness shall be of woven, high-strength nylon, with padded straps and forged steel buckles and rings. Harness shall distribute impact forces of a fall over climber's thighs, buttocks, chest, and shoulders.
   c. One shock-adsorbing Y-lanyard no longer than six feet, complying with ANSI Z359.1. Lanyard shall be 5/8-inch diameter nylon rope with double-locking snap hooks at each end.

E. Safety Post:
   1. Provide safety post for each fixed access ladder located below an access hatch. Safety post shall be manufactured of high-strength structural material with telescoping tubular section that locks automatically when fully extended.
   2. Products and Manufacturers: Provide products of one of the following:
      a. LadderUP Safety Post by Bilco Company
      b. Or equal.
   3. Use upward and downward movement of post shall be controlled by stainless steel spring balancing mechanism.

   4. Safety post shall be hot-dip galvanized steel.

F. Manhole Steps:
   1. Provide manhole steps as shown on the Drawings. Conform to requirements of 29 CFR 1910 and ANSI A14.3.
   2. Products and Manufacturers: Provide one of the following:
      a. R-1982-W, manufactured by Neenah Foundry Company.
      b. Or equal.
   3. Vertical separation of steps shall be uniform at maximum of 12 inches on centers. Steps shall project evenly from manhole or chamber walls.
   4. Material: Extruded aluminum.

G. Fasteners and Hardware: Provide Type 316 stainless steel fasteners for aluminum fabrications and zinc-coated hardware for galvanized fabrications, unless otherwise shown or specified.

H. Anchors and Expansion Anchors: Refer to Section 05 05 33, Anchor Systems.

2.3 FINISHING

A. Surface Preparation and Shop Priming: Perform surface preparation and apply primer coat to miscellaneous metal fabrications in the shop. Conform to surface preparation and shop priming requirements in Section 09 91 00, Painting.

B. Galvanizing:
   1. Galvanizing of fabricated steel items shall comply with ASTM A123/A123M.
   2. Details of fabrication of steel items and assemblies to be hot-dip galvanized shall conform to recommendations of ASTM A384/A384M to minimize the potential for distortion.

C. Aluminum Finish: Provide an Architectural Class 1 anodized finish, AA-M32C22-A41, (--1--), as specified in NAAMM Metal Finishes Manual.

D. Aluminum Finish: Provide natural mill finish for aluminum Work unless otherwise shown or specified.

2.4 SOURCE QUALITY CONTROL

A. Tests and Inspections:
   1. Materials and fabrication procedures shall be subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve CONTRACTOR of responsibility for providing materials and fabrication procedures complying with the Contract Documents.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine conditions under which the Work is to be performed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install miscellaneous metal fabrications accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels. Brace temporarily or anchor temporarily in formwork where fabrications are to be built into concrete, masonry, or other construction.

B. Anchor securely as shown and as required for the intended use, using concealed anchors where possible.

C. Fit exposed connections accurately together to form tight, hairline joints. Field-weld steel connections that are not to be exposed joints and cannot be shop-welded because of shipping size limitations. Comply with AWS D1.1/D1.1M, D1.2/D1.2M and D1.6, as applicable to the material being welded. Grind steel joints smooth and touch-up shop paint coat. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

D. Protection of Aluminum from Dissimilar Materials:
   1. Coat surfaces of aluminum that will contact dissimilar materials such as concrete, masonry, and steel, in accordance with Section 09 91 00, Painting.

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SECTION 09 91 00

PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and apply paint systems.
      a. CONTRACTOR is responsible for surface preparation and painting of all new interior and exterior items and surfaces throughout the Project areas included under this and other Sections.
   2. Extent of painting includes the Work specified below. Refer to Article 2.2 of this Section where all surfaces of generic types specified are specified for preparation and painting according to their status, intended function, and location, using the painting system for that surface, function, and location as specified, unless specifically identified on the Drawings as a surface not to receive specified painting system.
      a. All new surfaces and items except where natural finish of material is specified as a corrosion-resistant material not requiring paint; or is specifically shown as indicated by written note, or specified as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint them the same as adjacent similar materials or areas.
      b. Surface preparation and painting of all new items, both interior and exterior, and other surfaces, are included in the Work, except as otherwise shown or specified.
   3. This Section includes non-potable, multi-functional, painting systems for use on concrete, masonry, metals, wood, and plastics.
   4. Painting systems in contact with potable water are covered in other respective Sections.

B. Coordination:
   1. Review installation, removal, and demolition procedures under other Sections and coordinate them with the Work specified in this Section.
   2. Coordinate painting of areas that will become inaccessible once equipment and similar fixed items have been installed.
   3. Furnish information to ENGINEER on characteristics of finish materials proposed for use and ensure compatibility with prime coats used. Provide barrier coats over incompatible primers or remove and repaint as required. Notify ENGINEER in writing of anticipated problems using specified painting systems with surfaces primed by others. Reprime equipment

primed in factory and other factory-primed items that are damaged or scratched.

C. Related Sections:
   1. Section 33 05 05, Buried Pipe Installation
   2. Section 40 05 05, Exposed Piping Installation
   3. Section 40 05 07, Pipe Hangers and Supports
   4. Section 40 05 31, Thermoplastic Process Pipe
   5. Section 40 05 33, High Density Polyethylene Process Pipe
   6. Section 40 05 53, Process Valves Four-inch Diameter and Larger
   7. Section 40 60 05, Instrumentation and Control
   8. Section 46 07 53, Packaged WWTP.

D. Work Not Included: The following Work is not included as painting Work, or are included under other Sections or in other contracts:
   1. Shop Priming: Shop priming of structural metal, miscellaneous metal fabrications, other metal items and fabricated components such as shop-fabricated or factory-painted process equipment, plumbing equipment, heating and ventilating equipment, electrical equipment, and accessories shall conform to applicable requirements of this Section but are included under other Sections or in other contracts.
   2. Pre-finished Items:
      a. Items furnished with such finishes as baked-on enamel, porcelain, and polyvinylidene fluoride shall only be touched up at Site by CONTRACTOR using manufacturer's recommended compatible field-applied touchup paint.
      b. Items furnished with finishes such as chrome plating or anodizing.
   3. Concealed Surfaces: Non-metallic wall or ceiling surfaces in areas not exposed to view, and generally inaccessible areas, such as furred spaces, pipe chases, duct shafts, and elevator shafts.
   4. Concrete surfaces below grade, unless otherwise shown or specified.
   5. Concrete floors, unless specifically shown as a surface to be painted.
   6. Exterior face of architectural precast concrete.
   7. Corrosion-Resistant Metal Surfaces: Where the natural oxide of item forms a barrier to corrosion, whether factory- or Site-formed, including such materials as copper, bronze, muntz metal, terne metal, and stainless steel.
   8. Operating Parts and Labels:
      a. Do not paint moving parts of operating units, mechanical and electrical parts such as valve and damper operators, linkages, sensing devices, interior of motors, and fan shafts.
      b. Do not paint over labels required by governing authorities having jurisdiction at Site, or equipment identification, performance rating, nameplates, and nomenclature plates.
      c. Cover moving parts and labels during the painting with protective masking. Remove all protective masking upon completion of Work.

Remove all paint, coatings, and splatter that comes in contact with such labels.

9. Structural and miscellaneous metals covered with concrete need not receive primers, intermediate, or finish coats of paint.

E. Description of Colors and Finishes:
   1. Color Selection:
      a. ENGINEER reserves the right to select non-standard colors for paint systems specified within ability of paint manufacturer to produce such non-standard colors. Provide such colors at no additional expense to OWNER.
   2. Color Coding of Pipelines, Valves, Equipment, and Ducts:
      a. Color-coding of pipelines, valves, equipment and ducts shall comply with applicable standards of ANSI A13.1, ANSI Z535.1, CFR 1910.144, and Recommended Standards for Wastewater Facilities. For piping and equipment not covered by the above standards, color will be selected by ENGINEER.
      b. For equipment located on roofs and equipment that is exposed-to-view, color will be selected by ENGINEER.

1.2 REFERENCES

A. Referenced Standards: Standards referenced in this Section are:
   1. ANSI A13.1, Scheme for Identification of Piping Systems.
   2. ANSI Z535.1, Safety Color Code.
   3. ASTM D16, Terminology for Paint, Related Coatings, Materials and Applications.
   4. ASTM D2200, Pictoral Surface Preparation Standards for Painting Steel Surfaces.
   5. ASTM D4262, Testing Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
   6. ASTM D4263, Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
   7. ASTM D4541, Test Methods for Pull-Off Strength of Coatings Using Portable Adhesion-Testers.
   8. ASTM E329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
   9. Great Lakes Upper Mississippi River Board of Public Health and Environmental Managers (GLUMRB) Recommended Standards for Water Works.
   10. Ozone Transport Commission, (OTC), OTC Model Rule for Architectural and Industrial Maintenance Coatings.
   11. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
   12. SSPC VIS 1, Visual Standard for Abrasive Blast Cleaned Steel.

13. SSPC VIS 2, Method of Evaluating Degree of Rusting/Painted Steel Surfaces.
14. SSPC Volume 2, Systems and Specifications.

1.3 DEFINITIONS

A. Coating terms defined in ASTM D16 apply to this Section.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications:
   1. Engage a single applicator regularly performing installation of painting systems, with documented skill and successful experience in installing types of products required and agrees to employ only tradesmen trained, skilled, and with successful experience in installing types of products specified.

B. Testing Agency Qualifications: Provide independent testing agency with experience and capability to satisfactorily conduct testing specified in accordance with ASTM E329. Testing agency shall be selected by ENGINEER and paid for by CONTRACTOR.

C. Source Quality Control:
   1. Obtain products from manufacturers that will provide services of a qualified manufacturer's representative at Site at commencement of painting Work to advise on products, mock-ups, installation, and finishing techniques, at completion of the Work to advise ENGINEER on acceptability of completed Work, and during course of Work as requested by ENGINEER.
   2. Submit "or equal" products, when proposed, with direct comparison to products specified, including information on durability, adhesion, color and gloss retention, percent solids, VOC's grams per liter, and recoatability after curing.
   3. "Or equal" manufacturers shall furnish same color selection as manufacturers specified, including intense chroma and custom pigmented colors in painting systems.
   4. Color Pigments: Provide pure, non-fading, applicable types to suit surfaces and services indicated. Comply with the following:
      a. Lead and Chromate: Lead and chromate content shall not exceed amount allowed by authorities having jurisdiction.
      b. Through CONTRACTOR, paint manufacturer shall notify ENGINEER of colors that are not suitable for long-term color retention in areas subject to hydrogen sulfide fume exposure.
      c. Manufacturer shall identify colors that meet requirements of authorities having jurisdiction at Site for use in locations subject to contact with potable water or water that will be treated to become potable.

d. Comply with paint manufacturers' recommendations on preventing coating contact with levels of carbon dioxide and carbon monoxide that may cause yellowing during application and initial stages of curing of paint coatings.

D. Regulatory Requirements:
   1. Comply with regulatory requirements of authorities having jurisdiction over the Site.

E. Pre-Painting Conference:
   1. Conduct a pre-painting conference at the Site to review specified requirements. Meeting attendees shall include painting applicator and its foreman, paint manufacturer's technical representative, installers of other work in and around painting that must follow painting Work, ENGINEER, and other representatives directly concerned with performance of painting Work.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Copies of manufacturer's technical data sheets, including surface preparation, number of coats, dry film thickness, test performance data including paint analysis, VOC and chemical component content in comparison to maximum allowed by the Contact Documents, and application instructions for each product proposed for use
      b. Submit proof of acceptability of proposed application techniques by paint manufacturer selected.
      c. Copies of CONTRACTOR's proposed protection procedures in each area of the Work explaining methods of protecting adjacent surfaces from splatter, for confining application procedures in a manner that allows other work adjacent to surface preparation and painting Work to proceed safely and without interruption, and for maintaining acceptable application, curing, and environmental conditions during and after painting systems application.
      d. List each material and cross-reference to the specific painting system and application, including a list of site-specific surfaces to which painting system will be applied. Identify by manufacturer's catalog number and general classification. State number of gallons of each product being purchased for delivery to Site and square foot area calculated to be covered by each painting system specified based on theoretical loss of 20 percent. Where actual area to be covered by paint system exceeds area submitted to ENGINEER for that system, proof of additional material purchase shall be provided to ENGINEER. Calculated coverage shall be as specified for each component of each painting system specified. This requirement does

not take precedence over CONTRACTOR's responsibility to provide dry film thickness required for each component of each painting system.

e. Identify maximum exposure times allowable for each paint system component before next coat of paint can be applied. Submit proposed methods for preparing surfaces for subsequent coats if maximum exposure times are exceeded.

f. Information on curing times and environmental conditions that affect curing time of each paint system component and proposed methods for accommodating variations in curing time. Identify this information for each painting system in the Work.

g. Specification for spray equipment with cross-reference to paint manufacturer's recommended equipment requirements.

2. Samples:

a. Copies of manufacturer's complete color charts for each coating system.

B. Informational Submittals: Submit the following:

1. Certificates:

a. Certificate from paint manufacturer stating that materials meet or exceed Contract Documents requirements.

b. CONTRACTOR shall provide statement verifying that all painting systems are compatible with surfaces specified. All painting systems components shall be reviewed by an authorized technical representative of paint manufacturer for use as a compatible system. Verify that all painting systems are acceptable for exposures specified and that paint manufacturer is in agreement that selected systems are proper, compatible, and are not in conflict with paint manufacturer's recommended specifications. Show by copy of transmittal form that a copy of letter has been transmitted to paint applicator.

2. Test Reports:

a. Certified laboratory test reports for required performance and analysis testing in compliance with ASTM E329.

b. Adhesion testing plan and procedures.

c. Locations of and test methods for soil sampling before beginning Work and after Substantial Completion.

d. Proposed methods for testing, handling, and disposal of waste generated during Work.

e. Results of alkalinity and moisture content tests performed per ASTM D4262 and ASTM D4263.

f. Results of film thickness, holidays, and imperfections tests.

3. Manufacturer's Instructions: Provide paint manufacturer's storage, handling, and application instructions prior to commencing painting Work at Site.

4. Special Procedure Submittals:

a. Proposed protection procedures for each area of Work, explaining methods of protecting adjacent surfaces from splatter, for confining application procedures in a manner that allows other work adjacent to surface preparation and painting Work to proceed safely and without interruption.
b. Site-specific health and safety plan.
c. Procedures for maintaining acceptable application, curing and environmental conditions during and after painting systems application.
d. Procedures for providing adequate lighting, ventilation, and personal protection equipment relative to painting Work.

5. Qualifications:
a. Applicator.
b. Testing laboratory

C. Closeout Submittals: Submit the following:
1. Maintenance Manual: Upon completion of the painting Work, furnish ENGINEER three copies of detailed maintenance manual including the following information:
a. Complete and updated product catalog of paint manufacturer's currently available products including complete technical information on each product. Identify product names and numbers of each product used in the painting Work.
b. Name, address, e-mail address and telephone number of manufacturer, local distributor, applicator and technical representative.
c. Detailed procedures for routine maintenance and cleaning.
d. Detailed procedures for light repairs such as dents, scratches and staining.
2. Statement of Application: Upon completion of the painting Work, submit a notarized statement to ENGINEER signed by CONTRACTOR and painting applicator stating that Work complies with requirements of the Contract Documents and that application methods, equipment, and environmental conditions were proper and adequate for conditions of installation and use.

1.6 DELIVERY, STORAGE AND HANDLING

A. Product Delivery Requirements: Deliver products to Site in original, new, and unopened packages and containers, accurately and legibly and accurately labeled with the following:
1. Container contents, including name and generic description of product.
2. Manufacturer's stock number and date of manufacture.
3. Manufacturer's name.
4. Contents by volume, for major pigment and vehicle constituents.
5. Grams per liter of volatile organic compounds.
6. Thinning instructions, where recommended.

7. Application instructions.
8. Color name and number.

B. Product Storage Requirements:
   1. Store acceptable materials at Site.
   2. Store in an environmentally controlled location as recommended in paint manufacturer's written product information. Keep area clean and accessible. Prevent freezing of products.
   3. Store products that are not in actual use in tightly covered containers.
   4. Comply with health and fire regulations of authorities having jurisdiction at Site.

C. Product Handling Requirements:
   1. Handle products in a manner that minimizes the potential for contamination, or incorrect product catalyzation.
   2. Do not open containers or mix components until necessary preparatory work has been completed and approved by ENGINEER and painting Work will start immediately.
   3. Maintain containers used in storing, mixing, and applying paint in a clean condition, free of foreign materials and residue.

1.7 SITE CONDITIONS

A. Site Facilities:
   1. Supplemental heat sources, as required to maintain both ambient and surface temperatures within range recommended by paint manufacturer for paint system applications, are not available at the Site.
   2. Provision of supplemental heat energy sources, power, equipment, and operating, maintenance, and temperature-monitoring personnel is CONTRACTOR's responsibility.
   3. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas being painted. Properly locate and vent heat sources to exterior so that paint systems and personnel are unaffected by exhaust products.

B. Environmental Requirements:
   1. Comply with manufacturer's published requirements.

C. Protection:
   1. Cover or otherwise protect finished Work of other trades and those surfaces not being painted concurrently and not to be painted.
   2. Coordinate and schedule surface preparation and painting to avoid exposing personnel to hazards associated with painting Work. Provide required personnel safety equipment per requirements of authorities having jurisdiction at Site.

3. Submit protection procedures to be employed. Do not begin surface preparation and painting Work until ENGINEER accepts protection techniques proposed by CONTRACTOR.
4. When working with flammable materials, provide fire extinguishers and post temporary signs warning against smoking and open flame.

PART 2 - PRODUCTS

2.1 PAINTING SYSTEM MANUFACTURERS

A. Products and Manufacturers: Where referenced under painting systems, provide painting systems manufactured by the following:
   1. Tnemec Company, Incorporated (TCI).
   2. The Carboline Company, part of StonCor Group, an RMP Company (TCC).
   3. Sherwin-Williams Company (SWC).
   4. Or approved equal.

2.2 PAINTING SYSTEMS

A. New, Steel Surfaces Associated With Packaged WWTP; Non-submerged, Intermittently Submerged and Submerged, OTC Compliant; Interior:
   1. Provide painting system specified for steel surfaces of the Packaged WWTP, extending to top of tank horizontal walkway surface, including troughs, walls, beams, columns, undersides of walkways, and other locations that may be shown.
   2. Surface Preparation: All steel surfaces shall be sandblasted in accordance with Steel Structures Painting Council Specification SSPC-SP10 (near white metal blast cleaning). Comply with manufacturer's published recommendations for material and surface condition.
   3. First coat:
      a 46H-413 (TCI); Bitumastic 300M (TCC): 8.0 to 10.0 dry mils, per coat.
   4. Second coat:
      a. 46H-413 (TCI); Bitumastic 300M (TCC): 8.0 to 10.0 dry mils, per coat

B. New, Steel Surfaces Associated With Packaged WWTP; Non-submerged, OTC Compliant; Exterior:
   1. Provide painting system specified for exterior steel surfaces of the Packaged WWTP.
   2. Surface Preparation: All steel surfaces shall be sandblasted in accordance with Steel Structures Painting Council Specification SSPC-SP10 (near white metal blast cleaning). Comply with manufacturer's published recommendations for material and surface condition.

3. Primer:
    a. Products and Manufacturers: Provide one of the following:
        1) 69-1211 (TCI); Carbozinc 11 HS (TCC); 519 Inorganic Zinc (Engard): One coat, 3.0 dry mils.
4. Intermediate:
    a. Products and Manufacturers: Provide one of the following:
        1) 69 Hi-Build Epoxoline II (TCI); Carboguard 891 (TCC); 460 H.S. Epoxy Finish (Engard): One coat, 4.0 dry mils.
5. Finish:
    a. Products and Manufacturers: Provide one of the following:
        1) 75 Polyurethane, Semi-Gloss (TCI); Carbothane 133HB Satin (TCC); 428 Urethane Semi-Gloss (Engard): One coat, 3.0 dry mils.

C. New, Exposed Surfaces including PVC, Ductile Iron, and Cast Iron; Non-Submerged, Exterior:
1. Surface Preparation: Comply with manufacturer's published recommendations for material and surface condition.
2. Primer:
    a. Generic Components:
        1) Minimum 17 percent solids, waterborne modified polyamide epoxy, 170 grams per liter, VOC, maximum.
    b. Products and Manufacturers: Provide one of the following:
        1) Series N69 Hi-Build Epoxoline (TCI); Carboguard 954 HB (TCC); Macropoxy HS Epoxy (SWC): One coat, 4.0 to 6.0 dry mils.
3. Finish: Gloss:
    a. Generic Components:
        1) Minimum 49 percent solids, two-component, aliphatic acrylic, polyurethane coating; 247 grams per liter VOC, maximum.
    b. Products and Manufacturers: Provide one of the following:
        1) Series 1080 Endura-Shield (TCI); Carbothane 134 VOC (TCC); Centurion WB Urethane (SWC): Two coats, 2.0 to 3.0 dry mils, per coat.

2.3 INSTRUMENTS

A. Instruments:
1. CONTRACTOR to utilize a dry-film thickness gauge for checking film thickness, a holiday detector to detect holidays or holes in the coating, and a set of visual standards to check surface preparation. Calibrate dry film thickness gauge at Site using Bureau of Standards standard shim blocks.
2. Products and Manufacturers: Provide the following:
    a. Film Thickness Testers: Model FM-III manufactured by Mikrotest, or equal.

b. Holiday detector shall be Model M-1 as manufactured by Tinker & Rasor, or equal.
c. Visual Standards: ASTM D2200, Swedish Standards, SSPC VIS 1.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which painting Work is to be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

B. Do not paint over existing paint where there is no assurance that existing paint will provide an acceptable surface for long-term adherence and durability of painting systems specified, or where paint manufacturer requires removal of all existing paint to recommend use of specified painting system.

3.2 SURFACE PREPARATION

A. General:
1. Comply with paint manufacturer's published recommendations for products, surface condition, and surface preparation.

3.3 PROTECTION OF PROPERTY AND STRUCTURES

A. Protect property and structures adjacent to the Work from waste residues resulting from cleaning, surface preparation, and painting Work.

B. Use shrouding, vacuum blasting, or other acceptable methods for cleaning and surface preparation of exterior surfaces.

C. During blast cleaning and surface preparation of interior and exterior surfaces, control exhausting of dust and grit using shrouding, negative-pressure containment/dust collection systems, or other means to protect adjacent property and structures and prevent dust and grit from escaping. Similarly, control removal and temporarily store residues to protect adjacent property and structures.

D. For painting of exterior surfaces, use rollers, shrouding, or other acceptable methods as required to protect adjacent property and structures from wind-blown paint residues.

E. Submit proposed procedures for cleaning, surface preparation, and paint application that describe in detail methods to be used to protect adjacent property and structures from residues. Do not proceed with cleaning, surface preparation, or painting until proposed procedures are accepted by ENGINEER.

3.4 MATERIALS PREPARATION

A. General: Mix and prepare painting products in strict accordance with paint manufacturer's product data sheets.

3.5 APPLICATION

A. General:
   1. Apply paint systems by brush, roller, or airless spray per paint manufacturer's recommendations and in compliance with Paint Application Specifications No. 1 in SSPC Volume 2, where applicable, and in strict accordance with paint manufacturer's product data sheets.
   2. Except for color-coded process piping systems, surfaces of items not normally exposed-to-view do not require same color as other components of system of which they are a part, but require same painting system specified for exposed surfaces of system.
   3. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint before final installation of registers or grilles.
   4. Paint backs of access panels and removable or hinged covers to match exposed surfaces.
   5. Omit field-applied primer on metal surfaces that have been primed in the shop. Touch-up paint to shop-primed coats and pre-finished items only when approved by ENGINEER using compatible primers and paint manufacturer’s recommended compatible field-applied finishes.
   6. Welds shall be stripe-coated with intermediate or finish coat of paint after application of prime coat.

B. Minimum/Maximum Paint Film Thickness: Comply with manufacturer’s published recommendations for coating type and surface.

C. Scheduling Surface Preparation and Painting: Comply with manufacturer’s published recommendations for coating type and surface.

D. Prime Coats: Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to result in a finish coat with no burn-through or other defects caused by insufficient sealing.

E. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.

F. Brush Application:
   1. Brush-out and work all brush coats onto the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections are unacceptable. Neatly draw all glass and color break lines.
   2. Brush-apply all primer or first coats, unless otherwise allowed to use mechanical applicators.

G. Mechanical Applicators:
   1. Use mechanical methods for applying paint when allowed by applicable ordinances, paint manufacturer, and approved by ENGINEER.
   2. Limit roller applications, if approved by ENGINEER, to interior wall finishes for second and third coats. Apply each roller coat to provide equivalent hiding as brush-applied coats.
   3. Where spray application is used, apply each coat to provide equivalent hiding of brush-applied coats. Do not double back with spray equipment for purpose of building up film thickness of two coats in one pass.

H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint Work not in compliance with specified requirements as required by ENGINEER.

3.6 FIELD QUALITY CONTROL

A. Notify ENGINEER after completing each coat of paint. After inspection and checking of film thickness, holidays, and imperfections, and after acceptance by ENGINEER, proceed with succeeding coat. Perform testing using testing instruments specified in Article 2.3 of this Section.
   1. ENGINEER will witness all testing and shall be notified of scheduled testing at least twenty-four hours in advance.
   2. Apply additional coats, if required, to produce specified film thickness and to correct holidays and to completely fill all surface air holes.

B. For magnetic substrates, measure thickness of dry film nonmagnetic coatings following recommendations of SSPC PA-2. These procedures supplement manufacturers' approved instructions for manual operation of measurement gauges and do not replace such instructions.

C. Record time, location, number of coats, dry film thickness, holidays, and other imperfections and submit testing results to ENGINEER.

3.7 PROTECTION

A. Provide “Wet Paint” signs as required to protect newly painted finishes. After completing painting Work, remove temporary protective wrappings provided for protection of the Work.

3.8 ADJUSTMENT AND CLEAN-UP

A. Correct damage to work of other trades by cleaning, repairing or replacing, and repainting, as acceptable to ENGINEER.

B. During progress of the Work, remove from Site all discarded paint products, rubbish, cans, and rags at end of each workday.

C. Upon completion of painting, clean paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

D. At completion of Work of other trades, touch-up and restore all damaged or defaced painted surfaces as determined by ENGINEER.

+ + END OF SECTION + +

SECTION 26 00 05

ELECTRICAL WORK

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to complete the electrical Work, which includes:
      a. Furnish and install cables, conduit and fittings, hangers and supports to form complete, coordinated and grounded raceway systems.
      b. Furnish and install complete grounding for electrical systems, structures, and equipment.
      c. Furnish and install lighting fixtures, poles and associated controls, where shown in the drawings.
      d. Furnish and install lightning protection systems for the new WWTP facility.
      e. Furnish and install power distribution equipment, where shown in the drawings. This includes but is not limited to panelboards, disconnects, generators, automatic transfer switches and transformers.
   2. Materials and equipment installed by CONTRACTOR but furnished by other consists of the following:
      a. Flow Equalization Local Control Panel (FE-LCP), which shall be the responsibility of the Packaged WWTP Supplier to provide. CONTRACTOR shall responsible for all labor, materials, and incidentals for the installation of the FE-LCP.
      b. Anoxic Mixer Local Control Panel (AM-LCP), which shall be the responsibility of the Packaged WWTP Supplier to provide. CONTRACTOR shall responsible for all labor, materials, and incidentals for the installation of the AM-LCP.
      c. Recycle Pump Local Control Panel (RP-LCP), which shall be the responsibility of the Packaged WWTP Supplier to provide. CONTRACTOR shall responsible for all labor, materials, and incidentals for the installation of the RP-LCP.
      d. Main Air Blower Local Control Panel (MAB-LCP), which shall be the responsibility of the Packaged WWTP Supplier to provide. CONTRACTOR shall responsible for all labor, materials, and incidentals for the installation of the MAB-LCP.
      e. Duplex Lift Station Local Control Panel 1 (DLS-LCP1), which shall be the responsibility of the Packaged LS Supplier to provide. CONTRACTOR shall responsible for all labor, materials, and incidentals for the installation of the DLS-LCP1.

f. Duplex Lift Station Local Control Panel 2 (DLS-LCP2), which shall be the responsibility of the Packaged LS Supplier to provide. CONTRACTOR shall responsible for all labor, materials, and incidentals for the installation of the DLS-LCP2.

3. Temporary Utilities: CONTRACTOR shall provide temporary power and lighting in accordance with Section 01 51 05, Temporary Utilities.
4. Demolition: Responsibility for electrical demolition is indicated in 02 41 00, Demolition.
5. Utility Companies:
   a. Electric Utility Company: Perform the Work in connection with the electric service and utility metering in accordance with requirements of Clay Electric.

B. Coordination:
   1. Review installation procedures and schedules under other Specification Sections and coordinate with other trades the installation of electrical items that will be installed with or within formwork, walls, partitions, ceilings, and panels.
   2. Coordination and Intent of Electrical Drawings:
      a. Dimensions on Drawings related to equipment are based on equipment of certain manufacturers. Verify the dimensions of equipment furnished to space available at the Site and allocated to the equipment.
      b. Drawings show the principal elements of the electrical Work, and are not intended as detailed working drawings for the electrical Work. Drawings supplement and complement the Specifications and other Contract Documents relative to principal features of electrical systems. When conflict exists CONTRACTOR is to notify ENGINEER and provide the more costly solution if chosen by ENGINEER or OWNER.
      c. Equipment and devices provided under this Contract shall be properly connected and interconnected with other equipment and devices for successful operation of complete systems, whether or not all connections and interconnections are specifically mentioned or shown in the Contract Documents.
      d. Drawings are provided for CONTRACTOR's guidance in fulfilling the intent of the Contract Documents CONTRACTOR shall comply with Laws and Regulations, including safety and electrical codes, and provide materials, equipment, appurtenances, and specialty items necessary for complete and operable systems.
   3. Obtain from OWNER record drawings required to execute the Work.
   4. Field Coordination:
      a. Provide materials, equipment, and services to interface with existing circuits. Field-verify system and equipment requirements prior to modifying existing systems.

b. Coordinate the interface of equipment with OWNER's personnel and field conditions.
c. Field-trace existing circuits as required to interface the equipment provided.

C. Related Sections:
1. Section 03 00 05, Concrete
2. Section 05 05 33, Anchor Systems
3. Section 31 20 00, Earth Moving
4. Section 26 32 13, Engine Generators
5. Section 26 36 23, Automatic Transfer Switches
6. Section 40 60 05, Instrumentation and Control for Process Systems

D. Area Classifications:
1. Materials, equipment, and incidentals shall be suitable for the area classification(s) shown, specified, and required.
2. Wet Locations: Comply with NEC and NEMA requirements for wet locations. Enclosures in wet locations shall comply with NEMA 4 unless specified otherwise.
3. Corrosive Locations: Comply with NEC and NEMA requirements for corrosive locations. Enclosures in corrosive locations shall conform to NEMA 4X requirements unless specified otherwise.
4. Hazardous Locations: Comply with NEC requirements for the Class and Division designated. Refer to the Drawings for the extent of the classified areas.

1.2 QUALITY ASSURANCE

A. Qualifications:
1. Electrical Subcontractor:
a. Electrical Subcontractor shall have not less than five years experience installing electrical systems of the types required for the Project.
b. Electrical Subcontractor shall possess a valid Florida electricians' and contractors' license in the jurisdiction where the Site is located.
c. Submit the following information for not less than three successful, completed projects of similar size and type: project name and location; year completed; name and contact information for: prime contractor for whom electrical Subcontractor worked, project owner, and project engineer or architect, including addresses and telephone numbers.
2. Lightning Protection System Subcontractor:
a. Retain services of lightning protection Subcontractor regularly engaged in providing Master Labeled lightning protection systems.
b. Subcontractor shall be LPI-certified Master Installer or Inspector.
c. Subcontractor shall be listed with UL.

B. Component Supply and Compatibility:

1. Materials and equipment similar to each other shall be from the same manufacturer for uniformity.

C. Regulatory Requirements:
   1. Permits: Refer to the General Conditions, Supplementary Conditions, and other parts of the Contract Documents for responsibilities relative to obtaining and paying for permits, licenses, and inspection fees.

D. Products:
   1. Products and installation of products shall abided following regulatory requirements and standards:
      a. National Electrical Code (NEC).
      b. National Fire Protection Association (NFPA).
      c. National Electrical Manufacturers Association NEMA).
      d. American Society for Testing and Materials (ASTM).
      e. Underwriters Laboratory (UL), or Electrical Testing Labs (ETL).
      f. American National Standards Institute (ANSI)

1.3 SUBMITTALS

A. General:
   1. To the extent practical, submit Shop Drawings and other CONTRACTOR submittals for each Specification Section into the smallest number of submittals possible. Do not furnish partial submittals.
   2. Review of equipment submittals does not relieve CONTRACTOR of responsibility for providing complete and successfully operating systems.
   3. Submittals shall be bond and tabbed in a loose leaf binder. Tabs shall be coordinated with a Table of Contents at the beginning of the submittal. Table of contents will have submittal section, description and tab number. Any exceptions, deletions or substitutions will be noted on separate sheets at the beginning of the submittal.
   4. Failure to do any of the above will be grounds for rejection of submittal.

B. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Internal wiring diagram and drawings indicating all connections to components and numbered terminals for external connections.
      b. Dimensioned plan, section, elevations, and panel layouts showing means for mounting, conduit connection, and grounding.
      c. List of components including manufacturer's name and catalog number (or part number) for each.
      d. Complete scaled drawings showing proposed routing and layout of lightning protection system with installation details. Drawings shall include equipment connection details and downlead details.
      e. Schedule of light fixtures to be furnished, indicating fixture type and location for each. Submittal shall include customized wiring diagrams.

2. Product Data:
    a. Manufacturer's name and product designation or catalog number.
    b. Electrical ratings.
    c. Manufacturer’s technical data and specifications.
    d. Manufacturer’s indication of compliance with applicable reference standards.
    e. Painting and coating systems proposed.
3. Test Procedures: Proposed testing procedures and testing limitations for source quality control testing and field quality control testing.

C. Informational Submittals: Submit the following:
1. Manufacturer’s Instructions:
    a. Installation data and instructions.
    b. Instructions for handling, starting-up, and troubleshooting.
2. Source Quality Control Submittals: Results for required shop testing.
3. Field Quality Control Submittals: Results for required field testing.
4. Qualifications:
    a. Electrical Subcontractor.
    b. Lightning protection system Subcontractor
5. Certificates:
    a. Certificates of LPI code compliance provided by manufacturer, together with UL Master Label certificate or letter of finding.

D. Closeout Submittals: Submit the following:
1. Record Documentation:
    a. System Record Drawings: Include the following:
        1) One-line wiring diagram of the electrical distribution system.
        2) Actual, in-place conduit and cable layouts with schedule of conduit sizes and number, and size of conductors.
        3) Layouts of the power and lighting arrangements and the grounding system.
        4) Control schematic diagrams, with terminal numbers and control devices identified, for all equipment.
    b. Point-to-Point Interconnection Wiring Diagram Drawings: Include the following:
        1) External wiring for each piece of equipment, panel, instrument, and other devices and wiring to control stations, lighting panels, and motor controllers.
        2) Numbered terminal block identification for each wire termination.
        3) Identification of the assigned wire numbers for all interconnections.
        4) Identification of wiring by the conduit tag in which the wire is installed.
        5) Terminal, junction, and pull boxes through which wiring is routed.

6) Identification of equipment and the submittal transmittal number for equipment from which wiring requirements and termination information was obtained.

c. Record documents shall indicate final equipment and field installation information.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Product Delivery.

1. When practical, factory-assemble materials and equipment. Match mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable, protective coating.
2. Package materials and equipment to facilitate handling, and protect materials and equipment from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate the associated purchase order number, bill of lading number, contents by name, OWNER's contract name and number, CONTRACTOR name, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.
3. Protect materials and equipment from exposure to the elements and keep thoroughly dry and dust-free at all times. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Lubricate bearings and other items requiring lubrication in accordance with manufacturer's instructions.
4. Do not ship materials and equipment until:
   a. Related Shop Drawings, Samples, and other submittals have been approved or accepted (as applicable) by ENGINEER, including, but not necessarily limited to, all Action Submittals associated with the materials and equipment being delivered.
   b. Manufacturer's instructions for handling, storing, and installing the associated materials and equipment have been submitted to and accepted by ENGINEER in accordance with the Specifications.
   c. Results of source quality control testing (factory testing), when required by the Contract Documents for the associated materials or equipment, have been reviewed and accepted by ENGINEER.
   d. Facilities required for handling materials and equipment in accordance with manufacturer's instructions are in place and available.
   e. Required storage facilities have been provided.
5. Shipments shall be delivered with CONTRACTOR's name, Subcontractor's name (if applicable), Site name, Project name, and contract designation (example: "ABC Construction Co., City of Somewhere, Idaho, Wastewater Treatment Plant Primary Clarifier Improvements, Contract 25, General Construction") clearly marked.
6. Site may be listed as the "ship to" or "delivery" address; but OWNER shall not be listed as recipient of shipment unless otherwise directed in writing by

ENGINEER.

7. Provide CONTRACTOR's telephone number to shipper; do not provide OWNER's telephone number.
8. Arrange for deliveries while CONTRACTOR's personnel are at the Site. CONTRACTOR shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when CONTRACTOR is not present will be refused by OWNER, and CONTRACTOR shall be responsible for the associated delays and additional costs, if incurred.
9. Have materials and equipment delivered in manufacturer's original, unopened, labeled containers.
10. Clearly mark partial deliveries of component parts of materials and equipment to identify materials and equipment, to allow easy accumulation of parts, and to facilitate assembly.
11. Immediately upon delivery, inspect shipment to verify that:
    a. Materials and equipment comply with the Contract Documents and approved or accepted (as applicable) submittals.
    b. Quantities are correct.
    c. Materials and equipment are undamaged.
    d. Containers and packages are intact and labels are legible.
    e. Materials and equipment are properly protected.
12. Promptly remove damaged materials and equipment from the Site and expedite delivery of new, undamaged materials and equipment, and remedy incomplete or lost materials and equipment to furnish materials and equipment in accordance with the Contract Documents, to avoid delaying progress of the Work.
13. Advise ENGINEER in writing when damaged, incomplete, or defective materials and equipment are delivered, and advise ENGINEER of the associated impact on the Progress Schedule.
14. Provide equipment and personnel necessary to handle materials and equipment, including those furnished by OWNER, by methods that prevent soiling or damaging materials and equipment and packaging.
15. Provide additional protection during handling as necessary to prevent scraping, marring, and otherwise damaging materials and equipment and surrounding surfaces.
16. Handle materials and equipment by methods that prevent bending and overstressing.
17. Lift heavy components only at designated lifting points.
18. Handle materials and equipment in safe manner and as recommended by the manufacturer to prevent damage. Do not drop, roll, or skid materials and equipment off delivery vehicles or at other times during handling. Hand-carry or use suitable handling equipment.

B. Product Storage and Handling.
    1. Store and protect materials and equipment in accordance with manufacturer's recommendations and the Contract Documents.
    2. CONTRACTOR shall make all arrangements and provisions necessary for, and

pay all costs for, storing materials and equipment. Excavated materials, construction equipment, and materials and equipment to be incorporated into the Work shall be placed to avoid injuring the Work and existing facilities and property, and so that free access is maintained at all times to all parts of the Work and to public utility installations in vicinity of the Work. Store materials and equipment neatly and compactly in locations that cause minimum inconvenience to OWNER, other contractors, public travel, and owners, tenants, and occupants of adjoining property. Arrange storage in manner to allow easy access for inspection.

3. Store materials and equipment to become OWNER's property to facilitate their inspection and ensure preservation of quality and fitness of the Work, including proper protection against damage by freezing, moisture, and high temperatures with ambient temperatures as high as 100 degrees F. Store in indoor, climate-controlled storage areas all materials and equipment subject to damage by moisture, humidity, heat, cold, and other elements, unless otherwise acceptable to OWNER. When placing orders to Suppliers for equipment and controls containing computer chips, electronics, and solid-state devices, CONTRACTOR shall obtain, coordinate, and comply with specific temperature and humidity limitations on materials and equipment, because temperature inside cabinets and components stored in warm temperatures can approach 200 degrees F.
4. CONTRACTOR shall be fully responsible for loss or damage (including theft) to stored materials and equipment.
5. Do not open manufacturer's containers until time of installation, unless recommended by the manufacturer or otherwise specified in the Contract Documents.
6 Do not store materials or equipment in structures being constructed unless approved by ENGINEER in writing.
7. Do not use lawns or other private property for storage without written permission of the owner or other person in possession or control of such premises.
8. Equipment to be incorporated into the Work shall be boxed, crated, or otherwise completely enclosed and protected during shipping, handling, and storage, in accordance with above section 1.4.A.
9. Store all materials and equipment off the ground (or floor) on raised supports such as skids or pallets.
10. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Painted equipment surfaces that are damaged or marred shall be repainted in their entirety in accordance with equipment manufacturer and paint manufacturer requirements, to the satisfaction of ENGINEER.

11. Protect electrical equipment, controls, and instrumentation against moisture, water damage, heat, cold, and dust. Space heaters provided in equipment shall be connected and operating at all times until equipment is placed in operation and permanently connected.

PART 2 – PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. Performance Criteria:
   1. Electrical equipment shall be capable of operating successfully at full-rated load, without failure, with ambient outside air temperature of 32 degrees F to 115 degrees F and an elevation of 150 feet above mean sea level.
   2. Unless specified otherwise, electrical equipment shall have ratings based on 75 degrees C terminations.

B. Testing Laboratory Labels: Electrical material and equipment shall bear the label of Underwriters' Laboratories, Inc. or other nationally recognized, independent testing laboratory, where standards have been established and label service applies.

C. Products and installation of products shall abided following regulatory requirements and standards:
   1. National Electrical Code (NEC).
   2. American Society for Testing and Materials (ASTM).
   3. Underwriters Laboratory (UL).
   4. American National Standards Institute (ANSI)

2.2 600volt Cable

A. Insulated Cable In Raceways:
   1. Application: Use for circuits located indoors and outdoors.
   2. Manufacturers: Provide products of one of the following:
      a. Southwire.
      b. The Okonite Company.
      c. American Insulated Wire
      d. General Cable
   3. Material: Single conductor copper cable complying with ASTM B3 and ASTM B8 with flame-retardant, moisture- and heat-resistant insulation rated for 90 degrees C in dry or wet locations, listed by UL as Type XHHW-2 complying with UL 44.
   4. Wire Sizes: Not smaller than No. 12 AWG for power and lighting and No. 14 AWG for 120-volt control circuits.
   5. Stranding: 600-volt cable shall be stranded, except that solid cable, No. 10 and smaller may be used for lighting circuits.

B. Cable Splices:
   1. Products and Manufacturers:
      a. Compression-Type Splices: Provide one of the following:
         1) Burndy Hylink.
         2) T&B Color-Keyed Compression Connectors.
      b. Spring Connectors: Provide one of the following:
         1) Buchanan B-Cap.
         2) T&B Wire Connector.
   2. For wire sizes No. 8 AWG and larger, splices shall be made up with compression type copper splice fittings. Splices shall be taped and covered with materials recommended by cable manufacturer to provide insulation equal to that on conductors.
   3. For wire sizes No. 10 AWG and smaller, splices may be made up with pre-insulated spring connectors.
   4. For wet locations, splices shall be waterproof. Compression type splices shall be waterproofed by sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring thermosetting resin into mold that surrounds the joined conductor. Spring connector splices shall be waterproofed with sealant filler.
   5. Splices shall be suitably sized for cable, rated 90 degrees C, and 600 volts.

2.3 INSTRUMENT CABLE

A. Single Shielded Pair Instrument Cables:
   1. Manufacturers: Provide products of one of the following:
      a. Belden Company.
      b. Okonite Company.
      c. Dekoron Wire and Cable Company.
   2. Tinned copper, XLPE-insulated, stranded conductors, not less than no. 16 AWG, twisted pair, with overall shield, stranded tinned no. 18 AWG copper drain wire and overall PVC or CPE jacket. Rated for not less than 600 volts and complying with UL 1581.

B. Multi-Paired Shielded Instrument Cables:
   1. Manufacturers: Provide products of one of the following:
      a. Belden Company.
      b. Okonite Company.
      c. Dekoron Wire and Cable Company.
   2. Tinned copper, XLPE-insulated stranded conductors, not less than no. 16 AWG, twisted pairs with shield over each pair, stranded tinned no. 18 AWG copper drain wire, and overall PVC or CPE outer jacket. Rated for not less than 600 volts and complying with either UL 1581 or UL 13.

C. Multi-Conductor Shielded Instrument Cables:
   1. Manufacturers: Provide products of one of the following:
      a. Belden Company.
      b. Okonite Company.

c. Dekoron Wire and Cable Company.

2. Tinned copper, XLPE-insulated stranded conductors, not less than no. 16 AWG, stranded tinned no. 18 AWG copper drain wire, with overall 100 percent foil shield and overall PVC or CPE jacket. Rated for not less than 600 volts.

D. Cable Terminals:
   1. Manufacturers: Provide products of one of the following:
      a. T&B Sta-Kon.
      b. Burndy Insulug.
   2. Fork type copper compression terminals with nylon insulation for termination of cable at terminal blocks.

2.4 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

A. Bare Ground Cable:
   1. Manufacturers: Provide products of one of the following:
      a. Cablec Corporation.
      b. General Cable Corporation.
      c. Southwire Cable Company.
   2. Material: Soft-drawn, bare copper stranded cable complying with ASTM B8. No. 4/0 AWG minimum size unless otherwise shown or indicated on the Drawings.

B. Ground Rods:
   1. Manufacturers: Provide products of one of the following:
      a. Copperweld, Bimetallics Division.
      b. ITT Blackburn Company.
   2. Material: Copper-clad rigid steel rods, 3/4-inch diameter, ten feet long.

C. Grounding Connectors:
   1. Products and Manufacturers: Provide one of the following:
      a. Pressure Connectors:
         1) O.Z./Gedney, Division of General Signal Corporation.
         2) Burndy Corporation.
      b. Welded Connections:
         1) Cadweld by Erico Products, Incorporated.
         2) Therm-O-Weld by Burndy Corporation.
   2. Material: Pressure connectors shall be copper alloy castings, designed and fabricated specifically for items to be connected and assembled with Durium or silicone bronze bolts, nuts, and washers. Welded connections shall be by exothermic process utilizing molds, cartridges, and hardware designed specifically for connection to be made.

D. Ground Test Well
   1. Provide heavy-duty test well suitable for heavy-duty traffic.

2. Manufacturer
   a. Advanced Lightning Technology
3. Diameter and Material: 12.75-inch outside diameter, Schedule 80 PVC.
4. Depth: Two feet.
5. Cover: Provide test well with cast iron cover marked, "Ground" with cast iron ring to support lid.

E. Ground Bonding Jumpers
1. Braided copper tape, one inch wide, woven of No. 30 gage bare copper wire, terminated with copper ferrules.

F. Ground system components shall comply with UL 467.

2.5 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

A. Strut, Fittings, and Accessories:
1. General
   a. Unless otherwise shown or indicated, strut shall be 1-5/8 inches by 1-5/8 inches. Double struts shall be two pieces of the same strut, welded back-to-back at the factory.
   b. Attachment holes, when required, shall be factory-punched on hole centers approximately equal to the cross-sectional width and shall be 9/16-inch diameter.
   c. Fittings, braces, brackets, hardware, and accessories shall be Type 316 stainless steel.
   d. Strut nuts shall be spring captured Type 316 stainless steel.
   e. Square and round washers shall be Type 316 stainless steel.
2. Strut materials shall be suitable for area classifications indicated below:
   a. Wet Locations:
      1) Strut shall be 12-gage aluminum (Alloy 6061-T6).

B. Hanger Rods:
1. Material:
   a. Wet, Corrosive, or Hazardous Areas: Stainless steel.
2. Size: Not less than 3/8-inch diameter, unless otherwise shown on the Drawings or specified.

C. Beam Clamps for Attaching Threaded Rods or Bolts to Beam Flanges for Hanging Struts or Conduit Hangers:
1. Beam clamps shall be stainless steel equipped with stainless steel square-head set screw, and shall include threaded hole sized for attaching the all-thread rod or threaded bolt.

D. Miscellaneous Hardware:
1. Bolts, screws, and washers shall be stainless steel.
2. Hex Nuts: Shall be stainless steel and include nylon inserts.

E. Conduit spans shall not exceed maximum allowable span as defined by the latest adopted National Electrical Code.

2.6 RIGID CONDUITS

A. Conduit types and the installation methods shall comply with the following, unless otherwise shown or indicated in the Contract Documents:
   1. Use PVC-coated rigid steel or aluminum conduit for exterior conduit runs in hazardous, wet, and corrosive locations.
   2. Use PVC-coated rigid steel conduit for individual conduits direct-buried in the ground.
   3. Use steel or Schedule 40 PVC conduit for conduit runs embedded in structural concrete slabs.

B. Rigid Steel Conduit, Elbows, and Couplings:
   1. Manufacturers: Provide products of one of the following:
      a. Allied Tube and Conduit.
      b. Wheatland Tube Company.
      c. Western Tube and Conduit Corporation.
      d. Or equal.
   2. Material: Rigid, heavy-wall, mild steel, hot-dip galvanized, smooth interior, tapered threads and carefully reamed ends; 3/4-inch NPS minimum size.

C. PVC-coated Rigid Steel Conduit, Elbows, and Couplings:
   1. Manufacturers: Provide products of one of the following:
      a. Robroy Industries.
      b. Perma-Cote Industries.
      c. OCAL, Inc.
      d. Or equal.
   2. Material: Rigid, heavy-wall, mild steel, hot-dip galvanized, smooth urethane interior coating, tapered threads, carefully reamed ends, 3/4-inch NPS minimum size with factory exterior coating of 40-mil thick PVC.
   3. Color: Color of coating shall be the same on all conduit and fittings.

D. Aluminum Conduit, Elbows, and Couplings:
   1. Manufacturers: Provide products of one of the following:
      a. Allied Tube and Conduit.
      b. Wheatland Tube Company.
      c. Or equal.
   2. Material: Rigid, heavy-wall aluminum, smooth interior, tapered threads and carefully reamed ends; 3/4-inch NPS minimum size.

E. Metallic Conduit Fittings, and Outlet Bodies:
   1. Manufacturers: Provide products of one of the following:
      a. Crouse-Hinds Company.

b. Appleton Electric Company.
c. Or equal.

2. Material and Construction: Cast gray iron alloy, cast malleable iron or aluminum bodies and covers consistent with conduit material. Units shall be threaded type with five full threads. Materials shall comply with ANSI/NEMA FB1 and be listed by UL. Do not use "LB" fittings. Use type "LBD" fittings where use of fittings is unavoidable.
3. Use: Conduits shall be gasketed and watertight in hazardous, wet, and corrosive locations.

F. Non-metallic Conduit and Fittings:
1. PVC Plastic Conduit:
a. Manufacturers: Provide products of one of the following:
1) Amoco Chemicals Corp.
2) Carlon Electrical Products.
3) Or equal.
b. Material: Schedule 40 PVC for belowground installations or Schedule 80 PVC for aboveground installations, rated for 90 degrees C, complying with NEMA TC3 and UL 514B and 651.
c. Fittings: Form elbows, bodies, terminations, expansions, and fasteners of same material and manufacturer as base conduit. Provide cement by same manufacturer as base conduit.

G. Conduit Hubs:
1. Manufacturers: Provide products one of the following.
a. Myers Electrical Products Company.
b. Or equal.
2. Material: Threaded conduit hub, vibration-proof, weatherproof, with captive O-ring seal, zinc metal with insulated throat and bonding screw.
3. Use: Provide for all conduit terminations to boxes, cabinets, and other enclosures in areas designated as wet locations.

H. PVC-coated Conduit Hubs:
1. Manufacturers: Provide products one of the following:
a. Robroy Industries.
b. Perma-Cote Industries.
c. OCAL, Inc.
d. Or equal.
2. Material: Threaded conduit hub, vibration-proof, weatherproof, with captive O-ring seal, zinc metal with insulated throat and bonding screw, and factory coating of 40-mil thick PVC and smooth urethane interior coating.
3. Use: Provide for PVC-coated steel or aluminum conduit terminations to boxes, cabinets, and other enclosures in areas designated as corrosive location.

I. Conduit Bushings and Locknuts:
1. Manufacturers: Provide products one of the following:

a. O-Z/Gedney.
b. Appleton Electric Company.

2. Insulated Bushings: Malleable iron body with plastic liner. Threaded type with steel clamping screw. Provide with bronze grounding lug, as required.
3. Locknuts: Steel for sizes 3/4-inch through two-inch diameter and malleable iron for sizes 2.5-inch through four-inch diameter.
4. Use: Provide for all conduit terminations to boxes, cabinets and other enclosures except threaded type in areas designated as dusty locations.

J. Thruwall Seals
1. For new construction through exterior subsurface walls and exterior concrete walls.
a. Manufacturer: Provide one of the following:
1) Type WSK and WSCS by O-Z/Gedney.
2. For new construction passing through concrete floors and floor slabs.
a. Manufacturer: Provide one of the following:
1) Type FSK and FSCS floor seals by O-Z/Gedney.

2.7 FLEXIBLE CONDUITS

A. Flexible Conduit (Non-hazardous Areas and Class 1, Division 2, Hazardous Areas):
1. Material: Flexible galvanized steel core with smooth, abrasion-resistant, liquid-tight, polyvinyl chloride cover. Continuous copper ground built in for sizes 3/4-inch through 1.25-inch. Material shall be UL-listed.
2. Products and Manufacturers: Provide one of the following:
a. Anaconda Sealtite Type UA by Anamet Electrical, Inc.
b. Liquatite Type L.A. by Electric-Flex Company.
c. Or equal.

B. Flexible Conduit (Class 1, Group D, Division 1, Hazardous Areas):
1. Material: Flexible brass inner core with bronze outer braid and protective neoprene plastic coating. Steel, brass, or bronze end fittings. Minimum of 12 inches long.
2. Products and Manufacturers: Provide one of the following:
a. Type ECGJH or ECLK by Crouse Hinds Company.
b. Type EXGJH or EXLK by Appleton Electric Company.
c. Or equal.

C. Flexible Conduit Fittings:
1. Material and Construction: Malleable iron with cadmium finish. Fittings shall adapt the conduit to standard threaded connections, shall have an inside diameter not less than that of the corresponding standard conduit size and shall be UL listed.
2. Manufacturers: Provide products of one of the following:
a. Crouse-Hinds Company.
b. Appleton Electric Company.

3. Use: Provide on flexible conduit in non-hazardous and Class 1, Division 2 hazardous areas.

D. PVC-Coated Conduit Fittings:
   1. Material and Construction: Malleable iron with standard finish and 40-mil PVC exterior coating. Fittings shall adapt the conduit to standard threaded connections, and shall have an inside diameter not less than that of the corresponding standard conduit size.
   2. Manufacturers: Provide products of one of the following:
      a. Robroy Industries.
      b. Permacote Industries.
      c. OCAL, Inc.
      d. Or equal.
   3. Use: Provide on flexible conduit in areas designated as corrosive locations.

2.8 SEALED FITTINGS

A. Manufacturers: Provide products of one of the following:
   1. Crouse Hinds Company.
   2. Appleton Electric Company.
   3. Or equal.

B. Materials and Construction:
   1. Cast gray iron alloy, or cast malleable iron, or copper free aluminum bodies with zinc electroplate and lacquer or enamel finish.
   2. Ample opening with threaded closure for access to conduit hub for making dam.
   3. In corrosive locations, fittings shall include factory-applied 40-mil PVC coating.
   4. Construct fitting to allow 40 percent cross-sectional fill.

C. Sealing fiber for forming the dam within the hub and sealing compound shall be suitable for use with fittings furnished, and shall be products of fitting manufacturer.

D. Sealing fitting, fiber, and sealing compound shall conform to UL 886.

2.9 EXPANSION AND DEFLECTION FITTINGS

A. Products and Manufacturers: Provide one of the following:
   1. Type DX for expansion/deflection or AX for expansion only, by O-Z Gedney Company.
   2. Type XD for expansion/deflection or XJ for expansion only, by Crouse Hinds Company.
   3. Type DF for expansion/deflection or XJ for expansion only, by Appleton Electric Company.
   4. Or equal.

B. Cast gray iron alloy or bronze end couplings, malleable iron, or hot-dipped galvanized body, stainless steel clamps and tinned copper braid bonding jumper. Fitting shall be watertight, corrosion-resistant, UL-listed, and compatible with the conduit system.

C. Features:
   1. Expansion/Deflection Fittings:
      a. Axial expansion or contraction up to 3/4-inch.
      b. Angular misalignment up to 30 degrees.
      c. Parallel misalignment up to 3/4-inch.
   2. Expansion Fittings:
      a. Expansion/Contraction: Eight-inch total movement.

D. Expansion/Deflection fittings shall comply with UL 514B and UL 467.

2.10 PULL, JUNCTION AND TERMINAL BOXES

A. General:
   1. Materials and Construction - Wet Locations:
      a. Rating:
         1) Pull boxes in wet, corrosive, or outdoor areas shall be NEMA 4X.
         2) Boxes for areas classified as hazardous locations, where required by NEC, shall be explosion-proof and comply with UL 886.
      b. Material:
         1) Cast gray iron alloy with hot-dip galvanized finish, or cast malleable iron bodies and covers.
         2) Large boxes not generally available in cast iron construction shall be copper-free aluminum alloy or Type 316 stainless steel, as required by location.
         3) In corrosive locations, where the conduit system is PVC-coated, boxes shall be cast metal with factory-applied 40-mil PVC coating, Type 316 stainless steel, or non-metallic thermoplastic or fiberglass reinforced plastic material.

c. Gasket:
1) Provide neoprene gaskets for wet and corrosive locations.
2) Gaskets shall be an approved type designed for the purpose. Improvised gaskets are not acceptable.
d. Access: Stainless steel cover bolts.
e. Features:
1) External mounting lugs.
2) Drilled and tapped conduit holes.
3) Boxes where conduits enter building or structure below grade shall have 1/4-inch drain hole at bottom of the box.
4) Provide threaded connections for explosion proof boxes.

B. Terminal Blocks:
1. Products and Manufacturers: Provide one of the following:
a. Allen-Bradley Company, Bulletin, Model 1492.
b. General Electric Company, Model CR151K.
2. Material and Construction:
a. NEMA-rated nylon modular terminal blocks.
b. 600-volt rated.
c. Control and alarm circuit terminals shall be screwed type with permanently affixed numeric identifiers beside each connection.
d. Power terminals shall be copper and rated for the circuit ampacity.
3. Manufacturers: Provide products of one of the following:
a. Appleton Electric Company.
b. Crouse-Hinds Company.
c. Hoffman Engineering Company.

2.11 IDENTIFICATION FOR ELECTRICAL SYSTEMS.

A. Engraved Identification Devices (Nameplates and Legend Plates):
1. Nameplates:
a. Laminated thermoset plastic, 1/16-inch thick, engraved condensed block black lettering on white background, square corners, and beveled front edges, or match existing.
b. Size: As required.
c. Letter Size: Minimum 3/16-inch.
d. Nameplates one-inch or less in height shall have one mounting hole at each end. Nameplates greater than one-inch in height shall have mounting holes in the four corners.
2. Legend Plates:
a. Legend plates for pushbuttons, pilot lights, selector switches, and other panel-mounted devices shall be large size with dimensions of approximately 2-7/16 inches wide by 2-13/32 inches tall (Allen Bradley large automotive size), plastic, custom engraved with black letters on white background.
1) Provide standard-size legend plates where devices are mounted

on motor control centers and spacing of devices precludes using automotive-size legend plates.

b. Lettering size and line weight shall be the same for all legend plates on the same panel or enclosure. Maximum size shall be 1/4-inch and minimum size shall be 1/8-inch.

B. Safety Signs and Voltage Markers:
1. Provide high voltage signs for equipment operating over 600 volts.
2. High-Voltage Safety Signs for Outdoor Applications:
a. Products and Manufacturers: Provide one of the following:
1) B-120-45471 by Brady.
b. Unless otherwise shown or indicated, high voltage safety signs shall be not less than 10 inches high by 14 inches wide, of fiberglass reinforced plastic, and shall comply with 40 CFR 1910.145. Signs shall resist fading from exposure to temperature extremes, ultraviolet light, abrasive, and corrosive environments, and shall read, "DANGER – HIGH VOLTAGE – KEEP OUT"
c. Mounting hardware shall be Type 316 stainless steel.
3. Low-Voltage Safety Signs:
a. Products and Manufacturers: Provide one of the following:
1) B-302-86060 by Brady.
b. Low voltage safety signs shall be pressure-sensitive vinyl complying with 40 CFR 1910.145, five inches by 3.5 inches in size, and shall read, "DANGER – 480 VOLTS".
4. Low-Voltage Markers:
a. Products and Manufacturers: Provide one of the following:
1) CV442xx by Brady.
b. Low voltage markers shall be either pressure-sensitive vinyl or vinyl cloth with black lettering on orange background and shall read, "120 VOLTS", "208 VOLTS", "120/208 VOLTS", or "240 VOLTS" as required.

C. Arc-flash Safety Signs:
1. Products and Manufacturers: Provide one of the following:
a. Brady.
b. Or equal.
2. Warning signs shall be adhesive-backed polyester.
3. Warning signs shall read, "Warning – Arc Flash and Shock Hazard. Appropriate PPE Required. Arc flash warning signs shall indicate the flash protection boundary, incident energy in calories per square centimeter, hazard level, description of required protective clothing, shock hazard, limited approach boundary, restricted approach boundary, prohibited approach boundary, and equipment name.

D. Voltage System Identification Directories:
1. General:

a. Directories shall be laminated thermoset plastic, 1/16-inch thick, engraved block black letters on white background, square corners, and beveled front edges.
b. Directories shall identify all voltage systems within building or structure.
c. Directories shall list the colors that identify ungrounded and grounded conductors of each system.
d. Colors shall be in accordance with Section 26 05 19, Low Voltage Electrical Power Conductors and Cables, Section 26 05 13.23, 15KV Cable, and Section 26 05 13.26, 5KV Cable.
e. Example Directory Text:

Voltage System Identification		
System	**A, B, C**	**Neutral**
277/480	Brown, Orange, Yellow	Gray
120/208	Black, Blue, Red	White

2. Large directories for rooms shall have text height not less than 1/2-inch.
3. Small directories for equipment shall have text height of not less than 1/4-inch.

E. Conduit Labels:
1. Products and Manufacturers: Provide the following:
a. B-498-xxxxx by Brady for:
1) Conduit ID (P-XXXX, C-XXXX)
2) Conductor Voltage (480V, 208V, 120V)
3) Identifier (Power, Controls, Instrumentation)
2. Shall be thermal transfer printable, repositionable coated vinyl cloth labels.
4. Shall be blank for use with custom printed labels.
5. Custom Labels:
a. Shall have black lettering on yellow background.
b. Shall not contain abbreviations in legend.
c. Shall be custom printed on continuous tape with permanent adhesive using thermal printer specified below.

F. Wire Identification:
1. Heat Shrinkable Wire and Cable Labeling System:
a. Products and Manufacturers: Provide one of the following:
1) B-341 PS-xxx-2W by Brady.
b. White heat-shrinkable irradiated polyolefin shrink-on sleeves. Labels shall be thermal printed. Labels shall be not less than two inches wide.
2. Wrap-Around Wire and Cable Labeling System:
a. Products and Manufacturers: Provide one of the following:
1) THT-XX-427 by Brady.
b. Self-laminating white/transparent self extinguishing vinyl strips.

Length shall be sufficient to provide at least 2.5 wraps. Labels shall be thermally printed and not less than two inches wide.

G. Detectable Underground Warning Tape:
   1. Products and Manufacturers: Provide one of the following:
      a. Indentoline by Brady.
   2. Material: Polyethylene or polyester with detectable metal core and polyester underlaminate.
   3. Width: Two inches.
   4. Color and Labeling: Yellow or red with permanently imprinted black letters: "CAUTION – Buried Electric Line", repeated continuously over full length of tape.

H. Thermal Printing System:
   1. Utilize thermal transfer process to provide non-smearing labels and markers.
   2. Wire and Cable Markers:
      a. Portable, Products and Manufacturers: Provide one of the following:
         1) TLS2200 by Brady.
      b. Desktop, Products and Manufacturers: Provide one of the following:
         1) 200M by Brady.
   3. Cable Markers:
      a. Portable, Products and Manufacturers: Provide one of the following:
         1) Handimark by Brady.
         2) Or equal.
      b. Desktop, Products and Manufacturers: Provide one of the following:
         1) Labelizer PLUS by Brady.

I. Generator System Warning Signs:
   1. Generator warning signs shall be labeled in accordance with NEC Article 700, NEC Article 701, or NEC Article 702.
   2. Material, Colors, Letters: Plastic with white letters on red background. Letters shall be not less than 3/8-inch high.
   3. Attachment: Use stainless steel self-tapping screws.
   4. Location warning sign shall read, "WARNING – THIS SITE EQUIPPED WITH A DIESEL DRIVEN STAND-BY GENERATOR LOCATED ON THE SITE".
   5. Generator ground warning sign shall read, "WARNING – GENERATOR GROUNDED CIRCUIT CONDUCTOR IS CONNECTED TO THE GROUNDING ELECTRODE CONDUCTOR IN THIS ENCLOSURE. DO NOT OPERATE GENERATOR WHILE EITHER CONDUCTOR IS DISCONNECTED TO AVOID SEVERE SHOCK HAZARD AND POSSIBLE EQUIPMENT DAMAGE."

2.12 LOW VOLTAGE RECEPTACLES.

A. Receptacles:

1. Grounding receptacle, two-pole, three-wire, NEMA 5-20R configuration, ivory color.
    a. Single:
        1) Products and Manufacturers: Provide one of the following:
            a) HBL5361I by Hubbell, Inc.
            b) 5361-I by Pass & Seymour.
    b. Duplex:
        1) Products and Manufacturers: Provide one of the following:
            a) HBL5362I by Hubbell, Inc.
            b) PS5362-I by Pass & Seymour.
    c. Weather-resistant Duplex:
        1) UL-listed as weather-resistant.
        2) Products and Manufacturers: Provide one of the following:
            a) HBL5362IWR by Hubbell, Inc.
            b) WR5362-I by Pass & Seymour.

B. Ground Fault Interrupting Receptacles:
    1. Duplex grounding receptacle, two-pole, three-wire, NEMA 5-20R configuration, 125-volt AC, 20 amperes, gray color with ground fault circuit interrupting (GFCI) protection.
    2. Ground fault interrupting receptacles shall comply with UL 943.
    3. Provide Type 302 stainless steel cover-plate conforming to UL 514D. Provide weatherproof-while-in-use cover where shown on the Drawings as "WP" or "WPU", and provide where located in wet or corrosive location.
    4. Products and Manufacturers: Provide one of the following:
        a. GFR5362SGY by Hubbell, Inc.
        b. 2091-GRY by Pass & Seymour.
    5. Weather-resistant Ground Fault Interrupting Receptacles
        a. Products and Manufacturers: Provide one of the following:
            1) 2095TRWRGRY by Pass & Seymour.

2.13 SNAP SWITCHES.

A. Switches for Non-Hazardous Locations:
    1. Single pole AC toggle switch, quiet type, 120/277-volt AC, 20 amperes, Ivory, specification grade.
        a. Products and Manufacturers: Provide one of the following:
            1) Catalog No. 1221-I, by Harvey Hubbel, Inc.
            2) Catalog No. 1991-I, by Arrow-Hart, Inc.
            3) Catalog No. 20AC1-I, by Pass & Seymour
    2. Single pole, three-way AC toggle switch, quiet type, 120/277-volt AC, 20 amperes, Ivory, specification grade.
        a. Products and Manufacturers: Provide one of the following:
            1) Catalog No. 1223-I, by Harvey Hubbell, Inc.
            2) Catalog No. 1993-I, by Arrow-Hart, Inc.
            3) Catalog No. 20AC3-I, by Pass & Seymour

B. Switch Covers:
   1. Indoor covers shall be Type 304 stainless steel.
   2. Outdoor, wet, or corrosive location covers shall be weatherproof and corrosion resistant.

2.14 DISCONNECT SWITCHES.

A. Single Throw, Circuit Disconnect Switches:
   1. Type: Fused or unfused, horsepower rated, heavy-duty, single throw, quick-make, quick-break mechanism, visible blades in the "OFF" position and safety handle.
   2. Rating: Voltage and current ratings and number of poles as required for motor or equipment circuits being disconnected. Switches shall bear a UL label and shall comply with the requirements of UL 98, NEMA KS 1 and NEMA 250.
   3. Provide auxiliary dry contacts to indicate switch position.
   4. When fused switches are indicated, provide fuses as recommended by manufacturer or equipment being served.

2.15 CONTROL STATIONS.

A. Manufacturers: Provide products of one of the following:
   1. Cutler-Hammer.
   2. General Electric Company.
   3. Allen Bradley Company.
   4. Square-D Company.
   5. Or equal.

B. Type: 30.5 mm industrial, heavy duty, oil-tight construction with clearly-marked legend plates.

C. Emergency Stop or Lockout Stop: Lockout stop pushbuttons shall be two-position, push-pull type with maintained contact and mushroom head. Provide control stations with padlocking attachment and legend plate reading “PUSH-TO-STOP, PULL-TO-START”.

D. Pushbuttons: Momentary or maintained types, NEMA A600 contact rating.

E. Selector Switches: Rotary type with round or oval handles and positioning device to securely hold switch in selected position for maintained type and for spring return from left, right, or both left and right to maintained position.

F. Control stations shall comply with NEMA ICS 2, NEMA ICS 5, and UL 508, and shall bear the UL label.

G. Indicating Lights: 1LED Type, 120 VAC, push-to-test. Lens color shall be in accordance with this Section - Identification for Electrical Systems.

H. Enclosures: As required for area classifications specified in this Section, and complying with NEMA 250 and NEMA ICS 6.

I. Identification: Identify enclosures in accordance with this Section. Devices shall include front-mounted nameplates identifying function and equipment controlled, if not readily apparent.

2.16 LIGHTNING PROTECTION FOR STRUCTURES.

A. Guarantee:
   1. Lightning protection system shall be guaranteed by lightning protection system manufacturer against defective parts and installation for one year from date of Substantial Completion.

B. System Description:
   1. Each lightning protection system shall consist of a complete cable network on the roof or top of structure involving all air terminals, splices, and bonds with cable downleads routed concealed either directly in the building construction or in conduit to ground, and ground rods all connected together in an appropriate manner and certified by LPI to provide a zone of protection to entire building against lightning strikes, in accordance with NFPA 780.
   2. Provide complete, certified lightning protection system. Provide bonding connections and miscellaneous items for complete system.

C. Manufacturers: Provide products of one of the following:
   1. Heary Brothers Lightning Protection Company.
   2. Thompson Lightning Protection, Inc.
   3. Or equal.

D. General:
   1. Size materials in accordance with NFPA 780, UL 96A, and LPI 176.
   2. Materials and equipment shall be labeled or listed by UL for use in Master Labeled lightning protection systems. Completed system shall conform to NFPA 70, NFPA 780, LPI 175, LPI 176, and UL96A.
   3. Materials shall comply in weight, size, and composition for class of structure to be protected in accordance with the following:
      a. Use Class I materials for systems on structures not exceeding 75 feet in height.
      b. Use Class II materials for systems on structures exceeding 75 feet above grade.
   4. Materials shall be corrosion-resistant, heavy-duty type. Unless otherwise specified, materials shall be Type 316 stainless steel, copper, or high copper-content bronze castings. Bolts, screws, and hardware shall be Type 316 stainless steel.

5. Use aluminum materials in locations where system components are mounted on aluminum surfaces to avoid electrolytic corrosion of dissimilar metals.
6. Provide fittings, mounting bases, couplings, connectors, fasteners, and other system devices required for complete system.

E. Ground Rods: Comply with the above section 2.4.

F. Ground Cables:
1. Ground cables shall be copper, except in connections to aluminum surfaces as required to prevent dissimilar metals reaction.
2. Ground cable stranding, number and size shall be suitable for classification of structure to be protected.
3. Exposed ground cable shall be corrosion resistant.

G. Air Terminals:
1. Air terminals shall be stainless steel 5/8-inch diameter and minimum of 18 inches long.
2. Air terminals shall include a cast bronze point protector, stainless steel adapter, and copper base.

H. Non-Metallic Conduit and Fittings:
1. Non-metallic conduit shall be Schedule 80 PVC plastic, rated for 90 degrees C, conforming to UL 651.
2. Non-metallic fittings shall be of same material and manufacturer as base conduit. Provide cement for joining fittings to conduit. Fittings shall be by same manufacturer as base conduit.

2.17 SURGE PROTECTIVE DEVICE

A. Manufacturers: Provide equipment of one of the following:
1. General Electric.
2. Schneider Electric/Square-D Company.
3. Eaton/Cutler-Hammer.

B. General:
1. SPD shall be modular, high-energy, parallel design with fast-acting transient voltage suppression using metal oxide varistors. Equipment shall provide noise attenuation with electromagnetic interference filter.
2. SPD shall comply with requirements of the following:
   a. ANSI/UL 1449.
   b. UL 1283.
   c. IEEE C62.11, IEEE C62.41 and IEEE C62.45.
3. SPD shall be suitable for operation under the following environmental conditions:
   a. Relative Humidity: Zero to 95 percent, non-condensing.
   b. Frequency: 47 to 63 Hertz.

c. Temperature: Zero to 149 degrees F.

4. SPD operating voltage and IEEE C62.41 and IEEE C62.45 Category A, B, and C application environments shall be suitable for the associated SPD location(s) shown or indicated on the Drawings.
5. SPD shall be suitable for internal and external mounting. SPD shall be field-mounted and integrated into distribution of equipment specified as follows:
   a. Main Distribution Panel (HP-1) – As specified herein.
   b. Duplex Lift Station Local Control Panel (DLS-CP) – See Section 40 60 05, Instrumentation and Control for Process Systems.
   c. Flow Equalization Local Control Panel (FE-LCP) – See Section 40 60 05, Instrumentation and Control for Process Systems.
   d. Anoxic Mixer Local Control Panel (AM-LCP) – See Section 40 60 05, Instrumentation and Control for Process Systems.
   e. Recycle Pump Local Control Panel (RP-LCP) – See Section 40 60 05, Instrumentation and Control for Process Systems.
   f. Main Air Blower Local Control Panel (MAB-LCP) – See Section 40 60 05, Instrumentation and Control for Process Systems.
   g. Lighting Distribution Panel (LP-2) – As specified herein.

C. SPD shall include a surge suppression path for each mode as required for the system configuration shown on the Drawings. Each mode shall be individually fused and equipped with thermal cutouts. SPD short-circuit rating shall be 200 kA. Protection modes shall include, to the extent applicable, the following:
   1. Line-to-line.
   2. Line-to-neutral.
   3. Line-to-ground.
   4. Neutral-to-ground.

D. SPD shall include electromagnetic interference/radio frequency interference (EMI/RFI) noise rejection filter with attenuation up to 30 dB from 10 kHz to 100 MHz.

E. SPDs and components in the operating path shall have maximum continuous operating voltage greater than 115 percent of nominal system operating voltage.

F. ANSI/UL 1449 minimum withstand rating shall be 20 kA per pole, and ANSI/UL 1449 voltage protection rating for SPD shall not exceed the following:

Modes	208Y/120	480Y/277
L-N, L-G, N-G	800	1200
L-L	1200	2000

G. SPD surge capacity based upon IEEE C62.41 location category shall, as a minimum, be the following:

Category	Application	Per Phase	Per Mode
C	Service entrance	240 kA	120 kA
B	High exposure locations (distribution equipment)	160 kA	80 kA
A	Branch locations	120 kA	60 kA

H. Provide SPD equipped with the following accessories:
   1. Surge counter with display for indicating the number of surges detected.
   2. LED indicators for monitoring device status.
   3. Audible alarm and silence switch for indicating an inoperative condition.
   4. Dry contacts, "Form C", for remote annunciation of unit status.
   5. Indicators, counter, alarm, and silence switch shall be visible and accessible from front of the SPD. When SPD is integral to switchgear, motor control center, panelboard, or other equipment, indicators, counter, alarm, and silence switch shall be visible and accessible from front of the equipment in which the SPD is installed.
   6. Enclosure for each externally-mounted SPD: NEMA rating shall be as required for area classifications specified in the above section 1.1.D.

2.18 LIGHTING.

A. Type: Lighting fixtures required shall be in accordance with the Lighting Fixture Schedule on the drawings. Fixtures shall be complete with supports, ballasts, lamps, and incidentals, as required.

B. Fixtures in hazardous locations shall be listed in accordance with UL 1598 and UL 844.

C. Lamps:
   1. LED: Cool white, high-energy-efficient LED lamps with rain and dust tight enclosure and impact resistant lens with minimum 60,000 hours life expectancy unless indicated otherwise in the Lighting Fixture Schedule. Light fixture enclosure shall be UL listed and IESNA LM-79 and LM-80 compliant.
   2. Spare Parts and Extra Stock Materials: Ten percent spare lamps of each type and wattage.

D. Drivers:
   1. LED: Accepts 120V-240V, 60Hz input as required by the Lighting Fixture Schedule, with adequate thermal management system.
   2. Spare Parts and Extra Stock Materials: Ten percent spare drivers of each type and quantity, but not less than one.

E. Fixtures located in areas identified as wet or hazardous locations shall each be approved as a complete assembly, shall be clearly marked to indicate maximum wattage of lamps for which they are approved, and be protected against physical damage by suitable guards.

F. Hardware: Provide necessary hangers, supports, conduit adaptors, reducers, hooks, brackets, and other hardware required for safe fixture mounting. Hardware shall have protective, non-corrosive finish.

G. Outdoor Fixtures: Provide each fixture to be installed outdoors with cut-off lens to reduce the fixture's light pollution emissions.

H. Photocell:
   1. Products and Manufacturers: Provide one of the following:
      a. 2100 Series by Tork Time Controls, Inc.
      b. Or equal.
   2. Cadmium sulfide hermetically-sealed cell, fully temperature compensated, with time delay of not less than 15 seconds to prevent false switching.
   3. Built-in fail safe light level selector, adjustable within limits of two to 50 foot-candles and factory set at 25 foot-candles.

2.19 LOW VOLTAGE COMBINATION MAGNETIC MOTOR STARTERS (Requirements for Local Control Panels)

A. Type: Combination type with magnetic-only motor circuit protector with interrupting rating of not less than 25,000 ampere RMS symmetrical, unless otherwise indicated on the Drawings. Magnetic coil operated, NEMA horsepower rated, with thermal overload protection. Coil shall be rated 120 VAC.

B. Functional Type: Full-voltage, single speed, non-reversing, unless otherwise shown or indicated on the Drawings.

C. Control power transformer fused and grounded on low-voltage (120 VAC) side for all starters.

D. Auxiliary contacts for motor space heaters, remote status signals, and interlocks as shown or indicated on the Drawings and as required.

E. Overload Relays: Provide an overload relay for each motor starter. Overload relays shall be in accordance with:
   1. Thermal Overload Relays: Relays shall be thermal, bimetallic type, direct or current sensing. Relays shall include ambient compensation and be equipped with separate heater elements sized for full load amperes and service factor of actual motors furnished.
   2. Each overload relay shall be manual-reset type and include provisions for resetting by an insulating button on front of starter unit door.
   3. Overload relay shall include normally-open auxiliary contact for remote alarm purposes.
   4. Size overload relay for full-load amperes and service factor of actual motors installed.

F. Pushbuttons, selector switches, pilot lights, and other devices shall be as shown on the Drawings and in accordance with Section 40 60 05, Instrumentation and Control for Process Systems.

G. Provide nameplate identifying equipment controlled in accordance with Section 2.11 Identification for Electrical Systems.

2.20 CIRCUIT BREAKERS (Requirements for Local Control Panels)

A. Type:
   1. Breakers shall be molded-case with inverse time and instantaneous tripping characteristics.
   2. Circuit breakers shall be operated by toggle-type handle and shall have a quick-make, quick-break, over-center switching mechanism that is mechanically trip-free. Automatic tripping of circuit breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy with arc-extinction chutes. Push-to-trip button shall provide local manual means to exercise the trip mechanism.
   3. For frame sizes 250-ampere and above, provide with interchangeable trip unit.
   4. For frame sizes 150-ampere and below, provide with non-interchangeable trip.
   5. Terminations: Provide terminals for accommodating two normal-range copper cables per phase.
   6. Circuit breakers shall be UL-listed and bear the UL label, and shall comply with UL 489 and NEMA AB 1.

B. Interrupting Capacities:
   1. 100-ampere, 150-ampere, and 225-ampere Frame: Minimum 25,000 amperes RMS symmetrical at 480-volt, three-phase, 60 Hertz, or as shown.

2.21 INDUSTRIAL CONTROL TRANSFORMER (Requirements for Local Control Panels)

A. Individual control power transformers for all starters, capacity as required for all control circuit devices, sized as required, Class A insulation, two primary fuses, 120-volt secondary, one secondary fuse, and the other secondary leg grounded.
   1. To properly size circuit breakers, starters, and control power transformers, obtain motor nameplate data on equipment being furnished under this and other contracts as required.
   2. To properly size control power transformers, obtain data on motor space heater and other accessories.

2.22 PANELBOARDS

A. Manufacturers: Provide products of one of the following:
   1. General Electric Company.
   2. Eaton/Cutler-Hammer.
   3. Schneider Electric/Square D Company.
   4. Or equal.

B. Rating: Voltage rating, current rating, number of phases, number of wires and number of poles as shown or indicated on the Drawings.

C. Circuit Breakers: Molded case, bolt-in thermal magnetic type with number of poles and trip ratings as shown or indicated. Where indicated on the Drawings, circuit breakers shall be ground fault circuit interrupting type equipped with solid state sensing and five-milliamp sensitivity.

D. Circuit breakers for 480-volt panelboards shall have minimum interrupting rating of 14,000 ampere RMS symmetrical, unless otherwise indicated on the Drawings. Circuit breakers for other panelboards shall have minimum interrupting rating of 10,000 ampere RMS symmetrical, unless otherwise indicated on the Drawings.

E. Bus Bars: Bus bars shall be 98 percent conductivity copper. Four-wire panelboards shall have solid neutral bar. Each panel shall have ground bus bar.

F. Main: Panelboards shall have main circuit breaker, unless the Drawings specifically indicate main lugs only.

G. Connect branch circuit breakers for sequence phasing.

H. .Enclosures: Panel enclosures shall be as required for the area classifications indicated in this Section, unless otherwise indicated on the Drawings.

I. Construction: Code-grade steel, ample gutter space, flush door, flush snap latch and lock. Panelboards shall comply with NEMA PB 1 and UL 67.

J. Trim: Surface or flush as required.

K. Directory: Typed or computer-printed card, with transparent protective cover in frame on back of door giving circuit numbers and area or equipment served.

L. Identification: Identify panelboards in accordance with this Section. Identification shall indicate panel number and voltage.

M. Directory of Existing Panelboards: When adding or removing breakers or loads from existing panelboards, provide a new typed or computer-generated directory card, indicating the circuit numbers and equipment served.

N. Provide surge protective device in accordance with this Section, for each panelboard shown or indicated on the Drawings. Surge protective device shall be included and factory-mounted within panelboard by panelboard manufacturer. Surge protective device monitoring and display shall be visible from front of panelboard.

2.23 DRY TYPE TWO_WINDING TRANSFORMER

A. Type: Dry type, air cooled, low temperature rise. Transformers 15 kVA and larger shall be energy efficient, complying with NEMA TP-1 Class 1 efficiency levels. Transformers less than 15 kVA shall be general purpose.

B. Rating: KVA, primary voltage and connection, secondary voltage and connection, frequency and number of phases shall be as shown on the Drawings.

C. Insulation: Insulation and average winding temperature rise (in a 40 degree C maximum ambient) for rated kVA per the following table. Energy efficient transformers shall be capable of 15 percent continuous overload at 150 degrees C temperature rise.

kVA Rating	Insulation Class (degrees C)	Temperature Rise (degrees C)
1 to 15 kVA	185	115
25 to 500 kVA	220	115

D. Winding Taps, Transformers 15 kVA and Less: Two 5-percent below rated voltage, full capacity taps on primary winding.

E. Winding Taps, Transformers 25 kVA and Larger: Two 2-1/2-percent above rated voltage and four 2-1/2+ percent below rated voltage, full capacity taps on primary.

F. Basic impulse level shall be 10 kV.

G. Sound Level: NEMA ST-20 standard.

H. Enclosure: UL listed for the application.

I. Identification: Identify transformers in accordance with this Section, with the transformer number and voltages, connection data, kVA ratings, impedance, and overload capacity.

J. Transformers shall comply with NEMA ST-20, NEMA TP-1, NEMA TP-2, and UL 1561.

K. Transformers shall bear the label of the Underwriters' Laboratories, Inc.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which Work will be performed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. General:
   1. Install materials and equipment in accordance with the Contract Documents, Laws and Regulations, approved (and accepted, as applicable) Shop Drawings and other CONTRACTOR submittals, and manufacturer's recommendations.
   2. Provide tools and equipment required to trace circuits necessary for proper execution of the Work.
   3. Define and identify all wiring, circuit terminations, and equipment to be modified to ensure proper interface of components. The Contract Price includes all costs associated with field services specified for a complete and functional system.

B. 600 Volt Cable Installation
   1. Install cables complete with proper terminations at both ends. Check and correct for proper phase sequence and proper motor rotation.
   2. Pulling:
      a. Use insulating types of pulling compounds containing no mineral oil.
      b. Pulling tension shall be within limits recommended by wire and cable manufacturer.
      c. Use dynamometer where mechanical means are used.
      d. Cut off section subject to mechanical means.
   3. Bending Radius: Limit to minimum of six times cable overall diameter.
   4. Slack: Provide maximum slack at all terminal points.
   5. Splices:

a. Where possible, install cable continuous, without splice, from termination to termination.
b. Where required, splice as shown and also where required for cable installation. Splices below grade, in manholes, handholes, and wet locations shall be waterproof.
c. Splices are not allowed in conduits.

6. Identification:
   a. Identify conductors in accordance with above section 2.12.
   b. Identify power conductors by circuit number and phase at each terminal or splice location.
   c. Identify control and status wiring using numeral tagging system.
7. Color-code power cables as follows:
   a. No. 8 AWG and Smaller: Provide colored conductors.
   b. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, wrapped in overlapping turns to cover an area of at least two inches.
   c. Colors: Match color scheme in use at the Site. If the Site does not have an existing color scheme, use the following colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts Three-Phase, Four-Wire Delta, Center Tap Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts Three-Phase, Four-Wire	rounded Neutral Phase A Phase B Phase C	Gray Brown Orange Yellow

C. Instrumentation Cable Installation
   1. Install cables complete with proper terminations at both ends.
   2. Install in conduit separate from power cables, unless shown or indicated otherwise.
   3. Ground shield on shielded cables at one end only and as recommended by instrument manufacturer.
   4. Identify conductors in accordance with above section 2.12.

5. Install and terminate Supplier-furnished cable in accordance with equipment manufacturer requirements and cable manufacturer's recommendations.
6. Install in accordance with Laws and Regulations, including NEC.

D. Grounding and Bonding Installation
1. Provide ground grids as shown and indicated on the Drawings.
2. Provide No. 4/0 bare copper cable around exterior perimeter of structures at not less than 2.5 feet below grade, unless otherwise shown or indicated on the Contract Documents.
3. For structures with steel columns, provide No. 4/0 ground cable from grid to each column around perimeter of structure. Connect cable to steel with exothermic welds.
4. Connect grids to continuous underground water pipe system, when practical.
5. For new structures with concrete foundation or footings, connect structure's reinforcing steel or other concrete-encased electrode to grounding grid.
6. Provide accessible test points for measuring the ground resistance of each grid.
7. Weld all buried connections except for test points.
8. Ground electrical equipment in compliance with Laws and Regulations and the Contract Documents.
9. Equipment grounding conductors shall be bare stranded copper cable of adequate size installed in metal conduit where required for mechanical protection. Ground conductors, pulled into conduits with non-grounded conductors, shall be insulated. Insulation shall be green.
10. Control panels grounding conductors shall be bare stranded copper cable of adequate size to ground grid from AC ground bus, and an insulated stranded copper cable of adequate size to ground grid from DC ground bus.
11. Connect ground conductors to conduit with copper clamps, straps, or with grounding bushings.
12. Connect to piping by welding or brazing. Use copper bonding jumpers on gasketed joints.
13. Connect to equipment by means of lug compressed on cable end. Bolt lug to equipment frame using holes or terminals provided on equipment specifically for grounding. Do not use hold-down bolts. Where grounding provisions are not included, drill suitable holes in locations recommended by equipment manufacturer or designated by ENGINEER.
14. Connect to motors by bolting directly to motor frames, not to soleplates or supporting structures.
15. Connect to service water piping by means of copper clamps. Use copper bonding jumpers on gasketed joints.
16. Scrape bolted surfaces clean and coat with conductive oxide-resistant compound.
17. Fence Grounding: Provide at maximum intervals of 1,500 feet, except as follows:
    a. Ground fencing within 100 feet of buildings, structures, walkways, and roadways at maximum intervals of 750 feet.

1) Gates and Other Fence Openings: Ground fence on each side of opening.
   a) Bond metal gates to gate-posts.
   b) Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2-gage wire and bury wire at least 1.5 feet below finished ground surface.

b. Protection at Crossings of Overhead Electrical Power Lines: Ground fencing at location of crossing and at maximum distance of 150 feet on each side of crossing.

c. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2, unless otherwise shown or indicated.

d. Grounding Method: At each grounding location, drive ground rod vertically until the top is six inches below finished ground surface. Connect rod to fence with No. 6-gage conductor. Connect conductor to each fence component at grounding location, including the following:
   1) Each Barbed Wire Strand: Make grounding connections to barbed wire with wire-to-wire connectors designed for this purpose.

e. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

f. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Provide connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1) Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
   2) Make connections with clean, bare metal at points of contact.
   3) Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
   4) Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
   5) Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

g. Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor.

E. Hangers and Supports Installation
   1. Provide hangers and supports for electrical systems with necessary channels, fittings, brackets, and related hardware for mounting and supporting materials and equipment. Provide anchor systems, concrete inserts, and associated hardware for proper support of electrical systems.

2. Install equipment and devices on hangers and supports as shown on the Drawings, as specified, and as required.
3. Install hangers and supports level, true, free of rack, and parallel and perpendicular to building walls and floors, so that the hangers and supports are installed in a neat, professional, workmanlike manner.
4. Holes in suspended ceilings for rods for hangers and supports and other equipment shall be provided adjacent to bars, where possible, to facilitate removal of ceiling panels.
5. Coordinate installation of hangers and supports with equipment, cabinets, consoles, panels, enclosures, boxes, conduit, cable tray, wireway, busway, cablebus, piping, ductwork, lighting fixtures, and other systems and equipment. Locate hangers and supports clear of interferences and access ways.
6. Anchor Bolts, Expansion Anchors, and Concrete Inserts: Shall be in accordance with structural drawings.
7. Mounting of Conduit:
    a. Provide space of not less than 1/4-inch between conduit surfaces and abutting or near surfaces except struts, cable trays, steel beams, and columns.
    b. Fasten conduit to struts, cable trays, steel beams, and columns using specified clamps and straps as shown, specified, and required.
    c. Devices shall be compatible with size of conduit and type of support. Following installation, size identification shall be visible and legible.
    d. Install conduit supports and fasteners in accordance with above section 2.5.
8. Freestanding: Unless otherwise specified or shown on the Drawings, provide supports for floor-mounted equipment, cabinets, consoles, panels, enclosures, and boxes. Such supports shall be 3.5-inch high concrete equipment base with a 45 degree chamfered edge. Base shall extend two inches beyond outside dimensions of equipment on all sides.
9. Wall-Mounted:
    a. Provide space not less than 1/4-inch between cabinets, consoles, panels, enclosures, and boxes and the surface on which each is mounted. Provide non-metallic or stainless steel spacers as required.
    b. Do not mount equipment, enclosures, panels, and boxes directly to beams or columns. Mount struts to beams or columns using beam clamps, and mount equipment, enclosures, panels, and boxes to the struts.
10. Floor Stand Rack:
    a. Where equipment, cabinets, consoles, panels, enclosures, and boxes cannot be wall-mounted, provide an independent floor stand rack.
    b. Floor stand rack shall consist of struts, plates, brackets, connection fittings, braces, accessories, and hardware assembled in a rigid framework suitable for mounting of intended materials and equipment.
    c. Equip floor stand racks with brackets and bases for rigidly-mounting the framework to the ceiling or floor, as applicable; or equip floor stand racks with beam clamps, angle plates, washers, and bolts for fastening to beam flanges, as applicable.

d. When equipment, cabinets, consoles, panels, enclosures, and boxes weigh more than 100 pounds:
    1) Main vertical supports of floor stand rack assemblies shall be back-to-back struts.
    2) Bracing, clamping and anchoring of each floor stand rack shall be sufficient to ensure rigidity of the floor stand rack with the intended equipment, enclosures, conduit, cable tray, busway, cablebus, and wireway installed. Floor stand racks shall not be deflected more than 1/8-inch by a 100-pound force applied at any point on the floor stand rack in any direction.

11. Drilling into beams or columns is not allowed unless authorized by ENGINEER.
12. Tighten nuts and bolts to the manufacturer's recommended torque values.
13. Field Cutting:
    a. Cut edges of strut and hanger rod shall have rounded corners, edges beveled, and burrs removed. If field cutting the strut is required, use clean, sharp, dedicated tools. Remove oil, shavings, and other residue of cuttings prior to installation.
    b. Coatings: To prevent corrosion:
        1) Coat cut edges with epoxy-base touchup paint.
        2) Coat cut edges with zinc-rich paint.

F. Rigid Conduits
1. Supports:
    a. Rigidly support conduits by clamps, hangers, or Unistrut-type channels. Conduit supports and accessories shall be as specified herein.
    b. Support single conduits by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the support surface. Support multiple runs of conduits on trapeze type hangers.
2. Fastenings: Fasten raceway systems rigidly and neatly to supporting structures using specified materials.
3. Exposed Conduit:
    a. Install parallel or perpendicular to structural members or walls.
    b. Where possible, run in groups. Provide conduit racks of suitable width, length, and height, arranged to suit field conditions. Provide support every ten feet, minimum.
    c. Install on structural members in protected locations.
    d. Locate clear of interferences.
    e. Provide six inches of clearance from hot fluid lines and 1/4-inch from walls.
    f. Install vertical runs plumb. Unsecured drop length shall not exceed 12 feet.
4. Conduit Runs below Roadways and Parking Lot Areas:
    a. Provide protection for conduits run below roadways and parking lots, and in areas as shown in the drawings.

b. Run conduit below structural concrete in center of slabs and above waterstops. Conduit connections shall be made watertight.
c. Before placing concrete, arrange for observation of conduit installation by ENGINEER and make necessary conduit location measurements and provide required information on record documents.
d. See Electrical details for installation requirements.

5. Underground Conduits:
   a. Install individual, underground conduits minimum of 24 inches below grade, unless otherwise shown or indicated.
   b. Perform excavation, bedding, backfilling, and surface restoration, including pavement replacement where required, in accordance with Section 31 20 00, Earth Moving, and Section 32 12 00, Flexible Paving.
   c. Install warning tape 12 inches below finished grade over buried conduits.
6. Empty Conduits:
   a. Install nylon pull wire in each empty conduit and cap conduits not terminating in boxes with permanent fittings designed for the purpose.
7. Field Bends: No indentations. Diameter of conduit shall not vary more than 15 percent at bends.
8. Joints:
   a. Apply conductive compound to joints before assembly.
   b. Make up joints tight and ground thoroughly.
   c. Use standard tapered pipe threads for conduit and fittings.
   d. Cut conduit ends square and ream to prevent damaging wire and cable.
   e. Use full threaded couplings. Split couplings are not allowed.
   f. Use strap wrenches and vises to install conduit. Replace conduit with wrench marks.
   g. Apply zinc-rich paint to exposed threads and other areas of galvanized conduit system where base metal is exposed.
9. Terminations:
   a. Install insulated bushings on conduits entering boxes or cabinets, except when threaded hubs are used.
   b. Provide locknuts on both inside and outside of enclosure, except when threaded hubs are used.
   c. Use of bushings in lieu of locknuts is not allowed.
   d. Install conduit hubs on conduits entering boxes or cabinets in wet and corrosive areas.
10. Moisture Protection:
    a. Plug or cap conduit ends at time of installation to prevent entrance of moisture and foreign materials.
    b. Underground and embedded conduit connections shall be watertight.
    c. Thruwall Seals and Conduit Sealing Bushings: Install for conduits passing through concrete slabs, floors, walls, or concrete block walls.
    d. Drainage: Conduit runs shall be fully drainable. Where possible install conduit runs to drain to one end and away from building. Avoid pockets or depressions in conduit runs.
    e. Seal conduit openings within control and instrumentation panels and

distribution equipment with duct sealing compound to provide watertight seal.

11. Corrosion Protection:
    a. Conduit Curb:
        1) For conduits routed in concrete slabs or floors and stub-ups through floor, provide 4-inch high concrete curb, extending two inches from outer surface of conduit penetrating floor, to prevent corrosion. For floor-mounted equipment, concrete equipment base shall be in lieu of concrete curb.
        2) Conduit stub-ups shall be 90-degree, PVC-coated, rigid, galvanized steel conduit elbow. PVC-coated elbow shall extend a minimum of 1/2-inch above top of concrete curb or equipment base. Should elbow not reach specified height, provide PVC-coated conduit extension to accommodate specified requirements. Provide coupling or fitting for transition from PVC conduit in slab to PVC-coated elbow.
        3) For conduits stubbing up and terminating at equipment enclosure mounted on concrete base, provide insulated grounding bushing on PVC-coated rigid steel elbow.
        4) For conduits stubbing up and extending to boxes, cabinets, and other enclosures above the concrete curb in wet and dusty areas, provide conduit coupling/fittings between the PVC-coated rigid steel elbow and rigid steel conduit for transition between the two conduit types.
        5) For conduits stubbing up and extending to boxes, cabinets, and other enclosures above the concrete curb or equipment base in corrosive areas, continue conduit system with PVC-coated rigid steel conduit
    b. Dissimilar Metals:
        1) Prevent occurrence of electrolytic action between dissimilar metals.
        2) Do not use copper products in connection with aluminum, and do not use aluminum in locations subject to drainage of copper compounds on bare aluminum.
        3) Back paint aluminum in contact with masonry or concrete with two coats of aluminum-pigmented bituminous paint.

G. Non-metallic Conduit:
    1. Install in accordance with manufacturer's recommendations.
    2. Provide manufacturer's recommended adhesives or sealants for watertight connections.
    3. Provide expansion fittings for expansion and contraction to compensate for temperature variations. Fittings shall be watertight and suitable for direct burial.
    4. Transition to PVC-coated rigid steel conduit before making turn up to enclosures.

H. PVC-coated Rigid Steel Conduit:
   1. Install in accordance with manufacturer's recommendations.
   2. Install with manufacturer's installation tools to avoid damage to PVC coating.
   3. Repair damaged PVC coating with manufacturer's recommended touch-up compound.

I. Identify conduits, including spares, in accordance with this Section.

J. Flexible Conduit Installation
   1. Install at motors, transformers, field instruments, and equipment subject to vibration or require movement for maintenance purposes. Provide necessary reducer where equipment furnished cannot accept 3/4-inch diameter flexible conduit. Limit flexible conduit length to three feet maximum.
   2. Install in conformance with the Laws and Regulations.

K. Sealed Fitting Installation
   1. Install for hazardous locations as required by Laws and Regulations and as shown.
   2. Provide fittings for proper use relative to mounting position.
   3. Use oversized fittings with reducing bushings when necessary to maintain cable fill requirements of the conduit system.

L. Expansion/ Deflection Installation
   1. Install fittings in accordance with Laws and Regulations.
   2. Provide expansion fittings on exposed conduit runs crossing structural expansion joints and where necessary to compensate for thermal expansion and contraction. Provide expansion fittings on exposed conduit runs exceeding 200 feet.
   3. Provide expansion/deflection fittings on embedded conduit runs crossing structural expansion joints. Provide fittings above waterstops.
   4. Unless specifically shown or indicated otherwise, when crossing structural expansion joints larger than one inch, provide expansion fitting together with expansion/ deflection fitting. Install fittings on each conduit run in accordance with manufacturer's recommendations to accommodate additional movement necessary.
   5. Provide expansion/deflection fittings for underground conduit runs at penetrations of buildings, manholes, handholes, and outdoor concrete equipment pads.
   6. Where required in non-metallic conduit and duct systems, provide rigid metal conduit nipples and metal rigid-to-PVC adapters for connection to fittings. Ensure that joints exposed to water or other liquid are made watertight.

M. Pull, Junction, and Terminal Box Installation
   1. Mount boxes so that sufficient access and working space is provided and maintain clearance of not less than 1/4-inch from walls.

2. Securely fasten boxes to walls or other structural surfaces on which boxes are mounted. Provide independent supports that comply with section 2.5, where boxes will not be mounted on walls or other structural surface.
3. Install pull boxes where shown or indicated, and provide pull boxes where one or more of the following conditions exist:
   a. Conduit runs containing more than three 90-degree bends.
   b. Conduit runs exceeding 200 feet in length.
4. Provide removable, flame-retardant, insulating cable supports in boxes with any dimension exceeding three feet.
5. Field-apply PVC touch-up to scratched PVC boxes damaged during installation. Touch-up work shall be in accordance with manufacturer's recommendations and instructions.
6. Size junction, pull, and terminal boxes in accordance with NEC Article 314 and other Laws and Regulations.
7. Provide terminal blocks in boxes where shown and where cable terminations or splices are required.

N. Identification Installation
   1. Provide electrical identification in accordance with manufacturer recommendations and as required for proper identification of equipment and materials.
   2. Engraved Identification Devices (Nameplates and Legend Plates):
      a. Unless otherwise indicated in the Contract Documents, attach permanent nameplates with permanent adhesive and with 3/16-inch diameter, round head, stainless steel machine screws into drilled and tapped holes.
      b. Provide nameplate with 1.5-inch high letters to identify each console, cabinet, panel, or enclosure as shown or indicated.
      c. Provide nameplates for field-mounted motor starters, disconnect switches, manual starter switches, pushbutton stations, and similar equipment operating components, which shall describe motor or equipment function and circuit number.
      d. Provide nameplates with 1/2-inch high letters to identify each junction and terminal box shown or indicated.
   3. Except conduit, all electrical appurtenances including lighting panels, convenience outlets, fixtures, and lighting switches, shall be provided with nameplates indicating appropriate circuit breaker number(s).
   4. Push Buttons:
      a. Provide legend plates for identification of functions.
      b. Provide nameplates for identification of controlled equipment.
      c. Provide red buttons for stop function.
      d. Provide black buttons for other functions.
   5. Pilot Lights:
      a. Provide legend plates for identification of functions.
      b. Provide nameplates for identification of controlled equipment.
      Shall have lens colors as shown or indicated. Where no color is

indicated, provide the following lens colors:

Color	Legend
Green	Running, Open
Red	Stopped, Closed
Amber	Alarm
Blue	Power
White	Status

6. Selector Switches:
   a. Provide legend plates for identification of functions.
   b. Provide nameplates for identification of controlled equipment.
7. Panel Mounted Instruments:
   a. Provide nameplates for identification of function.
8. Interiors of Cabinets, Consoles, Panels, Terminal Boxes, and Other Enclosures:
   a. Provide nameplates for identification.
   b. Provide each item inside cabinet, console, panel, terminal box, or enclosure with laminated plastic nameplate as shown on approved Shop Drawings and CONTRACTOR"s other submittals. Install nameplates with adhesive.
   c. Interior items requiring nameplates include:
      1) Terminal blocks and strips.
      2) Bus bars.
      3) Relays.
      4) Rear of face-mounted items.
      5) Rear of door-mounted items.
      6) Interior mounted items that require identification when mounted externally.
   d. Circuit Breaker Directory:
      1) Provide engraved laminated plastic directory listing function and load controlled for each circuit breaker within panel used for power distribution.
9. Safety Signs and Voltage Markers:
   a. Provide safety signs and voltage markers on and around electrical equipment as shown or indicated.
      1) Install rigid safety signs using stainless steel fasteners.
      2) Clean surfaces before applying pressure-sensitive signs and markers.
   b. Install high voltage safety signs on all equipment doors providing access to uninsulated conductors, including terminal devices, greater than 600 volts.
   c. Provide cable tray safety signs on both sides of cable trays at maximum intervals of 20 feet. Install signs on side rails of tray as acceptable to ENGINEER.

1) Label cable trays that contain conductors greater than 600 volts with cable tray safety signs.
2) Cable trays that contain conductors greater than 208 volts and less than 600 volts shall be labeled with low voltage safety signs.
3) Cable trays that contain conductors of 120/208 volts shall be labeled with low voltage markers.

d. Do not label cable trays that contain only instrument signal cables.
e. Label cable trays that contain intrinsically safe wiring or cables in accordance with NEC Article 504.
f. Install low voltage safety signs on equipment doors that provide access to uninsulated 480-volt conductors, including terminal devices.
g. Install low voltage markers on each terminal box, safety disconnect switch, and panelboard installed, modified, or relocated as part of the Work and containing 120/208 volt conductors.

10. Voltage System Identification Directories
    a. Provide voltage system identification directories as required by NEC Article 210 and NEC Article 215.
    b. Provide in each electrical room voltage system identification directory mounted on wall or door at each entrance to room.
    c. For panelboards, switchboards, motor control centers, and other branch circuit or feeder distribution equipment that are not located in electrical rooms, provide voltage system identification directory mounted on equipment.
        1) Directories shall be affixed using epoxy glue. Screws or bolts shall not penetrate equipment enclosures.
        2) Directories shall be readily visible and not obscure labels and other markings on equipment.
11. Arc-flash Safety Signs:
    a. Provide arc-flash safety signs as required by NEC Article 110.
    b. Provide signs for switchboards, panelboards, motor control centers, and industrial control panels. Provide signs for control panels that contain 480 volt equipment. Provide arc flash warning signs on other equipment where the incident energy is greater than 1.2 calories per square centimeter.
12. Conduit Labels:
    a. Provide conduits with conduit labels unless otherwise shown or indicated.
    b. Do not label flexible conduit.
    c. Do not label exposed single conduit runs of less than 25 feet between local disconnect switches and their associated equipment.
    d. Conduit labels shall indicate the following information:
        1) Conductor Voltage.
        2) Conduit ID: Alphanumeric as shown on the Drawings, as assigned by CONTRACTOR for unlabelled conduits, and in

accordance with approved submittals.

3) Conductor Type.

e. Conduits that contain intrinsically safe wiring shall have an additional pipe marker provided that has blue letters on white background and reads, “INTRINSICALLY SAFE WIRING”.

1) Install intrinsically safe pipe markers in accordance with NEC Article 504 along entire installation. Spacing between labels shall not exceed 25 feet.

f. Provide conduit labels at the following locations:

1) Where each conduit enters and exits walls, ceilings, floors, or slabs.

2) Where conduit enters or exits boxes, cabinets, consoles, panels, or enclosures, except pull boxes and conduit bodies used for pull boxes.

3) At maximum intervals of 50 feet along length of conduit.

g. Orient conduit labels to be readable.

13. Wire and Cable Identification:

a. Color-coding of insulated conductors shall comply with above section 2.2

b. Use heat-shrinkable wire labels where wire or cable is terminated. Use wrap-around labels where wire or cable is to be labeled but is not terminated.

c. Do not provide labels for the following:

1) Bare (uninsulated) conductors, unless otherwise shown or indicated as labeled.

d. Provide wire and cable labels for the following:

1) New, rerouted, or revised wire or cable.

2) Insulated conductors.

3) Wire and cable terminations:

a) Wire labels shall be applied between 1/2-inch and one inch of completed termination

b) Apply cable labels between 1/2-inch and one inch of cable breakout into individual conductors.

c) Label individual conductors in a cable after breakout as specified for wires.

e. Wire or cable exiting cabinets, consoles, panels, terminal boxes, and enclosures.

1) Label wires or cables within two inches of entrance to conduit.

f. Wire or cable in junction boxes and pull boxes

1) Label wires or cables within two inches of entrance to conduit.

g. Wire and cable installed in cable tray.

1) Wire and cable shall have labels at maximum intervals of 20 feet.

h. Wire and cable installed without termination in electrical manholes.

1) Wire and cable shall have wrap-around labels applied within

one foot of exiting manhole.

i. Wire and Cable Identification System:
   1) Wire and cable labels shall be imprinted with an identifying designator.
      a) Wire and cable extending between two devices or items and that does not undergo a change of function shall be identified by a single unique designator as specified below.

14. Terminal Strip Labeling:
    a. Label panel side of terminal to match panel wire number.
    b. Label field side of terminal to match field wire number. Terminal number shall not include the Contract number.

15. Generator System Warning Signs:
    a. Provide warning signs for generator systems as required by NEC.
    b. Install generator location warning sign on or immediately adjacent to service equipment, or to "normal" source disconnecting means when generator is located out of sight of service equipment or disconnecting means.
    c. Install generator grounding warning sign on enclosure or immediately adjacent to point where generator neutral is connected to grounding electrode system if connection is made remote from generator.

O. Receptacle Installation
   1. Non-hazardous Locations: Install receptacles at locations shown,.
   2. Install receptacles with ground pole in the down position.
   3. Mount receptacles 18 inches above finished floor in non-hazardous locations and 4.5 feet above finished floor in hazardous locations, unless otherwise shown or indicated in the Contract Documents.
   4. Identification:
      a. Identify each conductor with circuit number and lighting panel number in accordance with above section 2.12
      b. Identify each receptacle with permanent phenolic tag. Tags shall include circuit number and lighting panel number.

P. Snap Switch Installation
   1. Install switches at locations as shown or indicated in the Contract Documents in outlet or device boxes
   2. Mount wall switches 4.0 feet above finished floor unless otherwise noted.
   3. Identify each conductor with circuit number and lighting panel number. Identification shall be in accordance with above section 2.12.

Q. Disconnect Switch Installation
   1. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

2. Securely fasten equipment to walls or other structural supports on which they are mounted. Provide independent stainless steel supports where no wall or other structural surface exists. Mount disconnect enclosures at a height not exceeding six feet.
3. Provide suitable 1/4-inch spacers to prevent mounting enclosure directly against walls.

R. Lightning Protection for Stuctures Installation
1. Install main conductors to provide two-way path from each air terminal horizontally or downward to connections with ground terminals.
2. Install conductors free of excessive splices and sharp bends. Conductor bends shall form an included angle of not less than 90 degrees and shall not have bend radius less than eight inches. Secure conductors to structure at intervals not exceeding three feet.
3. Conceal down conductors where possible in exterior wall construction. Space down conductors at intervals averaging not more than 100 feet around perimeter of structure. Provide at least two down conductors for each protected structure.
4. For structural steel frame construction, down conductors at upper and lower extremities and at intervals not exceeding 200 feet shall be connected to structural steel. Make connections to steel frame with bonding plates having eight square inches of contact, or by exothermic weld connections.
5. Provide air terminals at intervals not exceeding 20 feet along ridges and around perimeter of flat or gently-sloping roofs. Air terminals shall project a minimum of 10 inches above the area protected.
6. Protect flat or gently-sloping roofs exceeding 50 feet in width, by providing additional air terminals at intervals not exceeding 50 feet on flat or gently-sloping area. Locate air terminals within two feet of roof edges and outside corners of protected areas. Air terminal spacing exceeding these dimensions will be allowed if the area protected is within a "zone of protection" from lightning strikes.
7. Provide air terminals for stacks, flues, mechanical equipment, and other objects, having metal thickness less than 3/16-inch and not located within a "zone of protection". Connect objects having metal thickness 3/16-inch or greater to lightning protection system.
8. Do not connect copper equipment to aluminum surfaces, except using bimetal transition fitting. Lead coating is unacceptable for bimetal transition.
9. Install roof penetrations using through-roof assemblies with solid bars and appropriate roof flashing. Conductors shall not pass directly through roof.
10. Grounded metal bodies shall be bonded to the system using bonding connections and fittings. When ground conductors are installed in conduit, conduit shall be non-metallic.
11. Bond building ground systems including electrical, communication, and telephone services and arresters.
12. Bond metal pipes and roof mounted metal structure to the roof ground loop or to downlead cables.

13. Provide ground electrodes for each down conductor dedicated for lightning protection system and bond electrodes to building or structure grounding system. Connect down conductor to ground rod using high-strength, removable ground clamp. Provide bronze ground rod clamp having at least 1.5 inches of contact between rod and conductor, measured parallel to the axis of the rod, at ground test wells.

S. Lighting Installation
   1. General:
      a. Fixture mounting heights and locations indicated on the Drawings are approximate and are subject to revision in the field where necessary to clear conflicts and obstructions.
      b. Mounting Heights: Mounting heights or elevations are to bottom of fixture or to centerline of device.
      c. Install fixtures in accordance with Laws and Regulations, the Contract Documents, and manufacturer instructions and recommendations.
      d. Mount fixtures so that sufficient access is available for ready and safe maintenance.
      e. Securely fasten equipment to walls or other surfaces on which equipment is mounted.
   2. Suspended Fixtures:
      a. Pendant-mount using 1/2-inch diameter conduit stems.
      b. Ground to outlet box.
      c. Attach mounting to building structure with expansion anchors.
      d. Fixtures shall not be dependent on the outlet box cover screws for support.
   3. Surface Mounted Fixtures:
      a. Attach to appropriate outlet box.
      b. Attach to surface using fasteners and sealing washers when mounting fixture in damp or wet locations.
   4. Boxes and Fixtures:
      a. For units mounted against masonry or concrete walls, provide suitable 1/4-inch spacers to prevent mounting back of box directly against wall.
      b. Bolt units rigidly to building with expansion anchors, toggle bolts, hangers, or Unistrut.
      c. Do not install boxes with open conduit holes.
      d. Cable each circuit and identify with tag.
   5. Re-lamp all fluorescent fixtures provided under this Contract with new lamps following Substantial Completion.
   6. Mount photocells as shown and adjust foot-candle setting for proper dusk and dawn photo-control. Provide wiring in conduit from photocell to controls.

T. Panelboard Installation
   1. Mounting: Install panelboards at locations shown or indicated. Set cabinets so that top branch circuit breaker is not over six feet above the floor.

2. Directory: Complete typewritten or computer-printed directory indicating items controlled by each circuit breaker and the size of feeder serving the panel.
3. Arrange circuits to balance the loads on the panelboards.
4. Identify panelboards in accordance with this Section.
5. Install in accordance with Laws and Regulations, manufacturer's recommendations, and the Contract Documents. Verify proper installation prior to energizing panelboards.

U. Transformer Installation
1. Install transformers on walls or floors at locations shown. Install floor mounted transformers on raised concrete bases. Provide sufficient access and working space for convenient and safe operation and maintenance.
2. Mount transformers so that vibrations are not transmitted to the building structural parts and other equipment. Make connections to transformers with flexible conduit.
3. Adjust tap settings to provide proper voltage at panelboards.
4. Install dry type transformers in conformance with governing codes and manufacturer's instructions and recommendations, and the Contract Documents.

3.3 FIELD QUALITY CONTROL

A. Field Quality Control – General:
1. Perform field quality control for electrical Work in accordance with the Contract Documents.

B. Site Tests:
1. Prior to requesting certificate of Substantial Completion, demonstrate to ENGINEER that electrical systems and electrically-operated equipment installed or modified under the Contract operates in accordance with the Contract Documents and operates as required
2. Perform the following operational tests on electrical systems:
a. Operate power circuits to verify proper operation and connection to electrical systems materials and equipment, including mechanical key-interlocks for circuit breakers.
b. Remove and re-apply power supply to automatic transfer equipment to verify operation. Activate standby power systems to verify their automatic start-up, proper de-energization, and cool down upon resumption of normal power supply.
c. Operate control circuits, including pushbuttons, indicating lights, and similar devices, to verify proper connection and function. Operate all devices, such as pressure switches, flow switches, and similar devices, to verify that shutdowns and control sequences operate as required.
d. Operate lighting systems and receptacle devices to verify proper operation and connections.

3. Prepare and submit report on the equipment demonstration and operating field quality control tests. Report shall include complete information on the tests performed and results.

C. Manufacturer's Services:
   1. Furnish at the Site qualified, factory-trained representative(s) of equipment manufacturers for the services indicated in the Contract Documents.

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SECTION 26 32 13

ENGINE GENERATORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown on drawings, specified and required to furnish and install a standby power generator set with sub-base tank, weatherproof enclosure, remote control panel and appurtenances for a complete and operational system.
   2. The following generator system is included in this Section:
      a. Standby Rating: 60 kW, 75 kVA, 0.8 lagging power factor, 277Y/480V, 3-phase, 4-wire, outdoor, non-walk-in, weather protective enclosure, engine generator, located as shown on the drawings.
   3. Provide an automatic transfer switch as shown on the drawings and as specified in the following Section:
      a. Section 26 36 23 Automatic Transfer Switches

B. Coordination:
   1. Review installation procedures under other Sections and coordinate installation of items that must be installed with or before engine generator Work.

C. Related Sections:
   1. 05 05 33 Anchor Systems
   2. 26 36 23 Automatic Transfer Switches
   3. 26 00 05 Electrical Work

1.2 REFERENCES

A. Standards referenced in this section are:
   1. International Standards Organization (ISO), ISO 8528, Reciprocating Internal Combustion Engine Driven Alternating Current Generator Sets
   2. ISO 9001, Quality Management Systems – Requirements
   3. NEMA MG-1, Motors and Generators
   4. NFPA 30, Flammable and Combustible Liquids Code
   5. NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
   6. NFPA 70E, Electrical Safety in the Workplace
   7. NFPA 110, Standard for Emergency and Standby Power Systems
   8. UL 142, Steel Aboveground Tanks for Flammable and Combustible Liquids
   9. UL 508, Safety Standard for Industrial Control Equipment
   10. UL 2200, Standard for Safety Stationary Engine Generator Assemblies (rated 600 volts or less)

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:
      a. Shall have a minimum of five years of experience of producing substantially similar equipment to that specified and shall document at least five installations in satisfactory operation for at least five years
      b. Shall possess valid ISO 9001 certification
      c. Supplier shall have complete parts and service facilities, factory-trained service staff available for 24-hour emergency service, and be authorized to administer the warranty for all components of engine generator systems.

B. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of component manufacturer from a single generator set manufacturer. Materials, equipment, and parts shall be new, of current production of a firm that manufactures the generator set as a matched system. Manufacturer shall have full responsibility for engine generator performance. Generator set manufacturer shall prepare or approve all Shop Drawings and other submittals for all components furnished under this Section.
   2. Engine generator shall be factory-assembled. Verify in the factory that system is free from electrical and mechanical defects and conforms to the Contract Documents.

C. Regulatory Requirements: Comply with applicable provisions of authorities having jurisdiction, including the following:
   1. Code of Federal Regulations (CFR), Title 40, Part 89, Control of Emissions from New and In-Use Non-road Compression Ignition Engines, Subpart D Emission Test Equipment Provisions
   2. Local Ordinances: Systems shall conform to Laws and Regulations relative to noise control and emissions.
   3. Local and State Building Codes: Installations shall conform to applicable codes including requirements of local fire marshals.
   4. Permits: Obtain and pay for required permits, fees, and inspections by authorities having jurisdiction

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Installation drawings specific to the Project
      b. Bill of material for all equipment and spare parts
      c. Electrical wiring and interconnection diagrams with all external connections identified

d. Control panel data shall include:
    1) Description of control features
    2) Operator panel control switches and functions
    3) Alarm and status displays
    4) Provisions for remote start signal and remote status and alarm
    5) Compliance with UL 508.
e. Enclosure data shall include the following:
    1) Plan and elevation drawings showing overall dimensions, interior equipment arrangement, and working spaces
    2) Construction details and hardware specifications
    3) Exhaust piping and silencer mounting arrangement
    4) Sound attenuation provisions and decibel levels.
f. Fuel storage system data shall include:
    1) Belly tank arrangements
    2) Storage capacity and hours of operation at rated load and 3/4 load
    3) Alarm devices
    4) Construction details including secondary containment provisions for fuel tank
    5) Piping arrangements and details
    6) Compliance with UL 142 and local codes.
g. Provide the following relative to installation:
    1) Vibration isolators and anchor bolt requirements
    2) Seismic restraint requirements
    3) Provisions for fuel piping, electrical conduits, and other external connection requirements.

2. Product Data:
    a. Manufacturer's literature, specifications, engineering data sheets, and standard drawings, necessary to fully describe the engine generator sets and appurtenances, and substantiate compliance with the Contract Documents. Information shall be annotated to clearly indicate ratings, features, and options specific to the Project.
    b. Generator data shall include:
        1) Listed to UL 2200
        2) Heat rejection to room
        3) Combustion air requirements
        4) Factory painting specifications.
    c. Engine data shall include:
        1) Fuel flow at rated load
        2) Fuel consumption at 1/4, 1/2, 3/4, and full load
        3) Engine Type: Naturally aspirated or turbocharged and after-cooled
        4) Maximum exhaust backpressure
        5) Silencer attenuation rating
        6) Jacket water heater system

7) Gaseous emissions data measurements for hydrocarbons, carbon monoxide, particulate matter, and NOx conforming to 40 CFR 89, Subpart D
8) Alternator data shall include:
9) Winding insulation class and temperature rise in accordance with NEMA MG-1-1.65.
10) Standby and continuous KW/KVA ratings
11) Motor starting KVA at 90 percent sustained voltage
12) Surge KW capacity
13) Machine reactances and time constants.

d. Starting system data shall include:
1) Battery system
2) Battery charger
3) Cycle cranking configuration.

3. Testing Procedures:
a. Source Quality Control Testing Procedures: For Units 501 kW and larger, provide factory testing procedures and dates at least thirty days prior to testing.
b. Site Quality Control Testing Procedures: Testing procedures, provided at least thirty days prior to scheduled start of testing.

B. Informational Submittals: Submit the following:
1. Manufacturer's Instructions:
a. Manufacturer's unloading, rigging, installing, testing, and startup instructions. Information shall be specific to and indicate options for the Project
2. Source Quality Control Submittals:
a. For Units 500 kW and Smaller: Prototype testing certification.
b. For Units 501 kW and Larger: Provide factory testing results within seven days of completing factory test.
3. Site Quality Control Submittals:
a. Services to be performed by Supplier's representative, provided at least thirty days prior to start of Site testing.
b. Report on results of testing at the Site, provided within seven days of completion of testing.
4. Manufacturer Reports: Reports of visits to Site by Supplier's representative, including purpose of visit, problems encountered, and resolutions.
5. Qualifications Statements:
a. Manufacturer: When requested by ENGINEER, submit data documenting compliance with qualifications requirements of the Contract Documents.

C. Closeout Submittals:
   1. Operation and Maintenance Manuals: Provide in accordance with Section 01 78 23, Operations and Maintenance Data. Include the following information:
      a. Operating Instructions: Instructions for starting, stopping, protection of circuits, automatic controls, battery charging and safety considerations. Methods for adjusting speed, output voltage, and control timers.
      b. Performance Parameters: Provide nominal values and acceptable limits for output voltage, frequency, load, engine temperature, and oil pressure Include circuit drawings with component identifications for reference .
      c. Maintenance Instructions: Procedures for daily, weekly, monthly, and annual basis, or on an hours-run basis. Include guidance for selecting fuel oil, lubricating oil, use of water treatment additives, and anti-freeze.
   2. Warranty Documentation.

D. Maintenance Materials:
   1. Provide the following spare parts for each generator set:
      a. Two sets of primary and secondary fuel filters.
      b. One set of air filters.
      c. Two control circuit fuses of each size used.
      d. Two sets of lube oil filters.
      e. One set of fan belts.

1.5 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents. Obligations of CONTRACTOR under the Contract Documents shall not be limited by provisions of the specified special warranty.

B. Special Warranty:
   1. Provide manufacturer's written warranty, running to the benefit of OWNER, agreeing to correct or, at option of OWNER remove or replace materials or equipment specified in this Section found to be defective during a period of five years after date of Substantial Completion or 3,000 hours of operation.
   2. Products supplied under this Section shall be covered by a single warranty for the coverage period. Warranty shall provide for free replacement or repair of parts for five years or 3,000 hours of operation, and free labor for the first two years.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

1. Cover all generator air and exhaust openings with vapor inhibiting and water repellent material.
2. Deliver anchorage devices that are to be embedded in cast-in-place concrete in ample time to prevent delaying the Work.
3. Inspect equipment for shipping damage or loose parts upon delivery. Check for evidence of water that may have entered equipment during transit.
4. Notify ENGINEER of loss or damage to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

B. Handle equipment in accordance with manufacturer's instructions. Furnish at least one copy of instructions with equipment at time of shipment.

C. Storage:
1. Store equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.
2. Store materials for easy access for inspection and identification. Keep all materials off the ground, using pallets, platforms or other supports. Protect equipment from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Quantity and ratings of the systems shall be as indicated in Paragraph 1.1.A.2 of this Section.

B. Generators shall be rated for standby operation for duration of normal utility outage as defined by ISO 8528 for limited time operation. Generators shall meet Local and Federal Standby Generator Rating requirements.

C. Generator assemblies shall be UL 2200-listed, control panels shall be UL 508-listed and above-ground fuel tanks shall be UL 142-listed.

D. Generators shall be rated for the specified KW, without overload, at the following Site conditions:
1. Maximum Ambient Temperature: 40 degrees C.
2. Altitude: 500 feet above mean sea level.

2.2 MANUFACTURERS

A. Provide generator systems of one of the following:
1. Cummins/ONAN
2. Caterpillar

3. Approved equivalent by Owner and Engineer

2.3 ENGINE

A. Engine Type: Four-cycle compression ignition, water cooled diesel 1800 RPM. Two-cycle engines are not acceptable.

B. Engine Construction:
   1. Steel-backed bearings.
   2. Crank Case: Reinforced cast iron.
   3. Crank Shaft: Forged alloy steel with hardened journals, finished and dynamically balanced.
   4. Cylinder Head: Cast iron.
   5. Pistons: Aluminum alloy with chrome faced rings.
   6. Replaceable cylinder liners and valve seat inserts for engines rated over 200 horsepower.
   7. Single-block construction. Bolted, multiple blocks are not acceptable.

C. Cooling System:
   1. Radiator: Engine-mounted with engine-driven blower fan capable of cooling the engine under full load conditions in an ambient temperature of 104 degrees F without de-rating.
   2. Thermostatic valve in jacket water outlet between radiator and engine to maintain proper jacket water temperature. Engine-driven pump to circulate water through cooling system.
   3. Coolant: Fill system with 50 percent solution of ethylene glycol.
   4. Coolant water temperature gauge.
   5. High engine temperature shutdown.
   6. Loss of coolant shutdown.
   7. Fan guard.
   8. Radiator face duct connection.
   9. Engine coolant heaters, thermostatically controlled, capable of keeping jacket water at temperature not less than 90 degrees F in compliance with NFPA 110. Coolant heaters shall operate at 240 volts, single phase. House contactor for controlling heater in NEMA 4X stainless steel enclosure mounted on unit.

D. Lubrication System: Positive displacement, mechanical, full pressure lube pump, full flow and bypass lubrication filters with replaceable spin-on canister elements, oil drain line with valves and dipstick oil level indicator.

E. Fuel System: Suitable for operation on No. 2 diesel fuel oil. System to include primary and secondary fuel filters, fuel/water separator, fuel priming pump, flexible fuel lines and fuel pressure gauge.

F. Governor: Electronic system to provide automatic isochronous frequency regulation. System dynamic capabilities to be controlled as function of engine temperature for

fast stable operation at varying engine operating conditions. System to actively control fuel rate and excitation. Fuel rate to be regulated as function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.

G. Fuel Oil Sub-base Tank
   1. Construction: Heavy-gage steel primary tank, 24 hour capacity, and welded steel secondary containment sized to contain 110 percent of primary tank capacity. Rust inhibitor coating inside and prime- and finish-coated outside, color to match generator set exterior paint. Sub base tank capable of supporting generator.
   2. Comply with the following:
      a. UL142-listed and labeled.
      b. NFPA 30, NFPA 37, and NFPA 110.
      c. Codes for FDEP generator fuel tanks .
   3. Fittings: NPT for fuel supply and return; two-inch diameter NPT for normal vent, manual fill and level alarm; NPT for emergency vents, level gauge, basin drain, and leak detection alarm.
   4. Fuel level gauge and leak detector switch with alarm lights and contacts for remote annunciation of low fuel level and leak detection.
   5. Mushroom-type cap and screen for normal vent openings and pressure relief-type caps for emergency vent openings.
   6. Manufacturers: Provide sub-base tank of one of the following:
      a. Pryco, Inc.
      b. Tramont Corp.
      c. Approved equivalent by Owner and Engineer

H. Air Supply/Exhaust Systems:
   1. Critical grade silencer
   2. Heavy duty air cleaner with service (air restriction) indicator.
   3. Aluminized steel exhaust.

I. Air Emissions:
   1. Comply with United States Environmental Protection Agency (USEPA) standards for non-road engines and with state and local requirements.
   2. Submit emissions data measurements for hydrocarbons (HC), carbon monoxide (CO), particulate matter (PM) and oxides of nitrogen (NOx) conforming to USEPA test procedures. Include USEPA not-to-exceed requirements for each pollutant.

J. Starting System: DC system complete with engine mounted batteries, locally mounted charger and connecting cables between batteries and engine and between charger and batteries.
   1. Batteries: Lead-acid or calcium/lead antimony, engine cranking type, rated in accordance with engine manufacturer's requirements for minimum of three 15-second cranking cycles at firing speeds without recharging, and to

accommodate DC power requirements of control panel and other accessories requiring DC power.

2. Battery racks, cables, connectors, and disconnect switch.
3. Engine-mounted battery charging alternator and solid state voltage regulator.
4. Battery Charger:
    a. UL-listed, voltage regulated and equipped with float, taper and equalize charge settings.
    b. Analog DC ammeter and voltmeter; 12-hour equalize timer; AC and DC fuses.
    c. Loss of AC power, low battery voltage and high battery voltage alarm lights and contacts for remote annunciation; power on light.

2.4 ALTERNATOR

A. Alternator shall be capable of accepting maximum 120kVA in a single step and be capable of recovering to a minimum of 90% of rated no load voltage following the application of the specified kVA load at near zero power factor applied to the generator set.

B. Construction: Synchronous generator, four-pole, 2/3 pitch, revolving field, self-ventilated, drip-proof construction, single bearing, dynamically balanced rotor with amortisseur windings to minimize voltage deviations and heating effects under unbalanced load conditions. Rotor directly connected to engine flywheel housing to ensure permanent alignment.

C. Winding Insulation Systems: Class H in accordance with NEMA MG-1. Temperature rise not to exceed 125 degrees C over 40 degrees C ambient at rated load. Epoxy coating for fungus resistance and abrasion protection.

D. Excitation System: Brushless construction. Excitation support system, permanent magnet type, to sustain 300 percent rated current for up to 10 seconds under short circuit conditions. Provide surge suppressors to protect against voltage spikes.

E. Voltage Regulator: Automatic solid state system to maintain generator output voltage within plus or minus 0.5 percent from no load to full load. Control voltage buildup, provide volts per Hertz regulation, protect from over-excitation, limit voltage overshoot on startup, and be environmentally sealed.

F. Provide anti-condensation heater to maintain temperature approximately five degrees Fahrenheit above ambient when generator is idle.

2.5 CONTROL PANEL

A. Controls shall be in accordance with NFPA 110, Level 1, and control panel shall conform to the following:
   1. Install control panel on vibration isolators with controls, instruments, lights, and devices necessary to manually and automatically start, stop, monitor, and protect the generator.
   2. Controls shall be UL 508-listed and microprocessor-based with programmable adjustments. Control power from starting battery system. Panel shall include the following:
      a. Emergency stop pushbutton.
      b. Adjustable cycle cranking.
      c. KW, KVA, KVAR, and power factor meters.
      d. Engine coolant temperature readout.
      e. Engine oil pressure readout.
      f. Running time readout.
      g. RPM meter.
      h. Cool down timer.
   3. Readouts and dry contact outputs shall be provided as required by NFPA 110, Level 1.
   4. Provide readouts and output dry contacts for remote monitoring and control for the following:
      a. Generator running
      b. Generator common warning alarm.
      c. Generator common shutdown alarm.
      d. Low main tank fuel (warning alarm).
      e. Liquid leak in containments areas, including tank, double walled piping, and other fuel supply components (warning alarm).
   5. Reset Control: Remote restarts are not allowed and alarm lamps shall remain in alarm state until manual reset is accomplished even if alarm condition has been corrected.
   6. Provide control panel anti-condensation space heater.

2.6 CIRCUIT BREAKERS

A. General: Provide main and exciter circuit breakers, sized for protecting the engine-generator.

B. Type: UL-listed, molded case with interchangeable electromechanical trip unit for sizes 225-amp and larger. Provide NEMA 1 enclosed units and mount on engine generator.

C. Refer to drawings for proposed main circuit breaker size. Any deviation from this basis of design should be brought to the attention of the Engineer during the shop drawing submittal review.

2.7 ENCLOSURE

A. Provide engine-generator system with outdoor, weatherproof enclosure where indicated in Paragraph 1.1.A.2 of this Section.

B. Non-walk-in enclosure shall be constructed of minimum 14-gauge, reinforced sheet steel and shall attach directly to engine-generator base or sub-base fuel tank. Enclosure shall be factory assembled structure with key-lockable access doors for performing normal maintenance operations. Hardware and fasteners shall be stainless steel. Lube oil and coolant drains shall be extended to exterior of enclosure and terminated with drain valves, capped with pipe nipples on flanged connections.

C. Sound Attenuation: Engine-generator enclosure shall be sound-attenuated to reduce noise level to no more than ninety (90) dBA at a point seven (7) meters from engine-generator in free air environment, while operating at full load.

2.8 ACCESSORIES

A. Engine Generator Mounting:
   1. Vibration Isolators: Steel springs in combination with rubber pads.
   2. Vibration Isolation: Provide flexible connections between engine-generator set and fuel lines, exhaust system, electrical conduits, and other externally connected support systems.
   3. Anchor Bolts: Type 316 stainless steel, conforming to Section 05 05 33, Anchor Systems.
   4. Template shall be furnished by manufacturer for setting anchorages devices, pipe sleeves, and nuts for mounting spring-type isolators to concrete foundation. Provide bolts and nuts for bolting isolators to channel frame base of engine-generator set.

2.9 FINISHING

A. Engine generator ferrous metal surfaces shall be prime-coated for corrosion protection and finish-painted in accordance with manufacturer's standard painting system.

B. Color of finish paint to be selected by ENGINEER from manufacturer's standard colors.

2.10 SOURCE QUALITY CONTROL

A. Factory Tests
   1. Provide results of tests and evaluations previously performed on prototype generator sets representative of the models to be provided, in accordance with NFPA 110.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine the conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install engine generator system in accordance with the Contract Documents, approved Shop Drawings, and manufacturer's recommendations.

3.3 SITE QUALITY CONTROL

A. Site Testing: Test engine-generator set in accordance with NFPA 110. Provide all materials and equipment, including load banks, fuel, lubricants and material required for Site testing. Completely fill fuel tank at conclusion of testing.

B. Manufacturer's Services: Provide qualified, factory-trained serviceman to perform the following:
   1. Supervise unloading and installation of equipment.
   2. Instruct CONTRACTOR in the installation of equipment.
   3. Inspect and adjust equipment after installation and ensure that equipment operates properly.
   4. Instruct OWNER's personnel in operating and maintaining the equipment.
   5. Service representative shall make a minimum of 2 visits, with a minimum of 8 hours at the Site for each visit. First visit shall be for unloading supervision and instruction of CONTRACTOR in installing equipment; second visit shall be for assistance in installation of equipment; third visit shall be for checking completed installation and start-up of system; fourth visit shall be to instruct operations and maintenance personnel. Representative shall revisit the Site as often as necessary until installation is acceptable.

+ + END OF SECTION + +

SECTION 26 36 23

AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install automatic transfer switches.
   2. Switches specified under this Section shall be provided by the engine generator manufacturer as specified in Section 26 36 13 – Engine Generators.

B. Related Sections:
   1. Section 26 00 00 Electrical Work
   2. Section 26 36 13 Engine Generators

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. IEEE 472, Guide for Surge Withstand Capability Tests.
   2. IEEE 446, Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications.
   3. IEEE C62.41, Recommended Practice for Surge Voltages in Low Voltage AC Power Circuits.
   4. NEMA ICS1 109, Tests and Procedures.
   5. NEMA ICS10, AC Automatic Transfer Switches.
   6. UL 1008, Transfer Switch Equipment.
   7. UL 508, Industrial Control Equipment
   8. UL 61010B-1 (previously UL 3111-1), Electrical Measuring and Test Equipment; Part 1: General Requirements.
   9. ANSI C37.90a, Surge Withstand Capability Test (formerly IEEE Standard 472-1974) – Ring Wave Test.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. NEC Article 702, Optional Standby Systems.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Listing of transfer switches to be provided, including ratings and location of each.
      b. Equipment dimensions, and construction details of enclosures with conduit entry locations.
   2. Product Data:
      a. Manufacturer's technical information for products proposed, including catalog cut sheets.
   3. Test Procedures:
      a. At least thirty days prior to actual factory and field testing, submit proposed testing procedures, methods and apparatus.

B. Informational Submittals:
   1. Source Quality Control Submittals:
      a. Submit reports of completed factory tests, including test results and procedures used for testing.
   2. Field Quality Control Submittals:
      a. Submit reports of completed field tests, including test results and procedures used for testing.
   3. Supplier Instructions:
      a. Manufacturer's written instructions for transporting, handling, storing, and installing the products.
   4. Supplier Reports:
      a. Written report of each visit to Site by supplier's service representative.

C. Closeout Submittals
   1. Operation and Maintenance Data:
      a. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation, and spare parts information.
      b. Manuals shall include record drawings of control schematics, including point-to-point wiring diagrams.
      c. Furnish operation and maintenance manuals per Section 01 78 23, Operations and Maintenance Data.

D. Maintenance Material Submittals: Furnish the following:
   1. Spare Parts and Extra Stock Materials: Provide as specified in this Section.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver products to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices to be embedded in cast-in-place concrete in time to prevent delay of the Work.

B. Shipping sections shall be designed to be shipped by truck, rail, and ship. Indoor sections shall be bolted to skids.

C. Equipment shall be equipped to be handled by crane. Where cranes are not available equipment shall be suitable for skidding in place on rollers using jacks to raise and lower the sections.

D. Comply with Section 01 65 00, Product Delivery Requirements, and Section 01 66 00, Product Storage and Handling Requirements.

1.6 MAINTENANCE

A. Spare Parts and Extra Stock Materials:
   1. Furnish, tag, and box for shipment and long term storage the following spare parts for each switch:

Item	**Quantity per Switch**
a. Control relay	Two of each type used
b. Pilot light	Two per ten of each type used
c. Fuses	Two set of each type and size used

   2. Furnish a list of additional recommended spare parts for an operating period of one year. Describe each part, quantity recommended, and current unit price of each.
   3. Package spare parts in suitable containers bearing labels clearly indicating contents and equipment with which they are to be used. Deliver spare parts at same time as switchgear.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Provide automatic transfer switches as specified for transferring loads from one power source to another.

2.2 MANUFACTURERS

A. Manufacturers: Provide products of one of the following:
   1. As provided by the engine generator manufacturer

2.3 SWITCH

A. Ratings:
   1. Switches shall be capable of switching all classes of loads and rated for continuous duty when installed in a non-ventilated enclosure.
   2. Switches shall be rated with continuous ampere rating, number of poles and voltage as shown on Drawings.
   3. Switches shall be rated to withstand the magnitude of fault current available without welding of contacts in compliance with ANSI C37.90a and IEEE C62.41.

B. Standards and Performance:
   1. Switches shall comply with UL Standard 1008, NEMA Standard ICS10, and applicable requirements of NEC Article 700, IEEE 446, IEEE C62.41, UL 508, and UL 61010B-1. Switches shall be UL labeled with performance meeting or exceed the following:
      a. Temperature Rise: Measurements shall be made after overload and endurance tests.
      b. Withstand: UL listed to withstand magnitude of fault current available at switch terminals when coordinated with respective protective devices shown on Drawings at an X/R ratio of 6.6 or less. Main contacts shall not trip open or weld when subjected to fault currents.
         1) As a condition for approval, manufacturer of automatic transfer switches shall verify that switches are listed by Underwriters Laboratories, Inc., Standard UL-1008 with three-cycle short circuit closing and withstand as follows:

RMS Symmetrical Amperes at 480 VAC	
Amperes	**3 Cycle Closing & Withstand**
100 to 400	42,000
600 to 800	65,000
1000 to 1200	85,000
1600 to 4000	100,000

         2) During three-cycle closing and withstand tests, there shall be no contact welding or damage. Three-cycle tests shall be performed without using current limiting fuses, and oscillograph traces across main contacts shall be furnished to verify that contact separation has not occurred, and there is

contact continuity across all phases after completion of testing. Test procedures shall be in accordance with UL-1008, and testing shall be certified by UL.

3) When conducting temperature rise tests to UL-1008, Supplier shall include post-endurance temperature rise tests to verify ability of transfer switch to carry full rated current after completing overload and endurance tests.

c. Dielectric: Measurements shall be made at 1960 VAC RMS minimum following the withstand current rating test

d. Transient Withstand: Control panel shall pass the voltage surge withstand test per IEEE Standard 472 and voltage impulse withstand test per NEMA ICS1 109.

C. Construction:

1. Switch shall be double throw actuated by non-fused, momentarily energized operating mechanism(s).
2. Accomplish mechanical locking of main contacts in each direction without aid of latching solenoids, toggle mechanisms, or gear arrangements.
3. An overload or short-circuit shall not cause switch to go to a neutral position.
4. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
5. Switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
6. Main contacts shall be silver-tungsten composition. Switches shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
7. Inspection of contacts shall be possible from front of switch without disassembly of operating linkages and without disconnecting power conductors. Switches rated 600 amps and higher shall have front-removable and -replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors or bus bars.
8. Transfer switch shall be equipped with a safe manual operator designed to prevent injury to operating personnel. Manual operator shall provide same contact-to-contact transfer speed as electrical operator to prevent a flash-over from switching main contacts slowly. Manual operation shall be safe even if electrical operator becomes energized and shall not require prior disconnection of operators or control wiring. Safe manual transfer shall be possible under all load conditions, energized or non-energized. Manual operator shall be an external type, operable through door of transfer switch enclosure. Operating personnel shall not be required to open transfer switch door to facilitate manual transfer. Manual operator shall be functional at all times, regardless of switch position or status. Manually initiated electrical

operation does not meet intent of this requirement. Manual operator is not required on closed transition type switches.

D. Enclosure: Enclosed switches shall be NEMA 3R at a minimum.
   1. Standard and optional door-mounted switches and pilot lights shall be 30.5-mm industrial grade type or equivalent.

E. Identification: Identify switches per Section 26 00 05, Electrical Work

2.4 TRANSFER SWITCHING FEATURES

A. Delay Transition (Open): Provide automatic delayed open transition transfer for each switch. Switch shall transfer load in delayed transition (break-before-make) mode. Transfer shall be accomplished with a user-defined interruption period in both directions adjustable from one second to five minutes in at least 5 second increments.

2.5 SEQUENCE OF OPERATION

A. When voltage on any phase of normal source is outside of specified parameters and after a programmable time delay period to allow for momentary dips, engine starting contacts shall close to start generating supply.

B. Transfer switch shall transfer to emergency source when generating supply has reached specified (adjustable) voltage and frequency on all phases.

C. After restoration of normal supply on all phases to within specified (adjustable) parameters, an adjustable time delay shall delay retransfer to normal to assure stabilization of normal supply. After expiration of the time delay period, transfer switch shall retransfer to normal. Should emergency supply source fail during the time delay period, switch shall bypass time delay and automatically return to normal source. Provide an adjustable time delay between opening of closed contacts and closing of open contacts during transfers to allow loads to be demagnetized.

D. After retransfer to normal, engine generator shall be allowed to operate at no load for a programmable period to cool down.

E. Should transfer to emergency source be initiated by test switch rather than an actual source failure, transfer from normal to emergency shall be as described above.

2.6 MICROPROCESSOR CONTROLLER

A. Each switch shall include a microprocessor controller for operation of the switch. Equip controller with the following:
   1. Provide controller's sensing and logic by a built-in microprocessor with ability to communicate serially through an optional serial communication module.
   2. Controller shall provide a minimum of five selectable nominal voltages. Voltage sensing shall be true RMS type and be accurate to plus/minus one percent of nominal voltage. Frequency sensing shall be accurate to plus/minus 0.2 percent. Controller shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.
   3. Connect controller to transfer switch by an interconnecting wiring harness that shall include a keyed disconnect plug to enable controller to be disconnected from transfer switch for routine maintenance. Interfacing relays shall be industrial grade plug-in type with dust covers. Enclose controller with a protective cover. Mount controller internally but separately from transfer switch.
   4. Customer connections shall be wired to a common terminal block.

B. Controller Display and Keypad:
   1. Display and keypad shall be an integral part of controller for viewing available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through serial communications input port. The following parameters shall be adjustable:
      a. Nominal line voltage and frequency
      b. Single- or three-phase sensing
      c. Operating parameter protection
      d. Transfer operating mode configuration: Open transition, closed transition or delayed transition
   2. Instructions and controller settings shall be easily accessible, readable, and accomplished without using codes, calculations, or instruction manuals.

C. Controller Voltage, Frequency and Phase Rotation Sensing:
   1. Voltage and frequency on both the normal and emergency sources shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities values shown as a percent nominal unless otherwise specified:

Parameter	Sources	Dropout/Trip	Pickup/Reset
Under-voltage	Normal and Emergency, three-phase	70 to 98%	85 to 100%
Over-voltage	Normal and Emergency, three-phase	102 to 115%	2% below trip
Under-frequency	Normal and Emergency	85 to 98%	90 to 100%
Over-frequency	Normal and Emergency	102 to 110%	2% below trip

Voltage Unbalance	Normal and Emergency	5 to 20%	1% below dropout

2. Repetitive accuracy of all settings shall be within plus/minus 0.5 percent over an operating temperature range of -20 degrees C to +60 degrees C.
3. Voltage and frequency settings shall be field adjustable in one percent increments, either locally with the display and keypad or remotely via serial communications port access.
4. When activated by keypad or through serial port, controller shall be capable of sensing phase rotation of both normal and emergency sources. Source will be unacceptable if phase rotation is not preferred rotation selected (ABC or CBA).
5. Source status screens shall be provided for both normal and emergency to provide digital readout of voltage on all three phases, frequency, and phase rotation.

D. Controller Time Delays:
   1. Provide controller with time delays below. Time delay settings shall be adjustable over a range of zero to 9999 seconds (factory set at three seconds) unless specified otherwise.
      a. Normal source failure, for engine starting.
      b. Transfer to emergency on availability of emergency source.
      c. Emergency source failure, retransfer on availability of normal source.
      d. Engine cool down following retransfer to normal.
      e. Time delay to control contact transition time during open transition transfer to either source.
      f. All timers can be bypassed via operation on processor's keypad.
   2. Provide adjustable time-delay on retransfer to normal. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable.
   3. Time delay and sensing functions shall be field adjustable and operate with drift that does not exceed plus/minus one percent of set frequency, plus/minus two percent of set voltage, and plus/minus ten percent of set time delay, over the temperature range of -20 degrees C to +70 degrees C.
   4. Time delays shall be adjustable in one-second increments, except extended parallel time, that shall be adjustable in 0.01-second increments.
   5. Time delays shall be adjustable by using display and keypad or with a remote device connected to serial communications port. Time delay value displayed shall be time remaining until next event occurs.
   6. For (open) delay transition transfer switches controller shall include the following built-in time delays for delayed transition operation:
      a. Zero to five-minute time delay for load disconnect position for delayed transition operation.

2.7 ACCESSORY FEATURES:

A. Provide each switch with the following:
   1. A two-position maintained-type test switch for test/automatic/ modes. Test position shall simulate a normal source failure.
   2. A SPDT silver-tungsten contact, rated five amps at 30 VDC, for a low-voltage engine start signal. Start signal shall prevent dry cranking of engine by requiring generator set to reach proper output and run for duration of cool down setting regardless of whether normal source restores before load is transferred.
   3. Auxiliary contacts, rated ten amps at 250 VAC, consisting of the following:
      a. (1) NO/NC for switch is connected to normal source
      b. (1) NO/NC for switch is connected to emergency source
      c. (1) NO/NC for Utility Source available
      d. (1) NO/NC for Emergency Source Available
   4. LED indicating lights (30.5 mm, industrial heavy duty, oil-tight, NEMA rated to match automatic transfer switch enclosure). One shall indicate when switch is connected to normal source (green) and one to indicate when the switch is connected to emergency source (red).
   5. LED indicating lights (30.5 mm, industrial heavy duty, oil-tight, NEMA rated to match automatic transfer switch enclosure), energized by controller outputs. Lights shall provide true source availability of normal and emergency sources as determined by voltage sensing trip and reset settings for each source.
   6. Provide the following built-in to controller, capable of being activated through keypad programming or serial port only when required by user:
      a. Provide ability to select “commit/no commit to transfer” to determine whether load should be transferred to standby generator if normal source restores before generator is ready to accept load.
      b. Provide terminals for a remote contact that opens to signal switch to transfer to emergency, and for remote contacts that open to inhibit transfer to emergency or retransfer to normal. Provide ability to activate both inhibit signals through keypad or serial port.
      c. Controller shall be capable of accepting a normally open contact that will allow transfer switch to function in a non-automatic mode using an external control device.
      d. Engine Exerciser: Controller shall provide an internal engine exerciser that allows user to program up to seven different exercise routines. For each routine, user shall be able to:
         1) Enable or disable routine.
         2) Enable or disable transfer of load during routine.
         3) Set start time.
         4) Time of day
         5) Day of week

6) Week of month (first, second, third, fourth, last, alternate, and every)
7) Set duration of run.
8) At end of specified duration, switch shall transfer load back to normal and run generator for specified cool down period. A ten-year life battery that supplies power to real time clock in event of a power loss shall maintain time and date information.

7. System Status: Controller display shall include a "System Status" screen that shall be readily accessible from all points in the menu by a maximum of two key strokes. System status screen shall display a clear description of active operating sequence and switch position.
8. Self-Diagnostics: Controller shall contain a diagnostic screen for detecting system errors. Screen shall provide information on status input signals to controller that may be preventing completion of load transfer commands.
9. Communications Interface: Controller shall be capable of interfacing, through an optional full-duplex RS 485 serial communication module, with a network of transfer switches, within 4,000 feet (locally) and remotely through modem serial communications. Standard software specific for transfer switch applications shall be available from transfer switch manufacturer. Software shall include monitoring, control, and setup of parameters.
10. Data Logging: Controller shall have ability to log data and to maintain last 99 events, even during total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
    a. Event Logging
        1) Date and time and reason for transfer normal to emergency.
        2) Date and time and reason for transfer emergency to normal.
        3) Date and time emergency source available.
    b. Statistical Data
        1) Total number of transfers.
        2) Last ten numbers of transfers due to source failure.
        3) Total number of hours both normal and emergency sources are available.
11. Terminate control wires with crimp lugs and identify with sleeve type markers. Provide suitable copper connector lugs for each service and load connections.

2.8 SOURCE QUALITY CONTROL

A. Perform manufacturer's standard factory tests that shall include:
    1. Physical inspection and checking of components.
    2. Mechanical operation and device functional tests.
    3. Control operation and functionality tests.
    4. Primary, control, and secondary wiring hi-pot tests.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which Work is to be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

B. Install equipment in accordance with Contract Documents and manufacturer recommendations.

C. Securely fasten equipment to floors, walls, or other surfaces on which equipment will be mounted. Install freestanding switches on raised concrete pad at locations shown on Drawings. Install in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

A. Perform field testing and inspection of each automatic transfer switch. Testing and inspection shall be in accordance with manufacturer's recommendations and be performed by manufacturer's factory-trained representative, who shall inform OWNER and ENGINEER when equipment has been correctly installed. Do not energize equipment without permission of OWNER.

3.4 MANUFACTURER SERVICES

A. Manufacturer Services:
   1. Unloading and Installation: Manufacturer's factory-trained representative shall be present during unloading of equipment and installation at equipment's final location. In advance of installation, representative shall train installing personnel in proper handling and rigging of equipment, for at least 2 hours at the Site.
   2. Manufacturer's factory-trained representative shall test the system as specified in Article 3.3 of this Section. Representative shall operate and test system in the presence of ENGINEER and verify that equipment conforms to requirements. These services shall be at least 4 hours day at the Site.
   3. Manufacturer's factory-trained representative shall adjust the system to initial settings specified in Article 2.6 of this Section.

4. Representative shall revisit the Site as often as necessary until all deficiencies are corrected, prior to readiness for final payment.
5. Provide services of manufacturer's factory-trained representatives to correct defective Work within 72 hours of notification by OWNER during the Correction Period specified in the General Conditions as amended by the Supplementary Conditions.
6. Replacement parts or equipment installed during the Correction Period shall be equal to or better than the original.

B. Training: Furnish services of qualified factory trained specialists from manufacturer to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of the products. Training requirements, duration of instruction, and other qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.

+ + END OF SECTION + +

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to perform clearing and grubbing as shown and specified in the Contract Documents.
   2. The Work includes removing from the Site and disposing of trees, stumps, brush, roots, shrubs, vegetation, logs, rubbish, and other objectionable material.
   3. Pay all costs associated with transporting and disposing of debris resulting from clearing.
   4. Limits of Clearing and Grubbing Work: Clear and grub all areas within the Work areas unless otherwise shown or indicated in the Contract Documents.

B. Related Sections:
   1. Section 01 57 05, Temporary Controls.
   2. Section 02 41 00, Demolition.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. CONTRACTOR shall comply with all laws, regulations, and permitting requirements applying to the Work.

1.4 SUBMITTALS

A. Action Submittals: Submit the following
   1. Shop Drawings:
      a. Plan for removing trees and other large vegetation not explicitly shown or indicated for removal in the Contract Documents.
      b. Plan showing proposed limits of clearing and grubbing, if different from clearing and grubbing limits shown or indicated in the Contract Documents.

1.5 WARRANTY

A. CONTRACTOR shall warrant that Work performed under this Section will not permanently damage trees, shrubs, turf, and plants designated to remain, or other adjacent work, facilities, or property. If damage resulting from CONTRACTOR's

operations becomes evident during the correction period, CONTRACTOR shall replace damaged items and property at no additional cost to OWNER.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PREPARATION

A. Protection:
   1. Throughout the Project, protect existing site improvements, including streets, drives, and Underground Facilities to remain (if any), and adjacent property and structures. Repair damage caused by CONTRACTOR to original condition or replace in kind, to satisfaction of ENGINEER, at no additional cost to OWNER.
   2. Protect trees, shrubs, vegetation, and grassed areas to remain by providing temporary fencing, barricades, wrapping, or other methods shown, specified, or accepted by ENGINEER. Correct at CONTRACTOR's expense damage caused by CONTRACTOR outside the limits of clearing Work.
   3. Do not remove trees without approval of ENGINEER, unless shown or indicated for removal.
   4. Do not locate construction equipment, stored materials, or stockpiles within drip line of trees and vegetation to remain.

B. Site Preparation:
   1. Obtain, pay costs associated with, and comply with applicable permits required for clearing and grubbing Work.
   2. Delineation of Clearing and Grubbing Limits:
      a. Locate and clearly flag trees and vegetation to remain, and other materials to remain in the clearing and grubbing limits. Locate and clearly flag salvable vegetation to be relocated.
      b. Provide flagging to delineate limits of areas to be cleared or grubbed. Review at Site with ENGINEER before commencing removal of trees, vegetation, and other materials to be removed.
      c. Replace flagging that is lost, removed, or destroyed, until clearing and grubbing Work is complete and ENGINEER allows removal of flagging.
   3. Erosion and Sediment Controls:
      a. Provide applicable erosion and sediment controls before commencing clearing and grubbing Work.
      b. Comply with State and County Stormwater Pollution Prevention regulations

c. Comply with erosion and sediment control requirements of Section 01 57 05, Temporary Controls.
d. Continue providing erosion and sediment controls as clearing and grubbing Work progresses to previously uncleared, ungrubbed areas of the Site.

3.2 CLEARING AND GRUBBING

A. Remove and dispose of all trees, shrubs, stumps, roots, brush, logs, rubbish, and debris within limits of clearing and grubbing shown or indicated in the Contract Documents, unless otherwise shown or indicated.

B. Disposal of Cleared and Grubbed Materials:
   1. Dispose at appropriate off-Site location trees, stumps, rubbish, debris, and other cleared and grubbed material. Do not use cleared or grubbed material as fill, backfill, or in embankments.
   2. Dispose of cleared and grubbed material in accordance with Laws and Regulations.
   3. Do not burn clearing debris at the Site.

3.3 TOPSOIL REMOVAL

A. Existing topsoil to be removed is defined as friable, clay loam, surface soil present in depth of at least four inches. Topsoil shall be free of subsoil, clay lumps, stones, and other objects over two-inch diameter and other objectionable material.

B. Stripping:
   1. Strip topsoil to depths encountered, in manner that prevents intermingling of topsoil with underlying subsoil or other objectionable material. Remove heavy growths of grass and vegetation from areas before stripping.

   2. Do not strip topsoil from within drip line of each tree to remain as part of the completed Project.

C. Stockpile topsoil in storage stockpiles in areas shown, or where otherwise accepted by ENGINEER. Construct storage piles so that surface water drains freely. Stabilize large topsoil piles with a cover crop and mulch, and provide silt fencing around perimeter of pile to prevent topsoil erosion and sedimentation; silt fencing shall be in accordance with Section 01 57 05, Temporary Controls. Cover smaller topsoil stockpiles, when used, with reinforced fabric to prevent windblown dust. Distribute topsoil at locations as shown on the plans. Topsoil in excess of the quantity required for the finished Project shall remain property of OWNER.

+ + END OF SECTION + +

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SECTION 31 20 00

EARTH MOVING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to perform all excavating, filling, and grading, and disposing of earth materials as shown, specified, and required for construction of structures, Underground Facilities, roads, and other facilities required to complete the Work.
   2. Preparation of subgrade for slabs and pavements is included under this Section.
   3. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof.

B. Related Sections:
   1. Section 03 00 05, Concrete.

C. General:
   1. The CONTRACTOR shall examine the site and review the available test borings or undertake his own soil borings prior to submitting his bid, taking into consideration all conditions that may affect his work. The OWNER and ENGINEER will not assume responsibility for variations of subsoil quality or conditions at locations other than places shown and at the time the investigation was made. Boring log data and subsurface conditions are available for examination in Geotechnical Engineering Services Report, dated July 18, 2013, prepared by Cal-Tech Testing, Inc.
   2. The soil conditions have been classified as highly variable

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI/AISC 360, Specification for Structural Steel for Buildings.
   2. ASTM D422, Test Method for Particle-Size Analysis of Soils.
   3. ASTM D698, Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft^3 (600 kN-m/m^3)).
   4. ASTM D1556, Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
   5. ASTM D1557, Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

6. ASTM D2216, Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
7. ASTM D4253, Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
8. ASTM D4254, Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
9. ASTM D4318, Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
10. ASTM D6938, Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
11. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.

1.3 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning:
   1. "Subgrade" is the uppermost surface of native soil material unmoved from cuts; the bottom of excavation.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. CONTRACTOR's Testing Laboratory:
      a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of the materials specified in this Section.
      b. Testing laboratory shall comply with ASTM E329 and requirements of Section 01 45 29.13, Testing Laboratory Services Furnished by Contractor.
      c. Testing laboratory shall be experienced in the types of testing required.
      d. Selection of testing laboratory is subject to ENGINEER's acceptance.

B. Quality Assurance Testing:
   1. Quality assurance testing is in addition to field quality control testing required under Part 3 of this Section.
   2. Materials used in the Work may require testing and retesting, as directed by ENGINEER, during the Project. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be performed at OWNER's expense, including retesting of rejected materials and installed Work, shall be performed at CONTRACTOR's expense.
   3. CONTRACTOR's Testing Laboratory Scope:
      a. Collect samples and perform testing of proposed fill materials in the laboratory and in the field to demonstrate compliance of the Work with the Contract Documents.

b. Testing laboratory shall perform testing required to obtain data for selecting moisture content for placing and compacting fill materials.
c. Submit to ENGINEER and CONTRACTOR written report results of each test.

4. Required Quality Assurance Material Testing by CONTRACTOR's Testing Laboratory:
   a. Gradation in accordance with ASTM D422. Perform one test for every 1,000 cubic yards of each material incorporated into the Work.
   b. Atterberg limits in accordance with ASTM D4318. Perform one test for every 1,000 cubic yards of the following types of materials incorporated into the Work: general fill, and pipe bedding material.
   c. Moisture/density relations in accordance with ASTM D698, ASTM D1557, ASTM D4253, or ASTM D4254, as applicable. Perform one test for every 5,000 cubic yards of each material incorporated into the Work.
   d. Moisture content of stockpiled or borrow material in accordance with ASTM D2216. Perform one test for every 1,000 cubic yards of each material incorporated into the Work.

C. Regulatory Requirements:
   1. Perform excavation work in compliance with requirements of authorities having jurisdiction and Laws and Regulations, including:
      a. OSHA, 29 CFR Part 1926, Section .650 (Subpart P – Excavations).
   2. Obtain required permits and approvals for excavation and fill Work, including work permits from right-of-way owners and permits from environmental authorities having jurisdiction over discharge of water from excavations.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Modifications to the Work proposed due to intended excavation plan.

B. Informational Submittals: Submit the following:
   1. Procedure Submittals:
      a. Excavation Plan: Prior to starting excavation operations, submit written plan to demonstrate compliance with OSHA 29 CFR Part 1926.650. As a minimum, excavation plan shall include:
         1) Name of CONTRACTOR's "competent person" in responsible charge of excavation and fill Work.
         2) Excavation method(s).
         3) Copies of required permits and approvals, from authorities having jurisdiction and affected utility owners, for excavation methods proposed.

b. Proposed compaction procedure and compaction equipment proposed for use. Where different procedures or equipment will be used for compacting different types of material or at different locations at the Site, indicate where each procedure and equipment item will be used.

2. Quality Assurance Test Results Submittals:
   a. Submit results of quality assurance testing performed by in accordance with Paragraph 1.4.B of this Section, unless included as part of another submittal under this Section. Submit results for the following quality assurance testing:
      1) Tests on borrow fill material.
      2) Optimum moisture – maximum dry density curve for each type of fill material.
3. Field Quality Control Submittals:
   a. Submit results of testing and inspection performed in accordance with the field quality control Article in Part 3 of this Section, including:
      1) Field density testing.
4. Qualifications Statements:
   a. Quality Assurance Testing laboratory. Submit name and qualifications of testing laboratory to be employed, and qualifications of testing laboratory's personnel that will perform quality assurance testing required in this Section.
   b. Field Quality Control Testing Laboratory: Names and qualifications of testing laboratory employed, and qualifications of testing laboratory's personnel that will perform field quality control testing as required under this Section.

1.6 SITE CONDITIONS

A. Subsurface Information: The Supplementary Conditions indicate information available relative to subsurface conditions at the Site. Such information and data is not intended as a representation or warranty of continuity of conditions between soil borings or test pits, nor of groundwater levels at dates and times other than date and time when measured, nor that purpose of obtaining the information and data were appropriate for use by CONTRACTOR. OWNER will not be responsible for interpretations or conclusions drawn therefrom by CONTRACTOR.

B. Soil borings and other exploratory operations may be made by CONTRACTOR, at no additional cost to OWNER. Coordinate CONTRACTOR-performed test borings and other exploratory operations with OWNER and utility owners as appropriate. Perform such explorations without disrupting or otherwise adversely affecting operations of OWNER or utility owners. Comply with Laws and Regulations relative to required notifications.

C. Existing Structures:
   1. CONTRACTOR shall explore ahead of the excavation to determine the exact location of all existing structures and Underground Facilities. Existing structures and Underground Facilities shall be supported and protected from damage by CONTRACTOR. Immediately repair and restore existing structures and Underground Facilities damaged by CONTRACTOR without additional cost to OWNER.
   2. Movement or operation of construction equipment over Underground Facilities shall be at CONTRACTOR's sole risk and only after CONTRACTOR has prepared and submitted to ENGINEER and utility owners (as applicable), and received acceptance therefrom, a plan describing CONTRACTOR's analysis of the loads to be imparted and CONTRACTOR's proposed measures to protect structures and Underground Facilities during the Project.
   3. Coordinate with utility owners for shut-off of services in active piping and conduits. When required by utility owner, OWNER will assist CONTRACTOR with utility owner notifications. Completely remove buried piping and conduits indicated for removal and not otherwise indicated as being abandoned or to remain in place.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Backfill and Fill:
   1. Materials acceptable for use as backfill against walls, foundations, underground ductbanks, and other structures shall be stockpiled native sandy clay or granular soils obtained from on-site excavations and which are uniformly mixed, contain no organic matter, nor contain rocks or fragments greater than 4-inches in size, nor have greater than 12 percent passing the 200 sieve.
   2. All materials for use as backfill and fill material shall be tested by the laboratory and approved by ENGINEER.
   3. If on-site material is unsuitable as determined by ENGINEER, select backfill or approved imported fill shall be used.
   4. Fill adjacent to structures is classified as backfill to a distance measured horizontally from the structure that is equal to the depth from the finished grade. Outside these limits the fill is classified as embankments, unless otherwise specified.

B. Select Fill:
   1. Select Fill for use beneath structures, concrete slabs and asphalt pavements (and where shown or specified below and around structures) shall be crushed rock or aggregate conforming to the requirements below:

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
1.25-inch	100
No. 4	38 to 65
No. 8	25 to 60
No. 30	10 to 40
No. 200	3 to 12

C. General Fill:
   1. Material shall be free of: rock and gravel larger than three inches in any dimension, debris, waste, frozen materials, organic material, and other deleterious matter.
   2. Fill shall have a liquid limit not greater than 45, and plasticity index not greater than 25.
   3. Previously-excavated materials complying with the Contract Documents requirements for general fill may be used for general fill.
   4. When on-Site materials are found unsuitable for use as general fill, provide select fill or approved off-Site general fill materials. Prior to using off-Site material as general fill, furnish submittal for and obtain ENGINEER's approval of the material proposed for use.

D. Subbase Material:
   1. Material shall be naturally- or artificially-graded mixture of natural or crushed gravel, crushed stone, or natural or crushed sand, complying with the gradation requirements below. Crushed slag is unacceptable.

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
2-inch	100
1-inch	70 to 100
3/4-inch	50 to 90
No. 4	30 to 60
No. 30	9 to 33
No. 200	0 to 15

E. Drainage Fill:
   1. Material shall be washed, uniformly-graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing 1.5-inch sieve and not more than five percent passing a No. 4 sieve.

F. Pipe Bedding Material:
   1. Aggregate material shall be crushed stone and gravel, free of: rock or gravel larger than one-inch in any dimension, debris, waste, frozen materials,

organic material and other deleterious matter. Material shall comply with gradation requirements below:

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
1-inch	100
3/8-inch	30 to 65
No. 4	25 to 55
No. 10	15 to 40
No. 40	8 to 20
No. 200	2 to 8

2. Sand material, where required, shall consist of natural or manufactured granular material and shall contain no organic material. Sand shall be non-plastic, when tested in accordance with ASTM D4318, 100 percent shall pass a 1/2-inch screen and not more than five percent shall pass a No. 200 screen.

2.2 SOURCE QUALITY CONTROL

A. Perform quality assurance testing, and submit results to ENGINEER, in accordance with the 'Quality Assurance" Article in Part 1 of this Section.

PART 3 – EXECUTION

3.1 INSPECTION

A. Provide ENGINEER with sufficient notice and with means to examine areas and conditions under which excavating, filling, and grading will be performed. ENGINEER will advise CONTRACTOR in writing when ENGINEER is aware of conditions that may be detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 TEST PITS

A. General:
   1. In advance of the construction, excavate, make observations and measurements, and fill test pits to determine conditions or location of the existing Underground Facilities and structures. Perform all work required in connection with excavating, stockpiling, maintaining, sheeting, shoring, filling, and replacing pavement for test pits. CONTRACTOR shall be responsible for the definite location of each existing Underground Facility involved within the area of excavation for the Work. Exercise care during

such location work to avoid damaging and disrupting the affected Underground Facility or structure. CONTRACTOR shall be responsible for repairing, at his expense, damage to Underground Facility or structure caused during the Work.

3.3 PREPARATION

A. Site Preparation:
   1. Clear areas to be occupied by permanent construction of all trees, brush, roots, stumps, logs, wood and other materials and debris. Clean and strip vegetation, sod, topsoil, and organic matter from subgrades where fills will be placed, and from areas where structures will be constructed. Remove from the Site and properly dispose of all waste materials.
   2. Do not burn clearing debris at the Site unless approved by OWNER and authorities having jurisdiction. If burning is permitted, comply with requirements of authorities having jurisdiction and Laws and Regulations. If burning is permitted at the Site, also comply with OWNER's requirements.

B. Use of Explosives:
   1. Use of explosives is not allowed.

C. Dust Control:
   1. Control objectionable dust caused by CONTRACTOR's operation of vehicles and equipment, clearing, and other actions. To minimize airborne dust, apply water or use other methods subject to ENGINEER’s acceptance and approval of authorities having jurisdiction.

D. Maintenance and Protection of Traffic:
   1. Keep all streets and traffic ways open for passage of traffic and pedestrians during the Project, unless otherwise approved by owner of the street, traffic way, or right-of-way, as applicable.
   2. When required to cross, obstruct, or temporarily close a street or traffic way, provide and maintain suitable bridges, detours, and other acceptable temporary expedients to accommodate traffic. Closings of street or traffic way shall be for shortest time practical, and passage shall be restored immediately after completion of fill and temporary paving or bridging.
   3. Give required advance notice to fire department, police department, and other emergency services as applicable of proposed construction operations.
   4. Give reasonable notice to owners or tenants of private property who may be affected by construction operations. Give such notice not less than seven days prior to construction that will affect the property.
   5. Hydrants, valves, fire alarm boxes, postal boxes and delivery service boxes, and other facilities that may require access during construction shall be kept accessible for use.

6. Provide temporary signage, signals, barricades, flares, lights and other equipment, service, and personnel required to regulate and protect traffic and warn of hazards. Such Work shall comply with requirements of owner of right-of-way and authorities having jurisdiction at the Site. Remove temporary equipment and facilities when no longer required, and restore grounds to original or to specified conditions, as applicable.

3.4 DEWATERING

A. Dewatering – General:
   1. Provide and maintain adequate drainage and dewatering equipment to remove and dispose of all surface water and ground water entering excavations, or other parts of the Work and work areas. Keep each excavation dry during excavation, subgrade preparation, and continually thereafter until the structure to be built therein is acceptable to ENGINEER and backfilling operations are completed and acceptable to ENGINEER.
   2. Keep all working areas at the Site free of surface water at all times. Provide temporary drainage ditches and temporary dikes, and provide required temporary pumping and other work necessary for diverting or removing rainfall and all other accumulations of surface water from excavations and fill areas. Perform diversion and removal of surface water in manner that prevents accumulation of water behind permanent or temporary structures and at any other locations in the construction area where such accumulations may be detrimental.
   3. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the surface water or groundwater downstream of the point of discharge, shall not be directly discharged. Divert such waters through temporary settling basin or filter before discharging to surface water, groundwater, or drainage routes.
   4. CONTRACTOR shall be responsible for condition of piping, conduits, and channels used for drainage and such piping, conduits, and channels shall be clean and free of sediment.
   5. Remove water from excavations as fast as water collects.

B. Disposal of Water Removed by Dewatering System:
   1. CONTRACTOR's dewatering system shall discharge to existing drainage system, in accordance with Laws and Regulations.
   2. Dispose of water removed from excavations in a manner that does not endanger health and safety, property, the Work, and other portions of the Project.
   3. Dispose of water in manner that causes no inconvenience to OWNER, others involved in the Project, and adjacent and downstream properties.

3.5 EXCAVATION

A. Perform all excavation required to complete the Work as shown, specified, and required. Excavations shall include removing and handling of earth, sand, clay, gravel, hardpan, soft, weathered or decomposed rock, pavements, rubbish, and other materials within the excavation limits.

B. Excavation Protection:
   1. Provide excavation protection system(s) in accordance with Laws and Regulations to prevent injury to persons and property, including Underground Facilities.
   2. Excavation Less Than Five Feet Deep: Excavations in stable rock or in soil conditions where there is no potential for a cave-in may be made with vertical sides. Under all other conditions, excavations shall be sloped and benched, shielded, or shored and braced.
   3. Excavations Greater Than Five Feet Deep: Excavations in stable rock may be made with vertical sides. Under all other conditions, excavations shall be sloped and benched, shielded, or shored and braced.

C. Maintain excavations in dry condition in accordance with "Dewatering" Article in Part 3 of this Section.

D. Elevation of bottom of footings shown is approximate. ENGINEER may direct such minor changes in dimensions and elevations as may be required to secure a satisfactory footing.

E. When excavations are made below required grades without written order of ENGINEER, fill such excavations with compacted select fill, as directed by ENGINEER, at CONTRACTOR's expense.

F. Extend excavations sufficiently on each side of structures, footings, and similar construction to allow setting of forms, installation of excavation supports, and the safe sloping of banks, as necessary.

G. Subgrades – General:
   1. Subgrades shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations.
   2. If, in ENGINEER's opinion, subgrade becomes softened or mucky because of construction delays, failure to dewater properly, or other cause within CONTRACTOR's control, subgrade shall be excavated to firm material, trimmed, and backfilled with select fill material at CONTRACTOR's expense.

H. Pipe Trench Preparation:

1. Not more than 150 feet of trench may be opened in advance of installing pipe in trench.
2. Trench width shall be minimized to greatest extent practical, and shall comply with the following:
    a. Trench width shall be sufficient to provide space for installing, jointing and inspecting piping. Refer to the Drawings for trench requirements. In no case should trench be wider at top of pipe than pipe barrel OD plus two feet, unless otherwise shown or indicated.
    b. Enlargement of trench width at pipe joints may be made when required and approved by ENGINEER.
    c. Trench width shall be sufficient for shoring and bracing, or shielding and dewatering.
    d. Trench width shall be sufficient to allow thorough compaction of fill adjacent to bottom half of pipe.
    e. Do not use excavating equipment that requires the trench to be excavated to excessive width.
3. Depth of trench shall be as shown or indicated. If required and approved by ENGINEER in writing, depths may be revised.
4. Where ENGINEER considers existing material beneath bedding material unsuitable, remove and replace such unsuitable material with select fill material.

3.6 UNAUTHORIZED EXCAVATION

A. All excavations outside lines and grades shown or indicated and that are not approved by ENGINEER, together with removing and disposing of the associated material, shall be at CONTRACTOR's expense. Fill unauthorized excavations with properly-compacted select fill material at CONTRACTOR’s expense.

3.7 SHEETING, SHORING, AND BRACING

A. General:
    1. Provide sheeting, shoring, bracing, and similar excavation supports as shown, specified, and required for the Work.
    2. CONTRACTOR is responsible for adequacy of all sheeting, shoring, bracing, and similar excavation supports.
    3. Materials:
        a. Previously-used materials shall be in good condition, and shall not be damaged or excessively pitted. All steel or wood sheeting designated to remain in place shall be new. New or used sheeting may be used for temporary sheeting, shoring, and bracing.
        b. All steel work for sheeting, shoring, bracing, cofferdams and other excavation supports, shall be in accordance with ANSI/AISC 360, except that field welding will be allowed.
    4. As excavation progresses, carry down shoring, bracing, and similar excavation supports to required elevation at bottom of excavation.

5. Comply with Laws and Regulations regarding sheeting, shoring, bracing, and similar excavation supports.
6. Maintain sheeting, shoring, bracing, bracing, and other excavation supports in excavations regardless of time period excavations will be open.
7. Unless otherwise shown, specified, or directed, remove materials used for temporary construction when the Work is completed. Perform such removal in manner not injurious to the structures and Underground Facilities, their appearance, and adjacent construction.

B. Removal of Sheeting and Bracing:
   1. Remove sheeting and bracing from excavations, unless otherwise directed by ENGINEER in writing. Perform removal to avoid damaging the Work and adjacent construction. Removal shall be equal on both sides of excavation to ensure no unequal loads on structures and Underground Facilities.
   2. Defer removal of sheeting and bracing, where removal may cause soil to come into contact with concrete, until the following conditions are satisfied:
      a. Concrete has cured for not less than seven days.
      b. Wall and floor framing, up to and including grade level floors, is in place.

3.8 TRENCH SHIELDS

A. Excavation of earth material below bottom of trench shield shall not exceed the limits established in Laws and Regulations.

B. When using a shield for installing piping:
   1. Portions of trench shield extending below the mid-diameter of an installed, rigid pipe, such as prestressed concrete pipe and other types of rigid pipe, shall be raised above the pipe's mid-diameter elevation prior to moving the shield along the trench for further construction.
   2. Bottom of shield shall not at any time extend below mid-diameter of installed pipe that is flexible or has flexing capability, such as steel, ductile iron, PVC, CPVC, polyethylene, and other pipe that has flexing capability.

C. When using a shield for installing structures, bottom of the shield shall not extend below the top of the bedding for the structures.

D. When removing the shield or moving the shield ahead, exercise extreme care to prevent moving piping, structures, and other Underground Facilities, and prevent disturbance of bedding material for piping, structures, and other Underground Facilities. When piping, structures, or Underground Facilities are disturbed, remove and reinstall the disturbed items in accordance with the Contract Documents.

3.9 FILL AND COMPACTION – GENERAL PROVISIONS

A. Provide and compact all fill required for the finished grades as shown and as specified in this Section.

B. Place fill in excavations as promptly as progress of the Work allows, but not until completing the following:
   1. ENGINEER's authorization after observation of construction below finish grade, including dampproofing, waterproofing, perimeter insulation, and similar Work.
   2. Inspection, testing, approval, and recording of locations of Underground Facilities.
   3. Removal of concrete formwork.
   4. Removal of shoring and bracing, and filling of voids with satisfactory materials.
   5. Removal of trash and debris.
   6. Permanent or temporary horizontal bracing is in place on horizontally-supported walls.
   7. Field testing of tanks, Underground Facilities including piping and conduits, and water-retaining structures.

C. Fill that includes organic materials or other unacceptable material shall be removed and replaced with approved fill material in accordance with the Contract Documents.

D. Placement – General:
   1. Place fill to the grades shown or indicated. Bring up evenly on all sides fill around structures and Underground Facilities.
   2. Place fill materials at moisture content and density as specified in this Article's requirements on compaction density. Furnish and use equipment capable of adding measured amounts of water to the fill materials to bring fill materials to a condition within required moisture content range. Furnish and use equipment capable of discing, aerating, and mixing the fill materials to ensure reasonable uniformity of moisture content throughout the fill materials, and to reduce moisture content of borrow materials by air drying, when necessary. When subgrade or lift of fill materials requires moisture-conditioning before compaction, fill material shall be sufficiently mixed or worked on the subgrade to ensure uniform moisture content throughout the lift of material to be compacted. Materials at moisture content in excess of specified limit shall be dried by aeration or stockpiled for drying.
   3. Perform compaction with equipment suitable for the type of fill material placed. Select and use equipment capable of providing the minimum density required in the Contract Documents. Use light compaction equipment, with equipment gross weight not exceeding 7,000 pounds within horizontal distance of ten feet from the wall of completed, below-grade structures. Furnish and use equipment capable of compacting in restricted

areas next to structures and around piping and Underground Facilities. Effectiveness of the equipment selected by CONTRACTOR shall be tested at start of compacted fill Work by constructing a small section of fill within the area where fill will be placed. If tests on the test section of fill indicate that required compaction is not obtained, do one or more of the following: increase the amount of coverages, decrease the lift thicknesses, or use different compactor equipment.

4. Place fill materials in horizontal, loose lifts, not exceeding specified uncompacted thickness. Place fill in a manner ensuring uniform lift thickness after placing. Mechanically compact each lift, by not less than two complete coverages of the compactor. One coverage is defined as the conditions reached when all portions of the fill lift have been subjected to the direct contact of compactor's compacting surface. Compaction of fill materials by inundation with water is unacceptable.
5. Do not place fill materials when standing water is present on surface of the area where fill will be placed. Do not compact fill when standing water is present on the fill to be compacted. Do not place or compact fill in a frozen condition or on top of frozen material. Fill containing organic materials or other unacceptable material previously described shall be removed and replaced prior to compaction.
6. If required densities are not obtained because of improper control of placement or compaction procedures, or because of inadequate or improperly-functioning compaction equipment, CONTRACTOR shall perform all work required to provide the required densities. Such work shall include, at no additional cost to OWNER, complete removal of unacceptable fill areas and replacement and re-compaction until acceptable fill is provided.
7. Repair, at CONTRACTOR's expense, observed or measured settlement. Make repairs and replacements as required within 30 days after being so advised by ENGINEER.

E. Fill Against Concrete:
   1. Placing fill against concrete below finished grade is not allowed until the concrete has attained its specified strength, as determined by duration of concrete curing and testing of field-cured concrete cylinders. Requirements for strength and curing time are in Section 03 00 05, Concrete.
   2. Elevation of fill placed against concrete walls shall not differ by more than two feet on each side of walls, unless walls are adequately braced or all floor framing is in place up to and including grade level slabs.
   3. Backfill structural foundation units as soon as practicable, in accordance with this Section, after concrete has gained sufficient strength to avoid damage, to avoid ponding of surface water and accumulation of debris.
   4. Where fill is placed against waterproofed surface, exercise care that waterproofing material is not damaged.

F. Fill in Electrical Ductbank Trenches:
   1. Provide general fill for full depth of electrical ductbank trench, below and above electrical ductbank. Where one ductbank passes beneath another pipe or ductbank, provide select fill to the elevation of the bottom of upper ductbank or pipe, as applicable.
   2. Placing and compacting fill in electrical ductbank trenches shall comply with requirements of Paragraph "G. Fill in Pipe Trenches", of this Article.

G. Fill in Pipe Trenches:
   1. Piping Installed in Fills Above Pre-construction Grade:
      a. Prior to installing piping, place the fill in accordance with the Contract Documents until the fill reaches a minimum elevation two feet higher than the top of piping to be installed. Excavate the trench; install the piping, and backfill. Subsequently provide the remainder of the fill required for the Work.
   2. Piping trenches may be backfilled prior to testing of piping, unless nature of the test requires observation of pipe during testing. Do not construct building or structure over piping until piping has been successfully tested and passed.
   3. Pipe Bedding: Pipe bettering material shall be as follows:
      a. Install PVC, CPVC, and HDPE piping on a layer of sand. Sand shall extend to 12 inches above top of pipe and to the trenchwalls on each side of the pipe.
      b. Unless otherwise shown, install other types of piping on not less than six-inch layer of aggregate pipe bedding material. Aggregate pipe bedding material shall extend 12 inches above top of the pipe.
   4. Placing and Compacting Pipe Trench Fill: Unless otherwise shown, placement and compaction of pipe trench fill materials shall comply with the following:
      a. Pipe bedding material shall be spread and the surface graded to provide a uniform and continuous support beneath piping at all points between bell holes or pipe joints. Slight disturbance of installed pipe bedding material surface during withdrawal of pipe slings or other lifting tackle is acceptable.
      b. After each pipe's bedding material has been graded, and the piping has been aligned, joined in accordance with the Contract Documents, and placed in final position on bedding material, provide and compact sufficient pipe trench fill material under and around each side of the pipe and back of the bell or end thereof to hold piping in proper position and maintain alignment during subsequent pipe jointing and embedment operations. Deposit and compact pipe trench fill material uniformly and simultaneously on each side of piping to prevent lateral displacement of piping. Place and compact pipe trench fill material to an elevation 12 inches above top of pipe, unless otherwise shown or specified.

c. Each layer of pipe trench fill material shall be compacted by at least two complete coverages of all portions of surface of each lift using appropriate compaction equipment.
d. Method of compaction and compaction equipment used shall be appropriate for material to be compacted and shall not transmit damaging shocks to the piping.

H. Temporary Pavement:
1. Place 1.5 inches of temporary asphalt concrete pavement immediately after filling excavations in paved roadways and other paved areas that will remain for permanent use.
2. Maintain surface of paved area over the fill in good and safe condition during progress of the Work, and promptly fill depressions over and adjacent to the fill area caused by settlement of fill.
3. Permanent replacement pavement shall be equal to that of the existing roadways, unless otherwise shown or specified.

I. Subbase Placement:
1. Provide subbase material where shown to the limits shown or indicated.
2. Place subbase material in compacted lifts not exceeding depth of six inches each.

J. Drainage Fill Placement:
1. Provide drainage fill material where shown to the limits shown or indicated.
2. Place drainage fill material in compacted layers of uniform thickness not exceeding depth of six inches each. Compact lifts of drainage fill using suitable compaction equipment.

K. Compaction Density Requirements:
1. Minimum density for fill materials shall be 90 percent of maximum density obtained in the laboratory in accordance with ASTM D698. Compaction of fill materials less than five feet below final grade, behind concrete walls, and pipe bedding materials when not located below structures or pavement shall be 90 percent of maximum density in accordance with ASTM D698.
2. Place fill in trenches below Underground Facilities, foundations or paved areas in horizontal, uncompacted lifts not greater than eight inches deep, and thoroughly compact each lift before placing the next lift. In other pipe trenches, horizontal uncompacted lifts shall be six inches deep.
3. Fill shall be wetted and thoroughly mixed to achieve optimum moisture content plus-or-minus three percent, with the following exceptions:
a. On-site clayey soils: Optimum to plus three percent.
4. Replace natural, undisturbed soils or compacted soil subsequently disturbed or removed by construction operations with materials compacted as indicated.
5. Field quality control testing for density; to verify that specified density was obtained, will be performed during each day of compaction Work.

Responsibility for field quality control testing is specified in the "Field Quality Control" Article in Part 3 of this Section.

6. When field quality control testing indicates unsatisfactory compaction, provide additional compaction necessary to obtain the specified compaction. Perform additional compaction Work at no additional cost to OWNER until specified compaction is obtained. Such work includes complete removal of unacceptable (as determined by ENGINEER) fill areas and replacement and re-compaction until acceptable fill is provided in accordance with the Contract Documents.

L. Replacement of Unacceptable Excavated Materials: In cases where over-excavation to replace unacceptable soil materials is required, backfill the excavation to required subgrade with select fill material and thoroughly compact in accordance with the "Compaction Density Requirements" in this Article. Slope the sides of excavation in accordance with the maximum inclinations specified for each structure location.

3.10 GRADING

A. General:
   1. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas.
   2. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free of irregular surface changes, and shall comply with the following:
   1. Grassed Areas or Areas Covered with Gravel, Stone, Wood Chips, or Other Special Cover: Finish areas to receive topsoil or special cover to within not more than one inch above or below the required subgrade elevations.
   2. Sidewalks: Shape surface of areas under sidewalks to line, grade, and cross section, with finish surface not more than one inch above or below the required subgrade elevation.
   3. Pavements: Shape surface of areas under pavement to line, grade, and cross section, with finish surface not more than 1/2-inch above or below the required subgrade elevation.

C. Grading Surface of Fill Under Concrete Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2-inch when tested with a ten foot straight edge.

D. Compaction:
   1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

3.11 PAVEMENT SUBBASE COURSE

A. General:
   1. Place subbase material, in layers of specified thickness, over ground surface to support pavement base course.
   2. After completing filling and grading, shape and compact pavement subgrade to an even, firm foundation in accordance with this Section. Remove unsuitable subgrade materials, including soft materials, boulders, vegetation, and loose stones, and replace with compacted fill material as directed by ENGINEER.

B. Grade Control:
   1. During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Placing of Pavement Subbase Course:
   1. Place subbase course material on prepared subgrade in layers of uniform thickness, in accordance with indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placing operations.
   2. After completing compaction, other than that necessary for bringing material for the next course, do not haul or drive over the compacted subbase.
   3. Do not install pavement subbase in excess of 500 feet in length without compacting to prevent softening of the subgrade.
   4. If subgrade material becomes churned up into or mixed with the subbase material, remove the mixed material and replace with clean, compacted subbase material.

3.12 DISPOSAL OF EXCAVATED MATERIALS

A. General:
   1. CONTRACTOR shall haul away material removed from excavations that does not comply with requirements for fill, or is in excess of the quantity required for fill.
   2. Disposal of materials shall be in compliance with Laws and Regulations, at no additional cost to OWNER.

3.13 FIELD QUALITY CONTROL

A. Site Tests: OWNER will employ a testing laboratory to perform field quality control testing.
   1. Testing Laboratory Scope:
      a. Perform field moisture content and density tests to ensure that the specified compaction of fill materials has been obtained.

b. Tests of actual unconfined compressive strength or bearing tests on each stratum.
c. Report results of each test to ENGINEER and CONTRACTOR.

2. Required Material Tests:
   a. Compaction: Comply with ASTM D1556 and ASTM D6938, as applicable.
3. Authority and Duties of Testing Laboratory:
   a. Technicians representing the testing laboratory shall inspect the materials in the field, perform testing, and report findings to ENGINEER and CONTRACTOR. When materials furnished or the Work performed does not comply with the Contract Documents, technician will direct attention of ENGINEER and CONTRACTOR to such failure.
   b. Technician will not act as foreman or perform other duties for CONTRACTOR. Work will be checked as it progresses, but failure to detect defective Work or non-complying materials shall not in any way prevent later rejection when defect is discovered, nor shall it obligate ENGINEER for Substantial Completion or final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release requirements of the Contract Documents, or to approve or accept any portion of the Work.
4. Responsibilities and Duties of CONTRACTOR:
   a. Use of testing laboratory shall in no way relieve CONTRACTOR of the responsibility to provide materials and Work in full compliance with the Contract Documents.
   b. To facilitate testing laboratory, CONTRACTOR shall advise testing laboratory at least two days in advance of filling operations to allow for completion of field quality control testing and for assignment of personnel.
   c. It shall be CONTRACTOR's responsibility to accomplish the specified compaction for fill and other earthwork. CONTRACTOR shall control construction operations by confirmation tests to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the Contract Documents relative to compaction, control.
   d. CONTRACTOR shall demonstrate adequacy of compaction equipment and procedures before exceeding one or more of the following quantities of earthwork. Each test location shall include tests for each layer, type, or class of fill to finish grade.
      1) 200 linear feet of trench fill.
      2) 10 cubic yards of select fill.
      3) 100 cubic yards of general fill.
      4) 50 cubic yards of subbase material.
5. Testing laboratory will inspect and indicate acceptable subgrades and fill layers before construction work is performed thereon. Testing of subgrades and fill layers shall be taken as follows:

a. Trenches for Structures, and Underground Facilities (including buried ductbanks):
    1) In Open Fields: Two locations every 1,000 linear feet.
    2 Along Dirt or Gravel Roads or Off Traveled Right-of-Way: Two locations every 500 linear feet.
    3) Crossing Paved Roads: Two locations along each crossing.
    4) Under Pavement Cuts or Within Two Feet of Pavement Edges: One location every 400 linear feet.
b. Footing Subgrade: For each stratum of soil on which footings will be placed, perform not less than one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to ENGINEER.
c. For Select Fill: On 30-foot intervals on all sides of the structure for every compacted lift, but not less than one per lift on each side of the structure for structures less than 60 feet long on a side.
d. For General Fill: One per 1,000 square feet on every compacted lift.
e. Subbase Material: One per 1,000 square feet on every compacted lift.

6. Periodic compliance tests will be made by ENGINEER to verify that compaction is complying with the requirements specified, at no cost to CONTRACTOR. CONTRACTOR shall remove the overburden above the level at which ENGINEER wishes to test and shall fill and re-compact the excavation after testing is complete.
7. If testing laboratory reports or inspections indicate subgrade, fills, or bedding compaction below specified density, CONTRACTOR shall remove unacceptable materials as necessary and replace with specified materials and provide additional compaction at CONTRACTOR's expense until subgrades, bedding, and fill are acceptable. Costs for retesting of subgrade, fills, or bedding materials that did not originally comply with specified density shall be paid by CONTRACTOR.

+ + END OF SECTION + +

SECTION 31 24 00

EMBANKMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to excavate and place from borrow pits or from materials stored from excavations, suitable material for construction of earth embankments. Work includes compaction of the embankment to the specified degree and bringing it to the required lines and grades.
   2. All temporary means needed to prevent discharge of sediment to water courses caused by erosion or dewatering are included.
   3. Dust Control: Conduct all operations and maintain areas of activity, including watering of operations and sweeping and sprinkling of roadways, to minimize creation and dispersion of dust.

B. Related Sections:
   1. Section 31 20 00, Earth Moving.
   2. Section 31 11 00, Clearing and Grubbing.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Society for Testing and Materials, (ASTM).
      a. ASTM D 422, Test Method for Particle-Size Analysis of Soils.
      b. ASTM D 427, Test Methods for Shrinkage Factors of Soils by the Mercury Method.
      c. ASTM D 698 (AASHTO T99), Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures, Using 5.5 pound (2.5 kg) Rammer and 12-inch (304.8 mm Drop).
      d. ASTM D 1556, Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
      e. ASTM D 1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft 16/cu ft) (2,700 KN-m/cum).
      f. ASTM D 2166, Test Method for Unconfined Compressive Strength Of Cohesive Soils.
      g. ASTM D 2922, Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
      h. ASTM D 4318, Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

2. Occupational Safety and Health Administration, (OSHA).
    a. OSHA Standard, Title 29, Code of Federal Regulations, Part 1926, Section .650 (Subpart P - Excavations).

1.3 QUALITY ASSURANCE

A. Testing Services:
    1. General: Testing of materials, testing for moisture content during placement and compaction of fill materials, and of compaction requirements for compliance with technical requirements of these Specifications shall be performed by a testing laboratory as designated in Section 01 45 29, Testing Laboratory Services Furnished by CONTRACTOR.
    2. Testing Agency Scope:
        a. Test CONTRACTOR'S proposed materials in the laboratory and field for compliance with these Specifications.
        b. Perform field moisture content and density tests to assure that the specified compaction of backfill materials has been obtained.
        c. Report all test results to the ENGINEER and CONTRACTOR.
    3. Authority and Duties of Testing Agency: Technicians representing the testing laboratory shall inspect the materials in the field and perform tests and shall report their findings to the ENGINEER and CONTRACTOR. When the materials furnished or the Work performed fails to fulfill Specification requirements, the technician will direct the attention of the ENGINEER and CONTRACTOR to such failure.
        a. The technician shall not act as foreman or perform other duties for CONTRACTOR. Work will be checked as it progresses, but failure to detect any defective Work or materials shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the ENGINEER for final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release any requirements of the Contract Documents, nor to approve or accept any portion of the Work.
    4. Responsibilities and Duties of CONTRACTOR:
        a. The use of testing services shall in no way relieve CONTRACTOR of the responsibility to furnish materials and construction in full compliance with the Contract Documents.
        b. To facilitate testing services, CONTRACTOR shall:
            1) Secure and deliver to the ENGINEER or to the testing agency, without cost, preliminary representative samples of the materials he proposes to use and which are required to be tested.
            2) Furnish such casual labor as is necessary to obtain and handle samples at the Work site or at other sources of material.
            3) Advise the OWNER'S testing agency at least two days in advance of any backfill operations to allow for completion of quality tests and for the assignment of personnel.

c. CONTRACTOR'S Testing Service shall inspect and approve subgrades and fill layers before further construction Work is performed thereon.
d. It shall be the responsibility of CONTRACTOR to accomplish the specified compaction for backfill, fill, and other earthwork. It shall be the responsibility of CONTRACTOR to control his operations by confirmation tests to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.
e. The frequency of CONTRACTOR'S confirmation tests shall be not less than one per 1000 square feet on every compacted lift.
f. Copies of the test reports shall be submitted promptly to the ENGINEER. CONTRACTOR'S tests shall be performed by a soils testing laboratory acceptable to the ENGINEER.
g. CONTRACTOR shall demonstrate the adequacy of compaction equipment and procedures before exceeding 100 cubic yards of embankment Work.
h. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.
i. Periodic compliance tests will be made by the ENGINEER to verify that compaction is conforming to the requirements previously specified, at no cost to CONTRACTOR. CONTRACTOR shall remove the overburden above the level at which the ENGINEER wishes to test and shall backfill and recompact the excavation after the test is complete.
j. If compaction fails to conform to the specified requirements, CONTRACTOR shall remove and replace the backfill at the proper density or shall bring the density up to specified level by other means acceptable to the ENGINEER. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid by CONTRACTOR. CONTRACTOR'S confirmation tests shall be performed in a manner acceptable to the ENGINEER. Frequency of confirmation tests for remedial Work shall be double that amount specified for initial confirmation tests.

B. Permits and Regulations:
1. Obtain all necessary permits for work in roads, rights-of-way, railroads, etc. Also, obtain permits as required by local, state and federal agencies for discharging water from excavations.
2. Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

1.4 SUBMITTALS

A. Informational Submittals: Submit the following:

1. Site Quality Control Submittals:
    a. Borrow, Backfill and Grading: Testing laboratory shall submit copies of the following reports directly to ENGINEER, with copy to the CONTRACTOR:
        1) Tests on borrow material.
        2) Field density tests.
        3) Optimum moisture - maximum density curve for each soil used for backfill.
2. Qualifications Statements:
    a. Submit qualifications for earthwork testing agency.

PART 2 - PRODUCTS

2.1 CLASSIFICATION OF MATERIALS

A. Earth for embankments shall be obtained from designated borrow pit areas as shown, specified or otherwise approved. If suitable material is obtained from excavations, it may be used in the Work.

B. Class "A" material is the more impervious material found in the borrow areas. It shall be selected to vary in size such that 25 to 45 percent of the portion passing a No. 4 sieve will be finer than 0.8 mm. It shall be compacted by the procedures of AASHTO Designation T99 to at least 120 pounds dry weight per cubic foot at 10 to 12 percent moisture.

C. Class "B" material is the coarser fraction in the borrow area. It shall be selected such that 35 percent or less of the portion passing the No. 4 sieve will be finer by weight than 0.8 mm, and shall be compacted by the procedures of AASHTO Designation T99, to at least 120 pounds dry weight per cubic foot at 7 to 10 percent moisture.

D. Tests will be made during the course of the Work to ensure that suitable materials are used for each particular purpose. CONTRACTOR shall carry out the Work in such manner as to permit the selection of materials for various portions of the Work as directed by the ENGINEER, based upon tests of materials in the borrow pits and in the embankments.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the areas and conditions under which the Work is to be performed and notify the ENGINEER, in writing, of conditions detrimental to the

proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.

3.2 PREPARATION OF SURFACES UNDER EMBANKMENT

A. Prior to placing the embankment on earth surfaces, the earth shall be plowed or harrowed to a depth of at least 8-inches. Water shall be added, if required. Where embankments are placed on or against rock or concrete, the surface shall be cleaned thoroughly and moistened, if necessary to ensure a good bond. All holes and depressions shall be filled with Class "A" embankment placed in layers, moistened with water if necessary, and tamped with mechanical tampers to 95 percent of maximum density as specified in this Section. As soon as surfaces have been made reasonably level the balance of the embankment shall be constructed as specified.

3.3 CONSTRUCTION OF EMBANKMENT

A. Materials for construction of compacted embankment shall be transported in approved conveying units of such size and having such bearing tread areas that the completed fill shall not be unduly rutted by their passage. Equipment shall not be used if it is so heavy as to cause non-uniform consolidation of the earth fill. All earth fill surfaces which are too smooth to bind properly with succeeding layers shall be loosened by disking or harrowing or other approved means before the succeeding layer is placed thereon. The earth fill material shall be evenly and uniformly spread in layers as nearly as practical to 7-inches thick.

B. All stones greater than 6-inches diameter and all roots and other perishable materials shall be removed prior to rolling. Smaller stones shall be kept apart and not permitted to accumulate in groups. CONTRACTOR shall provide a sufficient workforce to be available when the spreading and rolling is being done to remove all oversize stones, roots and other unsuitable materials and to separate the smaller stones. No frozen material shall at any time be used in the construction of the embankment and no materials shall be placed which are frozen or loosened by freezing.

C. All excavation, transportation and placing operations shall be such as will produce a satisfactory mixture and gradation of materials after they have been spread and compacted. The spreading equipment shall be light-weight and no other equipment, except sprinklers or harrows, as required, shall pass over any layer which is being prepared for rolling before the rolling is completed. Dumping, spreading, sprinkling and compacting operations shall be carried out systematically so as not to interfere with each other.

D. Portions of the earth fill which are too near rock or concrete structures for proper compacting with rolling equipment shall be thoroughly compacted in 3-inch layers by tamping with mechanical tampers.

E. Embankment shall be compacted to 95 percent of maximum density at the approximate optimum moisture content determined by the standard procedure of AASHTO Designation T99. ENGINEER'S specific requirements as to selection of materials, water content and degree of compaction will be varied as necessary to obtain an earth fill of the required dry weight, imperviousness and stability.

3.4 MOISTURE CONTROL

A. The moisture content of materials in the embankment shall be controlled to meet the requirements of this Section. Where required, moisture shall be added by use of approved sprinkling equipment. Water shall be added uniformly and each layer shall be thoroughly disked or harrowed to provide proper mixing. Any layer found too wet for proper compaction shall be allowed to dry before it is rolled. Placing or rolling of material on earth fills will not be permitted during or immediately after rainfall which increase the moisture content beyond the limit of satisfactory compaction. The earth fill shall be brought up uniformly and its top shall be kept graded and sloped so that a minimum of rain water will be retained thereon. Compacted earth fill that is damaged by washing, shall be replaced by CONTRACTOR in an acceptable manner.

3.5 ROLLING

A. Approved tamping rollers shall be used for compacting all parts of the embankment which they can effectively reach. Each drum of a roller shall have an outside diameter of not less than five feet and shall be not less than four feet nor more than six feet in length. The space between two adjacent drums, when on a level surface, shall be not less than 12-inches nor more than 15-inches. Each drum shall be free to pivot about an axis parallel to the direction of travel. Each drum shall be equipped with a suitable pressure-relief valve.

B. At least one tamping foot shall be provided for each 100 square inches of drum surface. The space measured on the surface of the drum, between the centers of any two adjacent tamping feet, shall be not less than 9-inches. The length of each tamping foot from the outside surface of the drum shall be maintained at not less than 9-inches. The cross-sectional area of each tamping foot shall be not more than ten square inches at a plane normal to the axis of the shank, 6-inches from the drum surface, and shall be maintained at not less than seven square inches nor more than ten square inches at a plane normal to the axis of the shank, 8-inches from the drum surface.

C. The weight of a roller, when fully loaded, shall be not less than 4,000 pounds per foot of length of drum. The loading used in the roller drums and operation of the rollers shall be as required to obtain the required compaction. If more than one roller is used on any one layer of fill, all rollers used shall be of the same type and

essentially of the same dimensions and weight. Tractors used for pulling rollers shall have sufficient power to pull the rollers satisfactorily when drums are fully loaded with sand and water. During the operation of rolling, CONTRACTOR shall keep the spaces between the tamping feet clear of materials, which would impair the effectiveness of the tamping rollers.

D. The number of trips of the roller required over each layer shall be such as will provide at least 50 percent coverage. It is anticipated that ten to twelve trips of a single roller drum will produce the required degree of compaction. Tandum drums may be used to reduce the number of trips. In order to perform this operation to best advantage, the moisture content of the top two layers must be right, otherwise the embankment will sink and weave under the roller or material trucks, indicating that moisture content is excessive and compaction inadequate. If such condition develops to an unsatisfactory extent, operations shall be suspended until the embankment solidifies. Adjacent roller trips shall overlap to ensure proper coverage. All parts of the embankment shall be compacted to the extent directed by ENGINEER in accordance with the results and requirements described and specified hereinabove. In the early part of the Work, various numbers of roller trips will be tried in order to determine the proper compaction method. CONTRACTOR shall vary the number of roller trips as directed and shall cooperate with ENGINEER in obtaining a solid, tight embankment.

E. Other types of rollers may be used if it can be shown that equal or better results can be obtained. If CONTRACTOR wishes to make such substitution, he shall demonstrate the effectiveness of the roller by actual soil compaction results with laboratory work performed by an approved soil testing laboratory.

3.6 FINISHING EMBANKMENT

A. The embankment shall be constructed to the elevations, lines, grades and cross-sections as shown, specified or otherwise directed by ENGINEER with such increased heights and widths as deemed necessary by ENGINEER to allow for later shrinkage and settlement, but in no case will such increase exceed three percent of the dimensions shown. The embankment shall be maintained in a completely satisfactory manner and surfaces shall be compact and accurately graded before riprap, paving or topsoil is placed on them.

3.7 EROSION CONTROL

A. Erosion Control:
   1. In general, the construction procedures outlined herein shall be implemented to ensure minimum damage to the environment during construction. CONTRACTOR shall take any and all additional measures required to conform to the requirements of applicable codes and regulations, and the requirements

specified in Section 01 41 26, Stormwater Pollution Prevention Plan and Permit.

2. Whenever possible, access and temporary roads shall be located and constructed to avoid environmental damage. Provisions shall be made to regulate drainage, avoid erosion and minimize damage to vegetation.
3. Where areas must be cleared for storage of materials or temporary structures, provisions shall be made for regulating drainage and controlling erosion, subject to the ENGINEER'S approval.
4. Temporary measures shall be applied to control erosion and to minimize the silting of the existing waterways, and natural ponding areas. Such measures shall include, but are not limited to, the use of berms, baled straw silt barriers, gravel or crushed stone, mulch, slope drains and other methods. These temporary measures shall be applied to erodible materials exposed by any activities associated with the construction of the Work.
    a. Special care shall be taken to eliminate depressions that could serve as mosquito pools.
    b. Temporary measures shall be coordinated with the construction of permanent drainage facilities and other Work to the extent practicable to ensure economical, effective, and continuous erosion and silt control.
    c. CONTRACTOR shall provide special care in areas with steep slopes. Disturbance of vegetation shall be kept to a minimum to maintain stability.
5. Remove only those shrubs and grasses that must be removed for construction. Protect the remainder to preserve their erosion-control value.
6. Install erosion and sediment control practices where shown and according to applicable standards, codes and specifications. The practices shall be maintained in effective working condition during construction and until the drainage area has been permanently stabilized.
7. Mulching to be used for temporary stabilization.
    a. Suitable Materials for Mulching:
        1) Unrotted Straw or Salt Hay: 1-1/2 to 2 tons/acre.
        2) Asphalt Emulsion or Cutback Asphalt: 600 to 1200 gal./acre.
        3) Wood-fiber or Paper-fiber (hydroseeding): 1500 lbs./acre.
        4) Mulch netting (paper, jute, excelsior, cotton or plastic).
    b. Straw or salt hay mulches should be immediately anchored using peg and twine netting or a mulch anchoring tool or liquid mulch binders.
8. After stabilization, remove all straw bale dikes, debris, etc., from the Site.
9. In the event of any temporary Work stoppage, CONTRACTOR shall take steps any temporary or environmental damage to the area undergoing construction.
10. In the event CONTRACTOR repeatedly fails to satisfactorily control erosion and siltation, the OWNER reserves the right to employ outside assistance or to use its own forces to provide the corrective measures indicated. The cost of such work, plus engineering costs, will be deducted from monies due CONTRACTOR.

11. CONTRACTOR shall prevent blowing and movement of dust from exposed soil surfaces and access roads to reduce on and off-site damage and health hazards. Control may be achieved by irrigation in which the Site shall be sprinkled with water until the surface is moist. The process shall be repeated as needed.

++ END OF SECTION ++

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SECTION 32 31 00

CHAIN LINK FENCING AND GATES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified, and required to furnish and install fencing.
   2. Extent of fencing is shown or indicated.
   3. Types of materials required under this Section include:
      a. Aluminum-coated, steel chain link fabric.
      b. Galvanized steel framework.
      c. Barbed wire.
      d. Grounding and bonding.
      e. Auxiliary system components, gates, accessories, fasteners, and fittings.
   4. Substitutions: Structural shapes of satisfactory sections and equal strengths may be substituted upon ENGINEER's approval of CONTRACTOR's substitution request.

B. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 26 00 05, Electrical Work.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASTM A53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
   2. ASTM A90/A90M, Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
   3. ASTM A123, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   4. ASTM A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   5. ASTM A428/A428M, Test Method for Weight [Mass] of Coating on Aluminum-Coated Iron or Steel Articles.
   6. ASTM A491, Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
   7. ASTM A780, Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

8. ASTM A817, Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric.
9. ASTM A1011/A1011M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
10. ASTM B6, Specification for Zinc.
11. ASTM D412, Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension.
12. ASTM D746, Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
13. ASTM D792, Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
14. ASTM D1499, Practice for Filtered Open-Flame Carbon-Arc Exposures of Plastics.
15. ASTM D2240, Test Method for Rubber Property—Durometer Hardness.
16. ASTM F552, Terminology Relating to Chain Link Fencing.
17. ASTM F567, Practice for Installation of Chain-Link Fence.
18. ASTM F626, Specification for Fence Fittings.
19. ASTM A653, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
20. ASTM F668, Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.
21. ASTM F1043, Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
22. ASTM F1083, Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
23. ASTM F900, Specification for Industrial and Commercial Swing Gates.
24. ASTM F1664, Specification for Poly(Vinyl Chloride) (PVC) and Other Conforming Organic Polymer-Coated Steel Tension Wire Used with Chain-Link Fence.
25. ASTM F1665, Specification for Poly(Vinyl Chloride) (PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used With Chain-Link Fence.
26. CLFMI CLF 2445, Product Manual.
27. CLFMI, Step-by-Step Installation Guide.
28. IEEE C2, National Electrical Safety Code.
29. IEEE 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements.
30. UL 467, Grounding and Bonding Equipment.

1.3 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning.
   1. “Knuckling” describes the type of selvage obtained by interlocking adjacent pairs of wire ends and then bending the wire ends back into a closed loop.

2. "Fencing" describes an assembly of metal components, including wire chain-link fabric fastened to top, bottom and intermediate horizontal rails and to vertical line posts, corner posts and terminal posts. This assembly includes all auxiliary components, gates, fittings, fasteners, and other accessories, all with specified protective coatings.

B. Terminology used in this Section and not defined in this Article will be construed in accordance with the terminology used in CLF 2445 and ASTM F552.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Erector/Installer:
      a. Engage a single erector that is skilled and trained, and possesses successful and documented experience installing fencing, and employs only workers with specific skill and successful experience in the type of Work required.
      b. Erector shall be acceptable to fencing manufacturer,

B. Component Supply and Compatibility:
   1. Provide fencing as complete system with all gates, hardware, appurtenances and other components produced by a single manufacturer, including custom erection accessories, fittings, clamps, and fastenings as required for complete system.

C. Regulatory Requirements:
   1. Comply with Laws and Regulations, including:
      a. Americans with Disabilities Act of 1990 (Public Law 101-336), Appendix A of 28 CFR 36, Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Drawings of typical fence assembly, identifying all materials, dimensions, sizes, weights, and finishes of rails, posts, braces, supports and other fencing components. Show fence heights, and locations of gates. Show gate swing, or other operation, hardware, and accessories. Include plans, elevations, and sections, with required installation and operating clearances, and details of post anchorage, attachments, and bracing.
   2. Product Data:
      a. Copies of manufacturer's technical product information and specifications for all fencing components.
      b. Data substantiating that materials proposed comply with the following:

1) Weight of aluminum coating on wire fabrications, in compliance with ASTM A428.
2) Weight of zinc coating on pipe fabrications, in compliance with ASTM A90.

B. Informational Submittals: Submit the following:
   1. Manufacturer's Instructions:
      a. Manufacturer's installation instructions.

C. Closeout Submittals: Submit the following:
   1. Warranty documentation.
   2. Keys: Submit three sets of keys for locksets and/or padlocks.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:
   1. Packaging and Marking: Comply with CLFMI CLF 2445.
   2. Deliver materials in manufacturer's original, unopened packaging with all factory-applied tags, labels and other identifying information intact, legible and accurately representing material on approved submittals.

B. Storage of Materials:
   1. Store all materials under weatherproof cover, off the ground and away from other construction activities.
   2. Do not store material in a manner that would create a humidity chamber. Provide for free movement of air under protective cover and between components of the fencing.

C. Handling of Materials:
   1. Handle material in manner that is in compliance with manufacturer's recommendations and that avoids damaging coatings.

1.7 PROJECT CONDITIONS

A. Utilities: Do not damage or interrupt underground utilities during fencing installation.

B. Obtain measurements at the Site to verify layout information and dimensions for fencing and gates in relation to reference points provided by OWNER or indicated in the Contract Documents.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design Considerations:
   1. Verify size of framing members shown or indicated in the Contract Documents. Where structural analysis indicates the need, provide additional members, or increased member size, thickness or weight.
   2. Modifications may be made only as necessary to meet Site conditions to ensure proper fitting and support of the Work and only upon submittal of Shop Drawings and receipt of approval by ENGINEER.

2.2 MATERIALS

A. General:
   1. Tube sizes specified are nominal outside dimension.
   2. Roll-formed section sizes are nominal outside dimensions.
   3. Wire gages shall conform to American Steel and Wire Company gage.
   4. Heat-form arcs and chords before applying protective coatings to metal.
   5. Sizes specified are given for uncoated metal. Protective coatings are in addition to specified metal dimensions, gages, and sizes.
   6. Provide weights of zinc and aluminum coatings on wire and pipe fabrications in accordance with CLFMI CLF 2445.

B. Chain-Link Fence Fabric:
   1. One-piece fabric widths, for fencing less than or equal to 12 feet in height, complying with CLFMI CLF 2445.
   2. Wire mesh shall be woven throughout in form of approximately-uniform square mesh with parallel sides and horizontal and vertical diagonals of approximately-uniform dimensions, of size and gage specified and in compliance with ASTM A817, Type 1, cold-drawn carbon steel wire with minimum breaking strength of 2,170 pounds and coated with aluminized finish, as specified. Fabric shall be as recommended by CLFMI for heavy industrial usage.
   3. Provide fence fabric imprinted with manufacturer's trade name, country of origin, core wire gage, and finished outside diameter gage.
   4. Provide fabric knuckled to eliminate exposure of sharp edges.
   5. Fabric Gage: Provide the following:
      a. No. 9-gage wires.
   6. Mesh Size: Provide the following:
      a. Two-inch mesh.

2.3 FRAMEWORK

A. General: The following table presents actual OD and equivalent nominal NPS size and trade size of round members:

Actual OD (inches)	NPS Size (inches)	Trade Size (inches)
1.315	1.0	1-3/8
1.660	1.25	1-5/8
1.900	1.5	2
2.375	2.0	2.5
2.875	2.5	3
3.500	3.0	3.5
4.000	3.5	4
6.625	6.0	6-5/8
8.625	8.0	8-5/8

B. Pipe shall be commercial grade, plain-end steel pipe with standard-weight walls. Steel strip used for manufacture of pipe shall comply with ASTM F1083, Schedule 40 pipe with minimum yield strength of 25,000 psi and protected with zinc, as specified.

C. Fittings: Comply with ASTM F626.

D. End, Corner, and Pull Posts: Provide end, corner, and pull posts of following minimum sizes:
   1. Up to six feet fabric height:
      a. 2.375 inches OD pipe weighing 3.65 pounds per linear foot.

E. Line Posts: Provide line posts of following minimum sizes and weights:
   1. Up to six feet fabric height:
      a. 1.90 inches OD pipe weighing 2.72 pounds per linear foot.

F. Gate Posts: Provide gate posts for supporting single gate leaf, or one leaf of a double gate installation, for nominal gate widths as follows:
   1. Up to six feet wide:
      a. 2.875 inches OD pipe weighing 5.79 pounds per linear foot.
   2. Over six feet wide and up to 13 feet wide:
      a. Four inches OD pipe weighing 9.11 pounds per linear foot.
   3. Over 13 feet wide and up to 18 feet wide:
      a. 6.625 inches OD pipe weighing 18.97 pounds per linear foot.

G. Top Rail: Provide top rails, unless otherwise shown or indicated, conforming to the following:
   1. 1.900 inch OD pipe weighing 2.72 pounds per linear foot.

2. Provide in manufacturer's longest lengths, with expansion-type coupling 0.051-inch thick rail sleeves, approximately seven inches long, for each joint.
3. Provide means for attaching top rail securely to each gate, corner, pull, and end post.

H. Roll-Formed Steel: Provide rolled steel shapes produced from structural-quality steel conforming to ASTM A1011, Grade 45, with minimum yield strength of 45,000 pounds psi. Protective coating system shall conform to ASTM F1043, as specified.

I. Post Brace Assembly: Provide bracing assemblies at end and gate posts, and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric.
1. Use 1.900-inch OD pipe weighing 2.72 pounds per linear foot for horizontal brace and 3/8-inch diameter rod with turnbuckle for diagonal truss.

2.4 GATES

A. Swing gates shall comply with ASTM F900.

B. Gate hinges shall be double clamping offset type. To hold gate in the open or closed positions, provide each gate frame with a keeper that automatically engages gate shoe set in concrete. Gates shall have drop latch with provision for padlock.
1. Gate Hinges: Pressed or forged steel or malleable iron to suit gate size, non-lift-off type, 180-degree offset heavy-industrial hinges, 1.5 pair per leaf.
2. Latch: Forked-type or plunger bar type to permit operation from either side of gate, with padlock eye as integral part of latch.

C. Padlocks: Provide each gate with heavy-duty bronze padlock and shackle chain as follows:
1. Product and Manufacturer: Provide one of the following:
a. No. 160DHM with 11/32-inch marine brass shackle by Master Lock Company.
b. Or equal.
2. Provide three keys for each padlock. Where more than one gate is required for same enclosure, padlocks shall be keyed identically.

D. Gate frames shall be welded construction and shall be galvanized after fabrication. Provide double gates 16 feet or greater in width, with diagonal bracing extending from top to bottom rail.

E. Fabricate gate perimeter frames of tubular members. Provide additional horizontal and vertical members to ensure proper gate operation and for attachment of fabric,

hardware, and accessories. Space so that frame members are not more than eight feet apart. Fabricate as follows:

1. Up to six feet high, or leaf width of eight feet or less:
   a. 1.660-inch OD pipe weighing 2.27 pounds per linear foot.
2. Over six feet high, or leaf width exceeding eight feet:
   a. 1.900-inch OD pipe weighing 2.72 pounds per linear foot.

F. Gate Stops: Provide gate stops for double gates consisting of mushroom-type flush plate with anchors, set in concrete and designed to engage a center drop rod or plunger bar. Include locking device and padlock eyes as integral part of latch, using one padlock for locking both gate leaves.

G. Assemble gate frames by welding or with special malleable or pressed steel fittings and rivets for rigid connections. Use same fabric as provided for fence. Install fabric with stretcher bars at vertical edges. Bars may also be used at top and bottom edges. Attach stretchers to gate frame at not more than 15 inches on centers. Attach hardware with rivets or by other means that will provide security against removal and breakage.

H. Install diagonal cross-bracing on gates consisting of 3/8-inch diameter adjustable length truss rods provided with turnbuckles to ensure frame rigidity without sag or twist.

2.5 AUXILIARY FENCING MATERIALS AND ACCESSORIES

A. Wire Ties:
   1. For tying fabric to line posts, use nine-gage, aluminum alloy 1100-H4, wire ties to match fence fabric, spaced 12 inches on centers.
   2. For tying fabric to rails and braces, use nine-gage, aluminum alloy 1100-H4, wire ties to match fence fabric, spaced two feet on centers.
   3. For tying fabric to tension wire, use 11-gage, aluminum alloy 1100-H4, wire hog ring ties to match fence fabric, spaced two feet on centers.

B. Post Caps: Pressed steel, wrought iron, or cast aluminum alloy, designed as weather-tight closure cap, for tubular posts. Provide one cap for each post unless equal protection is afforded by combination post-top cap and barbed wire supporting arm, where barbed wire is required.
   1. Provide caps with openings to allow through-passage of top rail.
   2. Provide cone-type caps for terminal posts and loop-type caps for line posts.

C. Stretcher Bars: One-piece lengths equal to full height of fabric, with minimum cross-section of 3/16-inch by 3/4-inch. Provide one stretcher bar for each gate and end-post, and two for each corner- and pull-post, except where fabric is integrally woven into the post.

D. Stretcher Bar Bands: Pressed steel, galvanized, 0.078-inch to 0.108-inch thick depending on post diameter, spaced not greater than 15 inches on centers to secure stretcher bars to end-, corner-, pull-, and gate-posts.
   1. Bands may also be used with special fittings for securing rails to end-, corner-, pull-, and gate-posts.

E. Truss Rods: Steel rods, 3/8-inch diameter, merchant quality with turnbuckle.

F. Concrete: In accordance with Section 03 00 05, Concrete.

2.6 FENCE GROUNDING

A. Conductors: Refer to Section 26 00 05, Electrical Work, for fence grounding conductor requirements.

B. Connectors and Ground Rods: Refer to Section 26 00 05, Electrical Work, for fence grounding connectors and ground rod requirements.

2.7 FINISHING

A. Chain-Link Fence Fabric:
   1. Aluminized finish with not less than 0.40 ounces aluminum per square foot, complying with ASTM A491, Class II.

B. Framework and Appurtenances: Provide the following finishes for steel framework, auxiliary system components, and miscellaneous accessories:
   1. Galvanizing: Zinc for galvanizing shall be of High Grade or Special High Grade conforming to ASTM B6 with maximum aluminum content of 0.01 percent. Galvanize metal using hot-dip process in accordance with the following:
      a. Structural Iron and Steel Shapes: ASTM A123
      b. Rolled-Form Sheet Steel: ASTM A653
      c. Hardware and Accessories: ASTM A153
      d. Fittings: ASTM F626
      e. Pipe: ASTM A53
   2. Provide minimum weights of zinc as follows:
      a. Pipe: 1.8-ounces of zinc per square foot. Apply Type A coating both inside and outside according to ASTM F1043, as determined by ASTM A90.
      b. Rolled-Form Sheet Steel: 4.0-ounces of zinc per square foot of surface area.
      c. Hardware and Accessories: Zinc weights in compliance with Table 1 of ASTM A153.

C. Welded Joints:

1. Repair zinc coatings at welded joints by applying zinc-rich paint, as specified in Section 09 91 00, Painting, and ASTM A780.

2.8 SOURCE QUALITY CONTROL

A. Fabrication Tolerances:
   1. Fabric, posts, rails, and other supports shall be straight or uniformly curved to provide the profiles shown, to dimensional tolerance of 1/16-inch in 10 feet without warp or rack in the finished Work.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be erected and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 ERECTION

A. Comply with CLFMI Step-by-Step Installation Guide and ASTM F567. Do not begin installation and erection of fencing until final grading is completed.

B. Excavation: Drill holes of diameters specified, for post footings in firm, undisturbed or compacted soil.
   1. For posts set in cast-in-place concrete, provide hole diameters dug or drilled a minimum of four times the largest cross section of post.
      a. Unless otherwise shown or indicated, excavate hole depths approximately three inches lower than bottom of post, with bottom of posts set not less than two feet below the surface of finished grade when in firm, undisturbed soil, plus an additional three inches for each foot increase in the fence height over four feet.
   2. Spread soil from excavations uniformly adjacent to fence line, or on adjacent areas of the Site, as directed by ENGINEER.
   3. When solid rock is encountered at ground surface, drill into rock at least 12 inches for line-posts and at least 1.5 feet for end-, pull-, corner-, and gate-posts. Drill hole at least one inch greater diameter than largest dimension of post to be placed.
      a. If solid rock is below soil overburden, drill to full depth required, except penetration into rock need not exceed the minimum depths specified above for rock encountered at ground surface.

C. Setting Posts: Remove loose and foreign materials from sides and bottoms of holes, and moisten soil prior to placing concrete.
   1. Center and align posts in holes 3-inches above bottom of excavation.

2. Posts shall be set in concrete footings, except as otherwise shown or specified. Place concrete around posts in continuous pour, and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
3. Extend concrete to two inches above ground surface, or to two inches below ground surface if cover of sod, bituminous asphalt paving, or other material is shown or indicated to conceal concrete. Crown to shed water away from posts.
4. Extend footings for gate posts to underside of bottom hinge. Set keeps, stops, sleeves, and other accessories into concrete as required.
5. Keep exposed concrete surfaces moist for at least seven days after placement, or cure with membrane curing materials, or other acceptable curing method.
6. Grout posts set in sleeved holes, concrete constructions, or rock with grout, as specified in Section 03 00 05, Concrete, and as recommended in CLFMI CLF 2445.

D. Concrete Strength: Allow concrete to attain at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than seven days after placement, before installing rails, tension wires, barbed wire, or chain-link fabric.
1. Do not stretch and tension fabric and wires, and do not hang gates, until concrete has attained its full design strength.

E. Posts and Rails:
1. Line Posts: Set posts in cast-in-place concrete footings as specified, spaced not more than ten feet on centers. Provide caps on top of each post to exclude moisture and to receive top rail, unless equal protection is afforded by combination post-top cap and barbed wire supporting arm, where barbed wire is required.
2. Top Rails: Run rail continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by fencing manufacturer to form continuous rail between terminal posts.
3. Brace Assemblies: Install braces so posts are plumb when diagonal rod are under proper tension. Install brace assemblies at end-posts and at both sides of corner- and pull-post panels. Panels adjacent to gates shall have intermediate horizontal rails and diagonal bracing. Diagonal bracing shall run from center of first line-post to bottom of terminal-post.

F. Chain-Link Fabric:
1. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released. Fasten to terminal posts and gate posts with tension bars threaded through mesh and secured with tension bands at maximum intervals of 14 inches.
2. Tie to line-posts, gate frames and top and bottom rails with tie wires spaced at maximum 12 inches on posts and two feet on rails.

3. Connect tension bars to posts and frames by means of adjustable bolts and bands spaced not more than 14 inches apart.
4. Leave approximately two inches between finish ground surface and bottom selvage, except where bottom of fabric extends into concrete.
5. Join roll of chain-link fabric by weaving a single picket into the ends of roll to form continuous mesh.

G. Barbed Wire:
1. Install three parallel wires on each extension arm; on security side of fence, unless otherwise shown or indicated
2. Pull wire taut to remove sag and firmly install in slots of extension arms to prevent movement or displacement.
3. Secure wire to terminal posts utilizing terminal post band arms or brace bands.
4. Extend vertical members of gates to receive barbed wire.

H. Stretcher Bars: Thread through or clamp to fabric four inches on centers, and secure to posts with metal bands spaced 15 inches on centers.

I. Gates: Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage, as shown on approved Shop Drawings. Adjust hardware for smooth operation and lubricate where necessary.

J. Tie Wires: Use U-shaped wires conforming to diameter of pipe. Clasp pipe and fabric firmly with ends twisted at least two full turns. Bend ends of wire to minimize hazard to persons and clothing.

K. Fasteners: Install nuts for tension band and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.3 GROUNDING AND BONDING

A. Refer to Section 26 00 05, Electrical Work, for fence grounding requirements.

3.4 FIELD QUALITY CONTROL

A. Site Tests: Refer to Section 26 00 05, Electrical Work, for fence grounding site test requirements.

3.5 ADJUSTMENT AND CLEANING

A. Repair coatings damaged in the shop or at the Site by recoating with manufacturer's recommended repair compound, applied in accordance with manufacturer's directions. Repair hot-dip galvanized coatings in accordance with ASTM A780.

B. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, and malfunction throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

C. Lubricate operating equipment and clean exposed surfaces.

D. Repair and replace broken or bent components.

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SECTION 32 31 29

WOOD FENCING AND GATES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified, and required to furnish and install fencing.
   2. Extent of fencing is shown or indicated.
   3. Types of materials required under this Section include:
      a. Pressure-treated wood.
      b. Galvanized steel components.
      c. Gates, accessories, fasteners, and fittings.
   4. Substitutions: Structural shapes of satisfactory sections and equal strengths may be substituted upon ENGINEER's approval of CONTRACTOR's substitution request.

B. Related Sections:
   1. Section 03 00 05, Concrete.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASTM A53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
   2. A3. ASTM A123, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   3. ASTM F537, Design, Fabrication, and Installation of Fences Constructed of Wood and Related Materials.
   4. AASHTO M133, Preservatives and Pressure Treatment Processes for Timber
   5. ASTM F1043, Strength and Protective Coatings on Steel Industrial Fence Framework
   6. ASTM A780, Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
   7. ASTM A1011/A1011M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
   8. ASTM D1499, Practice for Filtered Open-Flame Carbon-Arc Exposures of Plastics.
   9. ASTM A653, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

10. ASTM F1083, Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
11. ASTM F900, Specification for Industrial and Commercial Swing Gates.

1.3 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning.
   1. "Fencing" describes an assembly of components, including wooden slats fastened to top, bottom and intermediate horizontal runners and to vertical runners, line posts, corner posts and terminal posts. This assembly includes all auxiliary components, gates, fittings, fasteners, and other accessories, all with specified protective coatings.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Erector/Installer:
      a. Engage a single erector that is skilled and trained, and possesses successful and documented experience installing fencing, and employs only workers with specific skill and successful experience in the type of Work required.
      b. Erector shall be acceptable to fencing manufacturer,

B. Component Supply and Compatibility:
   1. Provide fencing as complete system with all gates, hardware, appurtenances and other components produced by a single manufacturer, including custom erection accessories, fittings, clamps, and fastenings as required for complete system.

C. Regulatory Requirements:
   1. Comply with Laws and Regulations, including:
      a. Americans with Disabilities Act of 1990 (Public Law 101-336), Appendix A of 28 CFR 36, Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Drawings of typical fence assembly, identifying all materials, dimensions, sizes, weights, and finishes of rails, posts, braces, supports and other fencing components. Show fence heights, and locations of gates. Show gate swing, or other operation, hardware, and accessories. Include plans, elevations, and sections, with required

installation and operating clearances, and details of post anchorage, attachments, and bracing.

2. Product Data:
    a. Copies of manufacturer's technical product information and specifications for all fencing components.

B. Informational Submittals: Submit the following:
1. Manufacturer's Instructions:
    a. Manufacturer's installation instructions.

C. Closeout Submittals: Submit the following:
1. Warranty documentation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:
1. Packaging and Marking: Comply with manufacturers recommendations.
2. Deliver materials in manufacturer's original, unopened packaging with all factory-applied tags, labels and other identifying information intact, legible and accurately representing material on approved submittals.

B. Storage of Materials:
1. Store all materials under weatherproof cover, off the ground and away from other construction activities.
2. Do not store material in a manner that would create a humidity chamber. Provide for free movement of air under protective cover and between components of the fencing.

C. Handling of Materials:
1. Handle material in manner that is in compliance with manufacturer's recommendations and that avoids damaging coatings.

1.7 PROJECT CONDITIONS

A. Utilities: Do not damage or interrupt underground utilities during fencing installation.

B. Obtain measurements at the Site to verify layout information and dimensions for fencing and gates in relation to reference points provided by OWNER or indicated in the Contract Documents.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design Considerations:
   1. Verify size of framing members shown or indicated in the Contract Documents. Where structural analysis indicates the need, provide additional members, or increased member size, thickness or weight.
   2. Modifications may be made only as necessary to meet Site conditions to ensure proper fitting and support of the Work and only upon submittal of Shop Drawings and receipt of approval by ENGINEER.

2.2 MATERIALS

A. General
   1. Fences shall be solid board design made from pressure-treated pine lump.
   2. All wood dimensions are nominal lumber sizes.
   3. Pressure-treatment shall be suitable for buried wood (use category – ground contact).
   4. Hardware shall be as listed or heavier.

B. Fencing
   1. Slats shall be 1x6x6, with dog-ear cut on top end.
   2. Each section shall be a maximum width of eight feet with three 2x4 horizontal runners.
   3. Line and corner posts shall be 4x4x8 with two feet buried below slab finish grade and spaced apart by not more than four feet.
   4. Line and corner posts shall be placed in a hole thirty inches below grade filled with six inches of gravel. The hole shall have a diameter of ten inches. After the post has been placed in the hole at a ninety degree angle to the ground surface, concrete shall be placed in the hole. CONTRACTOR shall temporarily secure post in such a way to keep fence post upright while concrete cures (see Section 03 00 05, Concrete).
   5. Slats shall be attached to runners using either three #6 ring shank nails or three two-inch #8 SS deck screws.
   6. Runners shall be attached to posts using two 3-1/2 inch SS deck screws.

C. Gates
   1. Gates shall be of solid construction, eight feet per side for a 16 foot opening.
   2. Posts shall be 6x6x10 with four feet buried below slab finish grade.
   4. Posts shall be placed in a hole fifty-four inches below grade filled with six inches of gravel. The hole shall have a diameter of twelve inches. After the post has been placed in the hole at a ninety degree angle to the ground surface, concrete shall be placed in the hole. CONTRACTOR shall temporarily secure post in such a way to keep fence post upright while concrete cures (see Section 03 00 05, Concrete).
   5. Gate shall be provided with three horizontal runners and two vertical runners of steel tubing (1-1/2 inch square in size, 18 gauge, and hot galvanized). Runners shall be welded at all corners and mid points. All welds and drilled holes shall be patched with Cold Galvanizing.

6. Wood horizontal runners shall be attached to the steel tubing runners using 316 SS 3/8 inch carriage bolts, nuts, and washers (top wooden runner attached to bottom of top steel runner, bottom two wooden runners attached to top of bottom two steel runners).
7. Each gate shall have three hinges (1/8x2x4 inch, 1-5/8 standard female gate hinge). Each shall have one square hole to accommodate 3/8 inch carriage bolts, nuts, and washers (2-1/2 inch long). The top and bottom hooks shall be turned up and the center hook turned down. Gate hinge straps shall be secured to gates by bolts across the horizontal runners and secured with washer and nuts on the inside of the gate. Bolt hooks for straps shall be 5/8 inch in diameter by 13-3/8 inch long, threaded with 316 SS nuts and washers for each side.
8. The gate is to be secured by chains with 3/8 inch 316L SS bolts through gate slats and center horizontal runners, with washers and nuts on inside of gates. Each gate is to be provided with a 1/2 inch diameter by 34 inch long rod with 90 degree bend four inches long on the end for the gate drop rod.
9. Rods to be mounted with two 316L SS open eye bolts (3/8 inch by four inch), nuts, and washers and one 3/8 inch carriage bolt, to allow rod to drop 12 inches below the bottom of the gate to hold it in open position. Rods shall drop into a 1-1/4 inch diameter pipe that extends 18 inches below grade. Rods to be installed on the vertical steel tubing of the gate. 316L SS carriage bolts, nuts, and washers shall be installed on each gate to hold drop rods in the up position. A 1 inch diameter hole, nine inches deep shall be bored into the concrete to hold the right hand gate in the closed position.

2.8 SOURCE QUALITY CONTROL

A. Fabrication Tolerances:
   1. Slats, posts, runners, steel tubing, and other supports shall be straight or uniformly curved to provide the profiles shown, to dimensional tolerance of 1/16-inch in 10 feet without warp or rack in the finished Work.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be erected and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 ERECTION

A. Comply with ASTM F537. Do not begin installation and erection of fencing until final grading is completed.

B. Excavation: Drill holes of diameters specified, for post footings in firm, undisturbed or compacted soil.

1. For posts set in cast-in-place concrete, provide hole diameters dug or drilled a minimum of four times the largest cross section of post.
    a. Unless otherwise shown or indicated, excavate hole depths approximately six inches lower than bottom of post, with bottom of posts set not less than two feet below the surface of finished grade when in firm, undisturbed soil, plus an additional three inches for each foot increase in the fence height over four feet.
2. Spread soil from excavations uniformly adjacent to fence line, or on adjacent areas of the Site, as directed by ENGINEER.
3. When solid rock is encountered at ground surface, drill into rock at least 12 inches for line-posts and at least 1.5 feet for end-, pull-, corner-, and gate-posts. Drill hole at least one inch greater diameter than largest dimension of post to be placed.
    a. If solid rock is below soil overburden, drill to full depth required, except penetration into rock need not exceed the minimum depths specified above for rock encountered at ground surface.

C. Setting Posts: Remove loose and foreign materials from sides and bottoms of holes, and moisten soil prior to placing concrete.
1. Center and align posts in holes 6 inches above bottom of excavation.
2. Posts shall be set in concrete footings, except as otherwise shown or specified. Place concrete around posts in continuous pour, and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
3. Extend concrete to two inches above ground surface, or to two inches below ground surface if cover of sod, bituminous asphalt paving, or other material is shown or indicated to conceal concrete. Crown to shed water away from posts.
4. Extend footings for gate posts to underside of bottom hinge. Set keeps, stops, sleeves, and other accessories into concrete as required.
5. Keep exposed concrete surfaces moist for at least seven days after placement, or cure with membrane curing materials, or other acceptable curing method.
6. Grout posts set in sleeved holes, concrete constructions, or rock with grout, as specified in Section 03 00 05, Concrete, and as recommended in ASTM F537.

D. Concrete Strength: Allow concrete to attain at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than seven days after placement, before installing rails, tension wires, barbed wire, or chain-link fabric.
1. Do not hang gates until concrete has attained its full design strength.

E. Posts and Runners:
1. Line Posts: Set posts in cast-in-place concrete footings as specified, spaced not more than ten feet on centers. Provide caps on top of each post to exclude moisture and to receive top rail, unless equal protection is afforded

by combination post-top cap and barbed wire supporting arm, where barbed wire is required.

F. Gates: Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage, as shown on approved Shop Drawings. Adjust hardware for smooth operation and lubricate where necessary.

3.3 GROUNDING AND BONDING (NOT USED)

3.4 FIELD QUALITY CONTROL (NOT USED)

3.5 ADJUSTMENT AND CLEANING

A. Repair coatings damaged in the shop or at the Site by recoating with manufacturer's recommended repair compound, applied in accordance with manufacturer's directions.

B. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, and malfunction throughout entire operational range.

C. Lubricate operating equipment and clean exposed surfaces.

D. Repair and replace broken or bent components.

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SECTION 32 92 00

LAWNS AND MEADOWS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install all lawns and meadows.
   2. Extent of lawns and meadows is shown.
   3. Types of products required include the following.
      a. Sod.
      b. Fertilizers.
      c. Accessories.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, lawns and meadows.

C. Related Sections:
   1. Section 33 11 00, Clearing and Grubbing.
   2. Section 32 31 00, Fences.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. Association of Official Analytic Chemists, (AOAC).
      a. Official Methods of Analysis of AOAC International.
   2. Association of Official Seed Analysts, (AOSA).
      a. Journal of Seed Technology; Rules for Testing Seeds.
   3. American Society of Agronomy, (ASA).
      a. Reference No. 1 - Methods of Soils Analysis, Soil Science Society of America, Incorporated.
   4. American Society for Testing and Materials, (ASTM).
      a. ASTM B 221, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
      b. ASTM C 602, Specification for Agricultural Liming Materials.
      c. ASTM D 75, Practice for Sampling Aggregates.
      d. ASTM D 422, Test Method for Particle Size Analysis of Soil.
      e. ASTM D 977, Specification for Emulsified Asphalt.

f. ASTM D 2487, Practice for Classification of Soils for Engineering Purposes (United Soil Classification System).
g. ASTM D 5268, Specification for Topsoil Used for Landscape Purposes.
h. ASTM E 329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
i. ASTM E 548, Guide for General Criteria Used for Evaluating Laboratory Competence.

5. Turfgrass Producers International, (TPI).
   a. Guideline Specifications to Turfgrass Sodding.

1.3 DEFINITIONS

A. The term "finish grade" shall be used to describe the finished surface elevation of planting soil.

B. The term "manufactured topsoil" shall be used to describe soil produced off-Site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil acceptable as a component of loam.

C. The term "loam" shall be used to describe topsoil that has been mixed with additional organic and inorganic additives, as specified.

D. The term "percentage pure live seed" shall be defined as the percent (%) purity multiplied by percent (%) germination divided by 100 to equal the percent pure live seed (PLS) and shall be calculated for all seed lots using each seed lots own unique purity and germination test results. A PLS pound shall be defined as the bulk weight of seed required to equal one pound of 100 percent pure, germinated seed.

E. The term "subgrade" shall be used to describe the surface of subsoil remaining after completing excavation; or the top surface of a fill or backfill immediately beneath topsoil and which has not been tested for acceptable use as topsoil.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Engage a single landscape installer skilled, trained and with successful and documented experience in the planting of lawns and meadows and with specific skill and successful experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit names and qualifications to ENGINEER along with the following information on a minimum of three successful projects:

a. Names and telephone numbers of owner, architects or engineers responsible for projects.
b. Approximate contract cost of the lawns and meadows.
c. Amount of area installed.

2. Installer's Site Supervisor: Require installer to maintain an experienced full-time landscape supervisor on-Site during the time of preparation for, and planting of, lawns and meadows. Supervisor shall have achieved landscape or horticultural certification acceptable to governing authorities having jurisdiction at the Site.
3. Ratio of laborers to certified landscape supervisors shall not exceed 12 to one. Certified landscape supervisor shall be on-Site throughout the day-to-day performance of the Work of this Section.
4. Application of herbicides, chemicals and insecticides shall be done by personnel licensed to perform such applications by governing authorities having jurisdiction at the Site and in accordance with each manufacturer's instructions provided on each product label.

B. Soil-Testing Laboratory Qualifications:
1. An independent laboratory, recognized by governing authorities having jurisdiction at the Site, with the experience and capability to conduct testing indicated and that specializes in types of soil tests to be performed.
2. To qualify for approval, an independent testing agency shall demonstrate to ENGINEER'S satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work, in accordance with ASTM E 329 and as documented according to ASTM E 548.

C. References: Comply with the applicable requirements referenced in Section 01 42 00, References.

D. Source Quality Control:
1. Provide sod procured from areas having growing conditions similar to location of Site.
2. Machine-cut sod into rectangular sections, exercising care to retain the native soil on the roots of the sod, during stripping, transportation and planting.
3. Cut and move sod only when soil moisture conditions are such that favorable results can be expected.
4. Rectangular sections of sod may vary in length but shall be equal in width and of a size that permits the sod to be lifted and rolled without breaking.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Schedule for lawn and meadow-planting showing anticipated planting dates for each type of Work.
   2. Product Data:
      a. Manufacturer's product data, specifications and installation instructions for all required materials.
      b. Composition and analysis of commercial fertilizers and all purchase receipts showing the total quantity actually purchased for this Project.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Verify that sod contains no noxious weeds or other material that might be detrimental to the proposed planting.
   2. Test Reports: Submit the following:
      a. Soil analysis reports for existing soil and imported manufactured topsoil, as specified. Include recommendations for remediating existing soil into acceptable topsoil.
   3. Qualifications Data: Submit qualifications data for the following:
      a. Landscape installer.
      b. Landscape supervisor.
      c. Testing agency.
   4. Source Quality Control Submittals
      a. Written statement providing the locations of the property from which the sod is to be obtained and the names and addresses of the suppliers.

C. Closeout Submittals: Submit the following:
   1. Operations and Maintenance Data:
      a. Submit recommended procedures to be established by OWNER for the maintenance of lawns and meadows for one full year. Submit prior to expiration of required maintenance period.
   2. Warranty Documentation:
      a. Submit written warranty, signed by CONTRACTOR and landscape installer, as specified.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:
   1. Do not deliver seed, sprigs, plugs or sod until Site conditions are ready for installation.
   2. Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery.

3. Sod: Time delivery so that sod will be placed within 24 hours after stripping. Comply with requirements of TPI for harvesting, delivery, storage and handling of sod.
4. Inspect lawn and meadow materials upon arrival at Site. Immediately and permanently remove unacceptable materials from Site.

B. Storage of Materials:
1. Store and cover materials to prevent deterioration. Remove packaged materials that become wet or show deterioration or water marks from the Site.
2. Protect sod against drying and breaking of rolled strips.
3. If sod is stacked, place roots to roots or grass to grass.
4. Protect sod from exposure to wind and sun and from freezing.

C. Handling of Materials: Do not dump sod from vehicles.

1.7 PROJECT CONDITIONS

A. Environmental Requirements:
1. Proceed with and complete lawn and meadow planting as rapidly as portions of the Site become available, working within the seasonal limitations for each type of lawn, grass and wildflower planting required.
2. Proceed with planting only when current and forecasted weather conditions are favorable to successful planting and establishment of lawns and meadows.
3. Herbicides, chemicals and insecticides shall not be used on areas bordering wetlands.

B. Scheduling:
1. Coordinate planting with specified extended service periods to provide required service from date of Substantial Completion. Only plant during periods recommended by source sod farm.
2. Do not begin lawn and meadow planting until water, acceptable for use and adequate in supply, is available on-Site and can be successfully transported to the areas of Work. Coordinate provision of adequate and acceptable water supply with Project Schedule.

C. Pre-installation Conference:
1. Prior to commencement of lawn and meadow planting and associated Work, CONTRACTOR shall schedule and meet at the Site with the landscape installer, the installers of other Work in and around lawn and meadow areas that follows the lawn and meadow Work, including fencing Work specified in Section 32 31 00, Fences; and ENGINEER and other representatives directly concerned with performance of the Work. Review foreseeable

methods and procedures related to the lawn and meadow Work, including the following:

a. Review Project requirements and the Contract Documents.
b. Review required submittals, both completed and yet to be completed.
c. Review availability of water and methods of delivery.
d. Review status of below-grade work and required access during lawn and meadow planting and establishment.
e. Review Project Schedule and availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.
f. Review environmental conditions, other Project conditions, and procedures for coping with unfavorable conditions.
g. Review procedures required for protection of lawns and meadows during the remainder of the construction period.
h. Review required inspection, testing, and certifying procedures.

2. Record the discussions of the Pre-installation Conference and the decisions and agreements or disagreements reached, and furnish a copy of the record to each party attending. Record all revisions or changes agreed upon, reasons therefor, and parties agreeing or disagreeing with them.

1.8 WARRANTY

A. General Warranty: The special warranties specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents.

B. Special Warranties: Warranty lawns and meadows through the specified extended service period.

1.9 EXTENDED SERVICE

A. Extended Lawn Service:

1. Begin extended service immediately after each lawn area is acceptably established. Provide extended service for not less than the following periods:
2. Sodded Lawns: Thirty days from date after lawn areas are acceptably established.
3. Service lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.
4. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources. Keep newly germinated plants uniformly moist to a depth of 4-inches, applied at a minimum rate of 1-inch per week, or greater as required to maintain minimum moisture depth

specified. Provide and maintain watering gages and soil moisture probes until end of maintenance period.

a. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
b. After plants have their first true leaves and grasses show mature blades, watering shall be performed to provide moisture to a depth of 6-inches, and not performed again until top 1-inch of loam has dried.
c. During first week, water sod daily or more frequently as necessary to maintain moist loam to a minimum depth of 4-inches below bottom of sod blanket.

5. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 40 percent of grass-leaf height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowing. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowing to maintain the following grass height:
   a. Mow grass 2 to 3-inches high.
6. Lawn Fertilization: Apply fertilizer after initial mowing and when grass is dry.
   a. Use fertilizer that will provide actual nitrogen of at least one pound for each 1000 square feet of lawn area.
7. After seed has passed its expected germination period, reseed all areas and parts of areas that fail to show a uniform stand of grass. Reseed repeatedly until all areas are covered with grass.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Turf grass Sod:
   1. Certified Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes and insects, complying with TPI specifications and guidelines.
   2. Provide strongly rooted machine-cut sod, not less than two years old of uniform density, color and texture. Provide only sod capable of vigorous growth and development when planted (viable, not dormant) and in strips not more than 18-inches wide by 14 feet-0 inches long by 3/4-inch thick (excluding top growth and thatch). Provide sod composed principally of the following:
      a. Argentine Bahiagrass (Paspalum notatum Flugge)

B. Fertilizers:
   1. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

C. Accessories:
   1. Provide herbicides, chemicals and insecticides as needed for disease, fungus or pest control. All herbicides, chemicals and insecticides shall be bear approval labels indicating they are approved by the United States Department of Agriculture for the intended uses and application rates.
   2. Post Emergent Crab Grass and Plantain Chemical: Provide recommended post emergent crab grass and plantain control throughout the maintenance period to ensure germinated and established lawns free of crab grass and other undesirable grasses and forbs.

D. Water: Acceptable for lawn and meadow application and containing no material harmful to plant growth and establishment.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the areas and conditions under which lawn and meadow Work is to be performed, and notify ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Excavate or fill subgrade, as required, to bring subgrade to elevations shown. Maintain all angles of repose. Confirm that subgrade is at proper elevations and that no further earthwork is required to bring the subgrade to proper elevations. Provide subgrade elevations that slope parallel to finished grade and towards subsurface drains shown.

D. Remove all construction debris, trash, rubble and all extraneous materials from subgrade. In the event that fuels, oils, concrete washout or other material harmful to plant growth or germination have been spilled into the subgrade, excavate the subgrade sufficiently to remove all such harmful materials and fill with approved fill, compacted to the required subgrade compaction level.

3.3 FINE GRADING

A. Spread fertilizer and work lightly into the top 4-inches of site topsoil by harrowing or tilling prior sodding.

B. Grade planting areas to smooth, even surface with loose, uniformly fine texture. Remove all stones and extraneous material in excess of 1-inch diameter. Roll, rake and remove ridges and fill depressions, as required to meet finish grades.

C. Moisten prepared areas before sodding. Water thoroughly and allow surface moisture to dry before planting. Do not create a muddy loam condition.

3.4 SODDING LAWNS

A. Do not lay sod on ground that is frozen, dust dry or that has not been uniformly prepared, as specified. Do not lay dormant sod.
   1. Lay sod within 24 hours of harvesting.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod.
   1. Place sod strips in straight lines parallel to one another.
   2. Lay sod across angle of slopes exceeding one on three.
   3. Anchor sod with wooden pegs, or steel staples, on slopes exceeding one on six, spaced as recommended by sod supplier, but not less than two anchors for each sod strip to prevent slippage.

C. Immediately upon completion of a section of sodding, tamp, roll lightly and water, to ensure contact with subgrade and elimination of air pockets.

D. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass.

E. Immediately after planting, water sod thoroughly with a fine spray. Water sufficiently to ensure penetration of moisture to bottom of prepared loam layer, not just to bottom of sod blanket.

3.5 RECONDITIONING EXISTING LAWNS AND MEADOWS

A. Recondition existing lawn and meadow damaged by CONTRACTOR'S operations, including areas used for storage of materials or equipment and areas damaged by movement of vehicles. Recondition existing lawns and meadow areas where minor regrading is required.

B. Provide fertilizer, seed or sod and soil amendments, as specified for new lawn and meadow, and as required to provide satisfactorily reconditioned lawns and meadows. Provide new loam as required to fill low spots and meet new finish grades.

C. Remove diseased or unsatisfactory lawn and meadow areas; do not bury into soil. Remove topsoil containing extraneous materials resulting from CONTRACTOR'S operations including oil drippings, stone, gravel and other construction materials.

D. In areas approved by ENGINEER, where substantial lawns and meadows remain (but are thin), mow, dethatch, core aerate and rake. Fill low spots, remove humps, cultivate soil, fertilize, and seed. Remove weeds before seeding or if extensive, apply selective chemical weed killers, as required. Apply a seedbed mulch, if required, to maintain moist condition.

E. Water newly planted areas and keep moist until new lawns and meadows are established, as specified.

3.6 ACCEPTANCE CRITERIA FOR LAWNS AND MEADOWS

A. Lawn and meadow Work will be considered acceptable when:
   1. Sodded Lawn: When a healthy, well-rooted, even-colored, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.

3.7 CLEANUP AND PROTECTION

A. Promptly remove soil and debris, created by lawn and meadow Work, from paved areas. Clean wheels of vehicles before leaving Site to avoid tracking soil and loam onto roads, walks, or other paved areas.

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout extended service period and remove when service period ends. Treat, repair or replace damaged lawns and meadows.

3.8 INSPECTION AND ACCEPTANCE

A. Where lawns and meadows do not comply with specified acceptance criteria, reestablish lawns and meadows and continue extended service period until lawns and meadows comply with criteria for acceptance.

++ END OF SECTION ++

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SECTION 33 05 05

BURIED PIPING INSTALLATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all buried piping, fittings, and specials. The Work includes the following:
      a. All types and sizes of buried piping, except where buried piping installations are specified under other Sections.
      b. Unless otherwise shown or specified, this Section includes all buried piping Work required, beginning at the outside face of structures or structure foundations, including piping beneath structures, and extending away from structures.
      c. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, cathodic protection, and other Work required for a complete, buried piping installation.
      d. Supports, restraints, and thrust blocks.
      e. Pipe encasements, with the exception of piping embedded in concrete within a structure or foundation specified under Section 40 05 05, Exposed Piping Installation.
      f. Field quality control, including testing.
      g. Cleaning.
      h. Incorporation of valves, meters, and special items shown or specified into piping systems in accordance with the Contract Documents and as required.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before buried piping Work.
   2. Coordinate with appropriate piping Sections of Division 40, Process Integration.

C. Related Sections:
   1. Section 31 20 00, Earth Moving.
   2. Section 03 30 05, Concrete.
   3. Section 09 91 00, Painting.
   4. Section 40 05 31, Thermoplastic Process Pipe.
   5. Section 40 05 33, High Density Polyethylene Process Pipe.
   6. Section 40 05 19, Ductile Iron Process Pipe

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASME B31.3, Process Piping.
   2. American Society for Non-Destructive Testing (ASNT), ASNT-TC-1A, Recommended Practice, Personnel Qualification, and Certification in Non-destructive Testing.
   3. ASTM B32, Specification for Solder Metal.
   4. ASTM D2321, Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.
   5. ASTM D2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
   6. ASTM F1417, Test Method for Installation Acceptance of Plastic Gravity Sewer Lines using Low-Pressure Air.
   7. ASTM F2164, Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.
   8. ANSI/AWWA C105, Polyethylene Encasement for Ductile-Iron Pipe Systems.
   9. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   10. ANSI/AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
   11. AWWA M23, PVC Pipe - Design and Installation.
   12. AWWA M55, PE Pipe - Design and Installation.
   13. ASCE 37, Design and Construction of Sanitary and Storm Sewers.
   14. Chlorine Institute, Inc., Piping Systems for Dry Chlorine, Pamphlet No. 6.
   15. Recommended Standards for Wastewater Facilities, latest edition (10 States Stnadards)

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements and recommendations of authorities having jurisdiction.
   2. Obtain required permits for Work in roads, rights-of-way, railroads, and other areas of the Work.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Details of piping, specials, joints, harnessing and thrust blocks, and connections to piping, structures, equipment, and appurtenances.
   2. Product Data:
      a. Manufacturer's literature and specifications, as applicable, for products specified in this Section.

3. Testing Procedures:
    a. Submit proposed testing procedures, methods, apparatus, and sequencing. Obtain ENGINEER's approval prior to commencing testing.

B. Informational Submittals: Submit the following:
    1. Certificates:
        1. Certificate signed by manufacturer of each product certifying that product conforms to applicable referenced standards.
    2. Field Quality Control Submittals:
        a. Results of each specified field quality control test.

C. Closeout Submittals: Submit the following:
    1. Record Documentation:
        a. Maintain accurate and up-to-date record documents showing modifications made in the field, in accordance with approved submittals, and other Contract modifications relative to buried piping Work. Submittal shall show actual location of all piping Work and appurtenances at same scale as the Drawings.
        b. Show piping with elevations referenced to Project datum and dimensions from permanent structures. For each horizontal bend in piping, include dimensions to at least three permanent structures, when possible. For straight runs of piping provide offset dimensions as required to document piping location.
        c. Include profile drawings with buried piping record documents when the Contract Documents include piping profile drawings.
        d. Conform to Section 01 78 39, Project Record Documents.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
    1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
    2. Upon delivery inspect pipe and appurtenances for cracking, gouging, chipping, denting, and other damage and immediately remove from Site and replace with acceptable material.

B. Storage:
    1. Store materials to allow convenient access for inspection and identification. Store material off ground using pallets, platforms, or other supports. Protect packaged materials from corrosion and deterioration.
    2. Pipe and fittings other than PVC and CPVC may be stored outdoors without cover. Cover PVC and CPVC pipe and fittings stored outdoors.

C. Handling:
    1. Handle pipe, fittings, specials, and accessories carefully in accordance with pipe manufacturer's recommendations. Do not drop or roll material off trucks. Do not drop, roll or skid piping.

2. Avoid unnecessary handling of pipe.
3. Keep pipe interiors free from dirt and foreign matter.
4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Piping materials are specified in the Buried Piping Schedule at the end of this Section. Piping materials shall conform to Specifications for each type of pipe and piping appurtenances in applicable Sections of Division 40, Process Integration.

B. General:
   1. Pipe Markings:
      a. Manufacturer shall cast or paint on each length of pipe and each fitting pipe material, diameter, and pressure or thickness class.
   2. Bolts & Nuts:
      a. Provide graphite-free anti-seize compound for stainless steel nuts and bolts to prevent galling. Strength of bolted joints shall not be affected by use of anti-seize compound.

2.2 BURIED PIPING IDENTIFICATION

A. Detectable Underground Warning Tape for Non-Metallic Pipelines:
   1. Identification tape shall be manufactured of polyethylene with a minimum thickness of four mils and shall have a one mil thick metallic foil core. The tape shall be highly resistant to alkalies, acids and other destructive agents found in soil. Tape width shall be six inches. Tape shall be suitable for direct burial.
   2. Message shall read, "CAUTION: WASTEWATER FORCE MAIN BURIED BELOW" with bold letters approximately two inches high imprinted with black letters. Messages shall be printed at maximum intervals of two feet. Tape shall be custom colored the same as the pipeline colors as specified for the associated pipe service in Section 09 91 00, Painting.
   3. Manufacturer: Provide products of one of the following:
      a. Brady Corporation
      b. Seton Identification Products
      c. Marking Services, Inc.
      d. Reef Industries, Inc.
      e. Or equal.

B. Tracer Wire for Non-Metallic Pipelines:
   1. Install 14-guage copper UF (Underground Feeder per National Electric Code Article 339) solid tracer wire and joint seal (Kearney Aquaseal,

Bishop, or approved equal) along all non-metallic pipes. The wire shall be taped below the spring line of the pipe and shall be stubbed up at all valves. At each valve the wire shall be installed along the outside of the valve box. Sections of wire shall be spliced together using a Buchanon tool or wirenut. Splicing by twisting the wire together is not acceptable.

2. Each segment of tracer wire shall be demonstrated to be electrically continuous between turn-ups after backfilling and before the pipe is accepted as complete.
3. Tracer wire shall be color-coded to match pipe service.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install piping as shown, specified, and as recommended by pipe and fittings manufacturer.
   2. In event of conflict between manufacturer's recommendations and the Contract Documents, request interpretation from ENGINEER before proceeding.
   3. ENGINEER will observe excavations and bedding prior to laying pipe by CONTRACTOR. Notify ENGINEER in advance of excavating, bedding, pipe laying, and backfilling operations.
   4. Minimum cover over buried piping shall be 3 feet, unless otherwise shown or approved by ENGINEER.
   5. Earthwork is specified in Section 31 20 00, Earth Moving.
   6. Excavation in excess of that required or shown, and that is not authorized by ENGINEER shall be filled at CONTRACTOR's expense with granular material furnished, placed, and compacted in accordance with Section 31 20 00, Earth Moving.

B. Separation of Sewers and Potable Water Piping:
   1. Horizontal Separation:
      a. Where possible, existing and proposed potable water mains and service lines, and sanitary, combined, and storm sewers shall be separated horizontally by clear distance of at least ten feet.
      b. If local conditions preclude the specified clear horizontal separation, installation will be allowed if potable water main is in separate trench or on undistributed earth shelf on one side of sewer and with bottom of potable water main at least 18 inches above top of sewer.
      c. Exception:
         1) Where it is not possible to provide minimum horizontal separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe complying with public water supply design standards of authority having jurisdiction. Hydrostatically test water main and sewer as specified in this

Section prior to backfilling. Hydrostatic test pressure at crossing shall be at least 150 psi.

2. Vertical Separation:
   a. Provide minimum vertical distance of 18 inches between outside of potable water main and outside of sewer when sewer crosses over potable water main.
   b. Center a section of potable water main pipe at least 17.5 feet long over sewer so that sewer joints are equidistant from potable water main joints.
   c. Provide adequate structural support where potable water main crosses under sewer. At minimum, provide compacted select backfill for ten feet on each side of crossing.
   d. Exceptions:
      1) Where it is not possible to provide minimum vertical separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe. Hydrostatically test water main and sewer as specified in this Section, prior to backfilling. Hydrostatic test pressure at crossing shall be at least 150 psi.
      2) Encase either potable water main or sewer in watertight carrier pipe extending ten feet on each side of crossing, measured perpendicular to potable water main.

C. Plugs:
   1. Temporarily plug installed pipe at end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
   2. Install standard plugs in bells at dead ends, tees, and crosses. Cap spigot and plain ends.
   3. Fully secure and block plugs, caps, and bulkheads installed for testing to withstand specified test pressure.
   4. Where plugging is required for phasing of the Work or subsequent connection of piping, install watertight, permanent type plugs, caps, or bulkhead acceptable to ENGINEER.

D. Bedding Pipe: Bed pipe as specified and in accordance with details on the Drawings.
   1. Trench excavation and backfill, and bedding materials shall conform to Section 31 20 00, Earth Moving, as applicable.
   2. Where ENGINEER deems existing bedding material unsuitable, remove and replace existing bedding with approved granular material furnished, placed, and compacted in accordance with Section 31 20 00, Earth Moving. Payment for additional excavation and providing granular material will be made under the unit price payment items in the Contract.
   3. Excavate trenches below bottom of pipe by amount shown and indicated in the Contract Documents. Remove loose and unsuitable material from bottom of trench.

4. Carefully and thoroughly compact pipe bedding with hand held pneumatic compactors.
5. Do not lay pipe until ENGINEER approves bedding condition.
6. Do not bring pipe into position until preceding length of pipe has been bedded and secured in its final position.

E. Laying Pipe:
   1. Conform to manufacturer's instructions and requirements of standards and manuals listed below, as applicable:
      a. Thermoplastic Pipe: ASTM D2321, ASTM D2774, ANSI/AWWA C605, AWWA M23, AWWA M45, AWWA, M55.
      b. Sanitary and Storm Sewers: ASCE 37.
   2. Install pipe accurately to line and grade shown and indicated in the Contract Documents, unless otherwise approved by ENGINEER. Remove and reinstall pipes that are not installed correctly.
   3. Slope piping uniformly between elevations shown.
   4. Keep groundwater level in trench at least 24 inches below bottom of pipe before laying pipe. Do not lay pipe in water. Maintain dry trench conditions until jointing and backfilling are complete. Keep clean and protect interiors of pipe, fittings, valves, and appurtenances.
   5. Start laying pipe at lowest point and proceed towards higher elevations, unless otherwise approved by ENGINEER.
   6. Place bell and spigot-type pipe so that bells face the direction of laying, unless otherwise approved by ENGINEER.
   7. Excavate around joints in bedding and lay pipe so that pipe barrel bears uniformly on trench bottom.
   8. Deflections at joints shall not exceed 75 percent of amount allowed by pipe manufacturer, unless otherwise approved by ENGINEER.
   9. For PVC and CPVC piping with solvent welded joints, 2.5-inch diameter and smaller, and copper tubing, snake piping in trench to compensate for thermal expansion and contraction.
   10. Carefully examine pipe, fittings, valves, and specials for cracks, damage, and other defects while suspended above trench before installation. Immediately remove defective materials from the Site and replace with acceptable products.
   11. Inspect interior of all pipe, fittings, valves, and specials and completely remove all dirt, gravel, sand, debris, and other foreign material from pipe interior and joint recesses before pipe and appurtenances are moved into excavation. Bell and spigot-type mating surfaces shall be thoroughly wire brushed, and wiped clean and dry immediately before pipe is laid.
   12. Field cut pipe, where required, with machine specially designed for cutting the type of pipe being installed. Make cuts carefully, without damage to pipe, coating or lining, and with smooth end at right angles to axis of pipe. Cut ends on push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.
   13. Do not place blocking under pipe, unless specifically approved by ENGINEER for special conditions.

14. Touch up protective coatings in manner satisfactory to ENGINEER prior to backfilling.
15. Notify ENGINEER in advance of backfilling operations.
16. On steep slopes, take measures acceptable to ENGINEER to prevent movement of pipe during installation.
17. Thrust Restraint: Where required, provide thrust restraint conforming to Article 3.3 of this Section.
18. Exercise care to avoid flotation when installing pipe in cast-in-place concrete, and in locations with high groundwater.

F. Jointing Pipe:
1. Ductile Iron Mechanical Joint Pipe:
   a. Immediately before making joint, wipe clean the socket, plain end, and adjacent areas. Taper cut ends and file off sharp edges to provide smooth surface.
   b. Lubricate plain ends and gasket with soapy water or manufacturer's recommended pipe lubricant, in accordance with ANSI/AWWA C111, just prior to slipping gasket onto plain end of the joint assembly.
   c. Place gland on plain end with lip extension toward the plain end, followed by gasket with narrow edge of gasket toward plain end.
   d. Insert plain end of pipe into socket and press gasket firmly and evenly into gasket recess. Keep joint straight during assembly.
   e. Push gland toward socket and center gland around pipe with gland lip against gasket.
   f. Insert bolts and hand-tighten nuts.
   g. If deflection is required, make deflection after joint assembly and prior to tightening bolts. Alternately tighten bolts approximately 180 degrees apart to seat gasket evenly. Bolt torque shall be as follows:

Pipe Diameter (inches)	Bolt Diameter (inches)	Range of Torque (ft-lbs)
3	5/8	45 to 60
4 to 24	3/4	75 to 90
30 to 36	1	100 to 120
42 to 48	1.25	120 to 150

   h. Bolts and nuts, except those of stainless steel, shall be coated with two coats, minimum dry film thickness of eight mils each, of high build solids epoxy or bituminous coating manufactured by Tnemec, or equal.
   i. Restrained mechanical joints shall be in accordance with Section 40 05 19, Ductile Iron Process Pipe.
2. Ductile Iron Push-On Joint Pipe:
   a. Prior to assembling joints, thoroughly clean with wire brush the last eight inches of exterior surface of spigot and interior surface of bell, except where joints are lined or coated with a protective lining or coating.

b. Wipe clean rubber gaskets and flex gaskets until resilient. Conform to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.
c. Insert gasket into joint recess and smooth out entire circumference of gasket to remove bulges and to prevent interference with proper entry of spigot of entering pipe.
d. Immediately prior to joint assembly, apply thin film of pipe manufacturer's recommended lubricant to surface of gasket that will come in contact with entering spigot end of pipe, or apply a thin film of lubricant to outside of spigot of entering pipe.
e. For assembly, center spigot in pipe bell and push pipe forward until spigot just makes contact with rubber gasket. After gasket is compressed and before pipe is pushed or pulled in the rest of the way, carefully check gasket for proper position around the full circumference of joint. Final assembly shall be made by forcing spigot end of entering pipe past gasket until spigot makes contact with base of the bell. When more than a reasonable amount of force is required to assemble the joint, remove spigot end of pipe to verify proper positioning of gasket. Do not use gaskets that have been scored or otherwise damaged.
f. Maintain an adequate supply of gaskets and joint lubricant at the Site when pipe jointing operations are in progress.

3. Ductile Iron Proprietary Joints:
   a. Install pipe that utilizes proprietary joints for restraint specified in Section 40 05 19, Ductile Iron Process Pipe, or other such joints, in accordance with manufacturer's instructions.
4. Ductile Iron Flanged Joints:
   a. Assemble flanged joints using ring-type gaskets, thickness as recommended by pipe manufacturer but not less than 1/8-inch thick, for raised face flanges. Use full face gaskets for flat face flanges, unless otherwise approved by ENGINEER or recommended by pipe manufacturer. Gaskets shall be suitable for service intended in accordance with manufacturer's ratings and instructions. Gaskets shall be properly centered.
   b. Bolts shall be tightened as recommended by the manufacturer in sequence that ensures equal distribution of bolt loads.
   c. Length of bolts shall be uniform. Bolts shall not project beyond the nut more than 1/4-inch when fully tightened. Bolts shall not fall short of the nut when fully taken up. Ends of bolts shall be machine cut and neatly rounded. Do not use washers.
   d. Prior to assembly, lubricate bolt threads and gasket faces.
   e. After assembly, coat all bolts and nuts, except those of stainless steel, with two coats, minimum dry film thickness of eight mils each, of high-build epoxy or bituminous coating manufactured by Tnemec, or equal.
5. Thermoplastic Pipe Joints:
   a. Solvent Cement Welded Joints:
      1) Bevel pipe ends and remove all burrs before making joints.

Clean pipe and fittings thoroughly. Do not attempt to make solvent cement joints if temperature is below 40 degrees F. Do not make solvent cement welded joints in wet conditions.

2) Use solvent cement supplied or recommended by pipe manufacturer.

3) Apply joint primer and solvent cement and assemble joints in accordance with recommendations and instructions of manufacturer of joint materials and pipe manufacturer.

4) Take appropriate safety precautions when using joint primers and solvent cements. Allow air to circulate freely through pipelines to allow solvent vapors to escape. Slowly admit water when flushing or filling pipelines to prevent compression of gases within pipes.

b. Bell and Spigot Joints:

1) Bevel pipe ends, remove all burrs, and provide a reference mark at correct distance from pipe end before making joints.

2) Clean spigot end and bell thoroughly before making the joint. Insert O-ring gasket while ensuring that gasket is properly oriented. Lubricate spigot with manufacturer's recommended lubricant. Do not lubricate bell and O-ring. Insert spigot end of pipe carefully into bell until reference mark on spigot is flush with bell.

6. Copper Tubing Joints:

a. Threaded Joints:

1) When open flames for soldering are impractical, or at unions and connections to equipment and appurtenances, assemble copper tubing with flared ends as permitted by authority having jurisdiction.

2) Ends of tubing shall be flared at an angle of 45 degrees with flaring tool recommended by pipe manufacturer. Flaring tool shall have same outside diameter as tube to be flared.

3) Tubing to be flared shall be soft temper or annealed prior to flaring.

4) End of tube shall be cut square and reamed to remove burrs.

5) Tube that is out-of-round shall be resized back to round.

6) Clean and polish contact surfaces of joints using an abrasive cloth.

7) Place flare nut over the end of tube with threads closest to end being flared.

8) Insert appropriate length of tube between flaring bar of flaring tool and position the yolk with flaring cone over tube end and clamp yoke in place.

9) Turn handle of yolk clockwise without over-tightening. Cracked or deformed tubes will be rejected.

10) Do not apply jointing compounds to mating surfaces of flare fitting and flared tube end before attaching flare nut to threaded connection.

7. Mechanical Coupling Joints:
   a. Mechanical couplings include: sleeve-type flexible couplings, split flexible couplings, ANSI/AWWA C606 grooved or shouldered end couplings, plasticized PVC couplings, and other mechanical couplings specified in Section 40 05 06, Couplers, Adapters, and Specials for Process Piping.
   b. Prior to installing and assembling mechanical couplings, thoroughly clean joint ends with wire brush to remove foreign matter.
   c. For mechanical couplings that incorporate gaskets, after cleaning apply lubricant to rubber gasket or inside of coupling housing and to joint ends. After lubrication, install gasket around joint end of previously installed piece and mate joint end of subsequent piece to installed piece. Position gasket and place coupling housing around gasket and over grooved or shouldered joint ends. Insert bolts and install nuts tightly by hand. Tighten bolts uniformly to produce an equal pressure on all parts of housing. When housing clamps meet metal to metal, joint is complete and further tightening is not required.
   d. For plasticized PVC couplings, loosen the stainless steel clamping bands and remove clamps from coupling. Slide coupling over plain ends of pipes to be joined without using lubricants. Place clamps over each end of coupling at grooved section and tighten with torque wrench to torque recommended by manufacturer.
8. HDPE Pipe Joints:
   a. Butt Fusion Welded Joints:
      1) Install joints in accordance with manufacturer's instructions using hydraulic butt fusion machine or manual machine equipped with torque wrench. Equipment shall be able to achieve and maintain heating tool temperature range of 400 to 450 degrees F and an interface pressure of 60 to 90 psi.
      2) Clean interior and exterior of pipe and fitting ends with clean, dry, lint-free cloth.
      3) Align ends to be joined in the fusion machine without forcing ends into alignment. Adjust alignment as necessary and tighten clamps to prevent slippage.
      4) Place facing tool between ends to be joined and face them to provide clean, smooth, parallel mating surface. If stops are present, face ends down to the stops. Remove all shavings after facing without touching ends.
      5) Re-check alignment of ends and check for slippage against fusion pressure. There shall be no detectable gaps between ends. Align outside diameters.
      6) Heating tool shall maintain pipe manufacture's recommended temperature range. Place the tool between ends to be joined.

Move ends against heating tool to achieve full contact. Hold ends against heating tool without force until the following melt bead size is formed:

Pipe Diameter (inches)	Required Melt Bead Size (inches)
2 to 4	1/8 to 3/16
4 to 12	3/16 to 1/4
12 to 24	1/4 to 7/16
24 to 54	7/16 to 9/16

7) Upon forming proper melt bead size, quickly separate ends and remove heating tool. Quickly inspect melted ends and bring ends together applying joining force recommended by manufacturer, using 60 to 90 psi interfacial pressure to form double bead rolled over surface of pipe on both ends.
8) Hold joining force against ends until joint is cool to the touch. Cooling period shall be 30 to 90 seconds per inch of pipe diameter. Heavier wall thicknesses may require longer cooling times as recommended by pipe manufacturer.
9) Upon completing joint, inspect to verify double bead has been formed on both sides, uniformly rounded and consistent in size all around joint. Remove faulty joints and re-joint.

G. Backfilling:
1. Conform to applicable requirements of Section 31 20 00, Earth Moving.
2. Place backfill as Work progresses. Backfill by hand and use power tampers until pipe is covered by at least one foot of backfill.

H. Connections to Valves:
1. Install valves as shown and indicated in the Contract Documents.
2. Provide suitable adapters when valves and piping have different joint types.
3. Provide thrust restraint at valves located at pipeline terminations.

I. Transitions from One Type of Pipe to Another:
1. Provide necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

J. Closures:
1. Provide closure pieces shown or required to complete the Work.

3.2 TRACER TAPE INSTALLATION

A. Detectable Underground Warning Tape for Non-Metallic Pipelines:
1. Provide polyethylene tracer tape with aluminum backing for buried, non-

metallic piping, which includes pipe that is PVC and HDPE.

2. Provide magnetic tracer tape 12 to 18 inches below finished grade, above and parallel to buried pipe.
3. Tape shall be spread flat with message side up before backfilling.

3.3 THRUST RESTRAINT

A. Provide thrust restraint on pressure piping systems where shown or indicated in the Contract Documents.

B. Thrust restraint may be accomplished by using restrained pipe joints, concrete thrust blocks, or harnessing buried pipe.

C. Place concrete thrust blocks against undisturbed soil. Where undisturbed soil does not exist, or for projects where the Site consists of backfill material, thrust restraint shall be provided by restrained pipe joints.

D. Restrained Pipe Joints:
   1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.
      a. Ductile Iron, Push-on Joints and Mechanical Joints: Restrain with proprietary restrained joint system as specified in Section 40 05 19, Ductile Iron Process Pipe; lugs and tie rods; or other joint restraint systems approved by ENGINEER.
      b. Thermoplastic and HDPE Joints: Where bell and spigot-type or other non-restrained joints are utilized, provide tie rods across joint or other suitable joint restraint system, subject to the approval of ENGINEER.

E. Concrete Thrust Blocks:
   1. Provide concrete thrust blocks on pressure piping at changes in alignment of 15 degrees or more, at tees, plugs and caps, and where shown or indicated in the Contract Documents. Construct thrust blocks of Class B concrete, conforming to 03 00 05, Concrete.
   2. Install thrust blocks against undisturbed soil. Place concrete so that pipe and fitting joints are accessible for repair.
   3. Concrete thrust block size shall be as shown on the Drawings or as approved by ENGINEER.

F. Harnessed lengths of buried pipe shall be as shown on the Drawings.

3.4 WORK AFFECTING EXISTING PIPING

A. Location of Existing Underground Facilities:
   1. Locations of existing Underground Facilities shown on the Drawings should be considered approximate.

2. Determine the true location of existing Underground Facilities to which connections are to be made, crossed, and that could be disturbed, and determine location of Underground Facilities that could be disturbed during excavation and backfilling operations, or that may be affected by the Work.

B. Taking Existing Pipelines and Underground Facilities Out of Service:
   1. Conform to Section 01 14 16, Coordination with Owner's Operations.
   2. Do not take pipelines or Underground Facilities out of service unless specifically listed in Section 01 14 16, Coordination with Owner's Operations, or approved by ENGINEER.
   3. Notify ENGINEER in writing prior to taking pipeline or Underground Facilities out of service. Shutdown notification shall be provided in advance of the shutdown in accordance with the General Conditions and Section 01 14 16, Coordination with Owner's Operations.

C. Work on Existing Pipelines or Underground Facilities:
   1. Cut or tap piping or Underground Facilities as shown or required with machines specifically designed for cutting or tapping pipelines or Underground Facilities, as applicable.
   2. Install temporary plugs to prevent entry of mud, dirt, water, and debris into pipe.
   3. Provide necessary adapters, sleeves, fittings, pipe, and appurtenances required to complete the Work.
   4. Conform to applicable requirements of Section 01 14 16, Coordination with Owner's Operations.

3.5 FIELD QUALITY CONTROL

A. General:
   1. Test all piping.
   2. When authorities having jurisdiction are to witness tests, notify ENGINEER and authorities having jurisdiction in writing at least 48 hours in advance of testing.
   3. Conduct all tests in presence of ENGINEER.
   4. Remove or protect pipeline-mounted devices that could be damaged by testing.
   5. Provide all apparatus and services required for testing, including:
      a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain OWNER's operations.
      b. Temporary bulkheads, bracing, blocking, and thrust restraints.
   6. Provide air if an air test is required, power if pumping is required, and gases if gases are required.
   7. Unless otherwise specified, OWNER will provide fluid required for hydrostatic testing. CONTRACTOR shall provide means to convey fluid for hydrostatic

testing into piping being tested. CONTRACTOR shall provide fluid for other types of testing required.

8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.
9. Pipe testing shall closely follow pipe laying. No more than 1,000 feet of pipe shall remain untested at any time unless otherwise approved by ENGINEER. Testing shall not proceed until facilities are in place and concrete cured.

B. Test Schedule:
   1. Refer to the Buried Piping Schedule in this Section for type of test required and required test pressure.
   2. Unless otherwise specified, required test pressures are at lowest elevation of pipeline segment being tested.
   3. For piping not listed in Buried Piping Schedule in this Section:
      a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig.
      b. Use exfiltration testing or low-pressure air testing for other piping.
   4. Test Pressure:
      a. Use test pressures listed in Buried Piping Schedule in this Section.
      b. If test pressure is not listed in Buried Piping Schedule, or if test is required for piping not listed in the Buried Piping Schedule, or if test is required for piping not listed in the Buried Piping Schedule, test pressure will be determined by ENGINEER based on maximum anticipated sustained operating pressure and methods described in applicable ANSI/AWWA manual or standard that applies to the piping system.

C. Hydrostatic Testing:
   1. Preparation for Testing:
      a. For thermoplastic pipe and fiberglass pipe, follow procedures described in Section 7 of ANSI/AWWA Standard C605.
      b. For HDPE pipe, follow procedures described in ASTM F2164. Test duration, including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize, shall not exceed eight hours. If re-testing of a test section or pipeline is required, at least eight hours shall elapse between tests.
      c. For other piping follow procedures described in ANSI/AWWA Manual M9, except that minimum wetting period required immediately prior to testing for asbestos cement pipe shall be 24 hours rather than the 48 hours prescribed for concrete pipe. Wetting period is not required for pipe that is not cement mortar-lined.
      d. Prior to testing, ensure that adequate thrust protection is in place and joints are properly installed.
      e. Piping for Hydraulic Fluid, Lube Oil, and Diesel Fuel: Hydrostatically test system using the fluid with which system will function permanently. Allowable leakage is zero. For fluid power systems, pipe manufacturer

shall supervise installation and testing of system components, including field piping.

2. Test Procedure:
   a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in pipe being tested.
   b. Expel air from pipe as required. Obtain approval of ENGINEER prior to tapping pipe for expelling air.
   c. Examine exposed joints and valves, and make repairs to eliminate visible leakage.
   d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
   e. HDPE Pipe: After filling pipeline, gradually pressurize pipe to test pressure and maintain required test pressure for three hours for pipe to expand. During expansion, add fluid to maintain required test pressure. Begin timed test period after expansion period and other requirements are met.
   f. Timed test period shall not begin until after pipe has been filled, exposed to required wetting period, air has been expelled, and pressure stabilized.
   g. Timed Test Period: After stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure. For HDPE pipe, after three hour expansion phase, reduce test pressure by ten psig and do not add liquid. Test pressure shall then remain steady for one hour, indicating no leakage.
   h. Pump from test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at 15 minute intervals for duration of test.
3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of test pressure during timed test period. Allowable leakage rates for piping are:
   a. No Leakage: Pipe with flanged, welded, fused, threaded, soldered, or brazed joints.
   b. Rates based on formula or table in ANSI/AWWA C605:
      1) Plastic pipe joined with O-ring gasket sealing members.

D. Exfiltration Testing:
1. CONTRACTOR shall test piping using exfiltration/infiltration and low-pressure methods at his option and with ENGINEER'S approval. Method for exfiltration testing is described below.
2. Plug and bulkhead ends and lateral connections of pipe segment to be tested and admit fluid until the pipe is full. Admit fluid slowly to minimize air entrapment. Groundwater level shall be below the pipe during exfiltration test.
3. Maintain hydrostatic head during test to equal an elevation two feet above maximum groundwater elevation at pipe segment tested or two feet above

crown of upstream end of pipe segment tested, whichever is greater. ENGINEER will determine test water surface elevation for each pipe segment.

4. Add fluid from test container or from metered supply as required to maintain test water level within three inches of test head throughout the test.
5. Test duration shall be at least two hours.
6. Allowable Leakage Rates:
    a. Leakage is defined as the quantity of fluid that must be supplied to pipe segment tested to maintain hydrostatic head within three inches of test head during the test after pipe has been filled and exposed for required wetting period, plus quantity required to refill to original head at end of test.
    b. Leakage shall not exceed 100 gallons per inch of internal diameter per mile of pipe tested in 24 hours, or that required by authority having jurisdiction, whichever is less.

E. Infiltration Testing
1. CONTRACTOR shall test piping using exfiltration/infiltration and low-pressure methods at his option and with ENGINEER'S approval. Method for exfiltration testing is described below.
2. Plug and bulkhead ends and lateral connections of pipe segment to be tested.
3. Dewatering activities should be suspended three (3) days prior to the start of the test and throughout the duration of the test.
4. A 90 degree V-notch weir in pipe on downstream manhole shall be inserted.
5. Testing may begin after water flow over weir stabilizes.
6. Take five (5) reading of accumulated volume over period of 2 hours and use average for infiltration.
7. Allowable Leakage Rates:
    a. Leakage is defined as the quantity of fluid that enters the pipe segment to be tested during the testing period.
    b. Leakage shall not exceed 100 gallons per inch of internal diameter per mile of pipe tested in 24 hours, or that required by authority having jurisdiction, whichever is less.

E. Low-Pressure Air Testing:
1. CONTRACTOR shall test piping using exfiltration/infiltration and low-pressure methods at his option and with ENGINEER'S approval. Method for low pressure air testing is described below.
2. Plug and bulkhead ends and lateral connections of pipe segment to be tested.
3. Maintain a minimum positive head of two (2) feet throughout the test.
4. Test in accordance with requirements of authority having jurisdiction.
5. If there are no Laws and Regulations covering the test, use test procedures described in the following standards:
    a. Thermoplastic and HDPE Pipe: ASTM F1417.

F. Vertical Deflection Test for Thermoplastic and HDPE Pipe:

1. Conduct vertical deflection test at least thirty days after backfill has been placed.
2. Manually pull pin-type vertical gauge mounted on sled through pipe. Gauge shall be manufactured by Quality Test Products, or equal. Set gauge so that sled will stop if vertical deflection of pipe exceeds five percent. Excavate and re-install piping that fails deflection test, and retest.
3. Use rigid ball or mandrel for deflection test, which shall have diameter of at least 95 percent of base inside diameter or average inside diameter of piping, depending on which is specified in applicable ASTM standard, including appendix, to which pipe is manufactured. Perform test without mechanical pulling devices. Re-install and retest pipe segments that exceed deflection of five percent.

3.6 CLEANING

A. Cleaning, General: Clean pipe systems as follows:
   1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in manner approved by ENGINEER, prior to placing in service.

3.7 SCHEDULES

A. Schedules listed below, following the "End of Section" designation, are part of this Specification section.
   1. Table 33 05 05-A, Buried Piping Schedule.

+ + END OF SECTION + +

TABLE 33 05 05-A, BURIED PIPING SCHEDULE

Service	Diameter (inch)	Material	Interior Lining	Exterior Coating	Pressure Class/ Thickness	Joint	Test	Remarks
SFM	4”	HDPE	--	--	DR 17	BW	HYD (125) & VD	
RW	3”	PVC	--	--	SCH. 80	SW	HYD (125) & VD	Lift Station
SFM	4”	PVC	--	--	DR 18 / C900	POJ / MJ	HYD (125) & VD	
PEW	6”	PVC	--	--	C900	POJ	EX / AIR & VD	
SAN	8”	PVC	--	--	DR 35	POJ	EX / AIR & VD	
SAN	4”	DI	CE	AC	150 psi	Flg	HYD (125)	

A. Service Abbreviations

Service	Abbrev		Service	Abbrev.
Sanitary Sewer	SAN		Wastewater	WW
Storm Sewer	ST		Overflow	OF
Combined Sewer	CS		Centrate	CEN
Sanitary Force Main	SFM		Filtrate	FILT
Raw Water	RW		Scum	SCUM
Potable Water	PW		Primary Sludge	PS
City Water	CW		Return Activated Sludge	RAS
Non-Potable Water	NPW		Waste Activate Sludge	WAS
Plant Effluent Water	PEW		Thickened Sludge	TS
Spray Water	SPW		Mixed Sludge	MS
Backwash Water	BW		Digested Sludge	DS
Hot Water Supply	HWS		Chlorine Solution	CLS
Hot Water Return	HWR		Sodium Hydroxide	NAOH
Influent	INF		Sodium Hypochlorite	NAOCL
Effluent	EFF		Polymer Solution	POLYS
Drain	DR		Alum	AL
Process Air	PA		Hydraulic Fluid	HF
Instrument Air	IA		Fuel Oil	FO
Digester Gas	DIG		Lube Oil	LO
Chlorine Gas	CLG			

B. Material Abbreviations

Material	Abbrev		Material	Abbrev.
Ductile Iron	DI		Polyvinyl Chloride	PVC
Cast Iron	CI		Chlorinated Polyvinyl Chloride	CPVC
Carbon Steel	CS		Polyethylene	PE
Stainless Steel	SS		High Density Polyethylene	HDPE
Copper	C		Fiberglass Reinforced Plastic	FRP
Corrugated Metal Pipe	CMP		Acrylonitrile Butadiene Styrene	ABS
Reinforced Concrete Pipe	RCP		Vitrified Clay	VC
Prestressed Concrete Cylinder Pipe	PCCP			
Non-Prestressed Concrete Cylinder Pipe	CCP			
Steel Cylinder Pipe	SCP			

C. Lining/Coating Abbreviations

Lining	Abbrev		Coating	Abbrev.
Cement Mortar Lined	CL		Asphaltic Coated	AC
Glass Lined	GL		Polyethylene Wrapped	PEW
Ceramic Epoxy	CE		Painted	P
Fusion Bonded Epoxy Lined	FBEL		Fusion Bonded Epoxy Coated	FBEC
Plastic Lined	PL		Insulated	I
			Galvanized	Galv

D. Joint Abbreviations

Joint Type	Abbrev		Joint Type	Abbrev.
Bell and Spigot	BS		Butt Weld	BW
Restrained Bell and Spigot	RBS		Lap Weld	LW
Push-on Joint	POJ		Butt Fusion Weld	BFW
Restrained Push-on Joint	RPOJ		Solvent Weld	SW
Mechanical Joint	MJ		Sleeve-type Flexible Coupling	SLFC
Restrained Mech. Joint	RMJ		Split Flexible Coupling	SPFC
Soldered	Sd		Plasticized PVC Coupling	PPVC
Brazed	Bz		Grooved or Shouldered End Coupling	GSEC
Threaded	Thd		Flanged	Flg
Compression Sleeve Coupling	CSC		Compression Flange Adapter	CFA

E. Test Abbreviations

Test	Abbrev		Test	Abbrev.
Hydrostatic Test (test pressure in psig)	HYD ( )		Process Air Pipe Test (test pressure in psig)	PA ( )
Exfiltration	EX		Chlorine Pipe Test	CL
Infiltration	INF		Disinfection and Bacteriological Testing	DBT
Low-pressure Air Sewer Test	AIR		Examination of Welds	EW
Vacuum Test	VAC		Televised Inspection	TV
Vertical Deflection	VD		No Test Required	NR

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SECTION 33 05 07.13

DIRECTIONAL DRILLING

1.1 GENERAL

A. The CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to perform the successful installation of the pipeline using horizontal directional drilling.

B. The CONTRACTOR shall make an inspection of the area(s) within the vicinity of the project and the immediate area of the Work and become thoroughly familiar with the natural and man-made features.

C. The CONTRACTOR's attention is directed to the existing utilities shown on the Drawings. The ENGINEER does not make any representation to the accuracy or correctness of this conditions, locations, and elevations necessary for the proper completion of the work under this Contract.

D. Related Sections
   1. Section 33 05 05, Buried Piping Installation
   2. Section 40 05 33, High Density Polyethylene Process Pipe
   3. Section 31 20 00, Earth Moving
   4. Section 01 78 39, Project Record Documents
   5. Section 01 51 05, Temporary Controls
   6. Section 01 33 00, Submittal Procedures

1.2 QUALITY ASSURANCE

A. Experience Requirements:
   1. The CONTRACTOR shall have a minimum of five (5) years of similar experience using horizontal directional drilling for the installation of pipelines. Additionally, the CONTRACTOR shall have performed at least five (5) prior waterway and road way crossing projects with length and pipe diameter equal to or greater than that required by this project. These projects must have been completed using high-density polyethylene (HDPE) as the pipe material.

B. Requirements of Regulatory Agencies:
   1. Comply with OSHA standards, Underwriter Laboratories, Federal Department of Transportation (FDOT), and all other authorities having jurisdiction. All crossings shall be as specified in the FDOT's "Utility Accommodation Manual.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM D3261, Specifications for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
   2. State of Florida, Department of Transportation (FDOT) Standards, Utility Accommodation Manual, latest edition

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. The CONTRACTOR shall submit all directional drilling installations for the Work shown, specified, or intended for approval in accordance with Section 01 33 00, Submittal Procedures.
   2. Tests: Submit description of pipe joint testing methods, procedures and apparatus. Submit copies of all test reports.
   3. Certificates: Submit certificates of compliance with referenced standards indicated above and in Section 40 05 33, High Density Polyethylene Process Pipe.
   4. Provide drawings both plan and profile of all intended directional drilling installations for the Work. Include existing utilities and proposal clearance for each. Provide clearance of top of pipe from the pavement surface, bottom of roadway and/or land surface as each one relates.
   5. As-Built Drawings: During progress of the Work, keep an up to date set of drawings showing field and shop drawing modifications. The drawings shall show all piping in plan and profile, with all reference dimensions and elevations required for complete as-built drawings of the piping systems. Conform to the requirements of Section 01 78 39, Project Record Documents.

B. Experience Qualifications: In accordance with Paragraph 1.2.A of this Section.

C. Pipe Material Calculations: The CONTRACTOR shall provide calculations determining the maximum pulling force that may be anticipated during the pullback operation to overcome theoretical frictional forces. The calculated pulling force will not exceed the manufacturer's recommended yield tensile strength and factor of safety for the proposed pipe material and fused joint.

D. Drilling Plan: The CONTRACTOR shall submit a detailed narrative description of the sequence of events that will be performed to install the specified pipe using horizontal directional drilling. The plan shall indicate

the diameter of the pilot hole, rig pulling capacity, torque, and mud pumping capabilities. Included shall be a description of methods and precautions the CONTRACTOR proposes to use to prevent exceeding the pipe manufacturer's approved safe yield tensile strength during pullback.

E. Fusion Technician Qualification Certification: In accordance with Paragraph 3.1.C.4 of this Section.

F. Boring Path Report: The CONTRACTOR shall furnish a Bore Path Report to the ENGINEER within seven (7) days of the completion of the bore path. The report must include:
   1. Location of project
   2. Name of person collecting data, including title, position and company name
   3. Investigation site location (Contract drawings station number or reference to a permanent structure within the project right-of-way)
   4. Identification of the detection method used
   5. Elevations and offset dimensions of the bore path in both relative and NAVD 1988 and NAD 1983.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Refer to Section 33 05 05, Buried Piping Installation for additional requirements.

B. Pipe and appurtenances shall be unloaded opposite to or as close to the place where they are to be laid as is practical to avoid unnecessary handling. Interiors shall be kept completely free from dirt and foreign matter.

C. The CONTRACTOR shall be responsible for the proper support of the piping to ensure that the pipe is not overstressed or damaged.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The material standards are to be interpreted as the minimum in place standards. Use materials that are appropriate for the stresses generated by the selected equipment and field conditions.
B. The CONTRACTOR shall ensure that the appropriate material is used to retain compliance once it is installed.
C. Refer to Section 40 05 33, High Density Polyethylene Process Pipe for additional requirements.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:

1. The CONTRACTOR shall refer and comply to the manufacturer's requirements for the horizontal drilling of HDPE pipe.
2. In general, the Work will proceed as follows if the horizontal directional drilling material is HDPE:
   a. Drill a pilot hole from one side of the bore path to the other side. The pilot hole shall follow the design centerline of the pipe with the path recorded and controlled using a specially designed instrument package situated behind the drill bit.
   b. The entire length of pipeline shall be fused and hydrostatically tested prior to pull back.
   c. A cutter/reamer shall be used to widen the drilled hole to its final diameter. A barrel reamer shall be used to smooth the wall of the hole and direct cuttings to the surface. A swivel shall be installed between the barrel reamer and the pipeline to ensure that no torque is transmitted to the pipeline while being pulled back. A bulkhead shall be fused to the end of the pipeline prior to attaching the swivel and barrel reamer.
   d. The HDPE pipeline shall be pulled back in a continuous operation at a constant speed until the pullback is complete. The pipe shall be filled with potable water during pull back unless otherwise approved by the OWNER. The pipe shall be pulled beyond the exit pit a minimum distance equilibrium before any other work is performed on the pipeline.
   e. Should the pipe become lodged during the pullback operation, the CONTRACTOR shall be responsible for all additional costs to dislodge the pipe. Additional costs may include, but shall not be limited to, replacement of overstressed sections of the pipe, additional excavation, environmental damage, or drilling of a new hole. All required work must be in compliance with all necessary permits.
   f. After the pipeline is in place, it shall be tested in accordance with the requirements of Section 33 05 05, Buried Pipe Installation.

B. Drill Path Geometry:

7. The CONTRACTOR shall be responsible for horizontal and vertical alignment of the pilot drill and final installed pipe. The

pilot drill alignment shall conform to the pipeline alignments shown on the Drawings. The CONTRACTOR shall submit all proposed changes to the vertical alignment shown on the Contract Drawings for approval prior to commencing work. Under no circumstances shall installed pipe be at a different elevation than 2-feet from the horizontal alignment shown on the Drawings.

8. Should the completed directional drill pipeline alignment differ from the Drawings such that additional/different fittings are necessary to join the excavated pipe, then these shall be provided and installed at no additional cost to the OWNER.
9. Entry and exit points shall be surveyed by experienced survey personnel licensed in the State of Florida. Refer to Section 01 78 39, Project Record Documents for documentation requirements.
10. The CONTRACTOR shall map the location of each pilot drill string joint to a minimum horizontal and vertical scale of 1-inch equals 40-feet. The map shall be posted in the CONTRACTOR's office and at no additional cost to the OWNER.
11. Should the CONTRACTOR exceed the limits described above, a new pilot drill shall be performed at no additional cost to the OWNER.
12. Sump pits are required to contain drilling fluids if vacuum devices are not operated throughout the drilling operation.
    a. Within 48 hours of completing installation of the boring product, clean the work site of all excess slurry or spoils.
    b. The CONTRACTOR shall take responsibility for the removal and final legal disposition of the excess slurry or spoils.
    c. The CONTRACTOR shall ensure that the work site is restored to pre-construction conditions.

C. HDPE Joining and Installation:
1. Sections of HDPE pipe shall be joined into continuous lengths on the job site above ground.
2. Joining method shall be the butt joint heat fusion method and shall be performed in accordance with the pipe manufacturer's recommendations.
3. Butt fusion equipment used in the joining procedures shall be capable for meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements, alignment and 75 psi interfacial fusion pressure.
4. Pipe and fitting joints shall be heat fused by a qualified fusion technician; trained by an approved manufacturer's representative, in accordance with the manufacturer's recommended fusion procedures. The CONTRACTOR shall provide written certification from the pipe manufacturer for each fusion technician

employed on the Project. Training or requalification shall have been obtained within the 12 months prior to the beginning of work.

5. Each person making butt or socket fusion joints shall demonstrate proficiency by making trial joints and destructively testing the trial fusions by bent strap testing or ultra-sonic testing. Trial joints shall be allowed to cool completely before testing, and shall not fail at the joint. During construction, the first fusion of the day shall be a trial fusion, which shall be allowed to cool, and destructively bent strap tested or ultra-sonically tested. If the fusion fails, additional trial fusions shall be made and tested until successful fusions are made, then that procedure shall be used for the balance of the day's construction provided the procedure is within the limitations recommended by the manufacturer.
6. The CONTRACTOR shall provide the services of a competent specialist representing the pipe manufacturer. The manufacturer's representative shall be available, at a minimum, during the welding and testing of the pipe segments and during the pipe pullback operation.

D. Project Conditions:

1. Existing Utilities: The CONTRACTOR shall be responsible to field locate existing underground utilities in the areas of Work.
   a. Should uncharted or incorrectly charted piping or utilities be encountered during the work, consult piping or utility OWNER immediately for instructions. The CONTRACTOR shall cooperate with the utility companies in keeping respective services and facilities in operation. Damaged utilities shall be repaired to the satisfaction of utility OWNER.
   b. Do not interrupt existing utilities serving facilities occupied and used by others, except when permitted in writing by OWNER and then only after acceptable temporary utility services have been provided.
   c. Coordinate with utility companies for shut-off of services, if required.
2. Topographic mapping shown on plan/profile drawings was provided from survey services. Refer to Drawing G-5. The mapping should be regarded as accurate within those standards adopted pursuant to minimum technical standards. For further details please refer to Section 01 78 39, Project Record Documents for additional requirements.
3. Use of Explosives: Do not bring explosives onto site or use in the Work. Use of explosive materials is specifically prohibited.
4. Dust Control: Refer to Section 01 51 05, Temporary Controls.
5. The CONTRACTOR shall take responsibility for restoration for any damage caused by heaving, settlement, separation of

pavement, escaping drilling fluid (frac-out) or the directional drilling operation at no additional cost to the OWNER.

6. If remediation plans are required, the CONTRACTOR shall provide the detailed drawings which show how damage will be remedied. The details shall become part of the as-built drawing package and shall be approved by the OWNER and ENGINEER prior to work proceeding.
7. If an obstruction is encountered during boring which prevents completion for the installation in accordance with the original location, the pipe may be taken out of service and left in place at the discretion of the OWNER and ENGINEER. Immediately fill the product left in place with excavatable flowable fill. Submit a new installation procedure and revised plans to the OWNER and ENGINEER for approval before resuming Work at another location.
8. If conditions warrant removal of any materials installed in a failed bore path, as determined by the ENGINEER, the cost of removal shall be the responsibility of the CONTRACTOR. The CONTRACTOR shall promptly fill all voids by injection all taken out of service products that have any annual space with excavatable flowable fill at no additional cost to the OWNER.

E. Installation Specialist:

1. The CONTRACTOR shall provide the full time services of a competent installation specialist during the directional drilling to assist in technical matters. The specialist shall advise the CONTRACTOR on drilling matters which may include, but may not be limited to, drilling procedures, pipe support, mapping of the pipe location, quality assurance of the work, safety or other items as necessary. The installation Specialist may be the CONTRACTOR's superintendent.

3.1 ENVIRONMENTAL CONTROLS

A. The CONTRACTOR shall meet the requirements of all specifications for all Work in this project and at all locations utilized by the CONTRACTOR during the progress of the Work.

B. Disposal Site: All costs for legal disposal of drilling mud and excess excavated materials shall be included in the bid price for the Work intended.

C. All operations involving drilling mud shall be controlled and monitored by the CONTRACTOR to ensure containment.

1. The CONTRACTOR shall establish bermed or sandbagged pits of sufficient size to accommodate the volume of drilling mud

anticipated plus a two (2)-foot freeboard. The bermed areas shall be maintained and designed by the CONTRACTOR to ensure containment and prevent loss of drilling mud.

2. Transportation of the disposal materials off site by public roads shall meet all Columbia County and the Florida Department of Transportation requirements.

+ + END OF SECTION + +

SECTION 33 05 07.23

UTILITY BORING AND JACKING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment, dewatering, supervision and incidentals required to furnish and install casing and carrier pipe as shown on the Drawings and specified herein.

B. Related Sections
1. Section 33 05 05, Buried Piping Installation
2. Section 40 05 31, Thermoplastic Process Pipe
3. Section 31 24 00, Earthwork
4. Section 01 51 05, Temporary Utilities

1.2 QUALITY ASSURANCE

A. Installer's Qualifications and Experience:
1. Installer shall be a specialist in the construction of casing pipes by jacking and boring and shall have at least five (5) years experience in this specialty. Within the past five (5) years, installer shall have personally constructed completely not less than five (5) similar installations, which are comparable in diameter and length to that shown and specified herein.

2. Use only personnel thoroughly trained and experienced in the skills required. The field supervisor of boring operations and the boring machine operator shall have not less than 12 months experience in the operations of the equipment being used.

3. Welds shall be made only by welders, workers and welding operators who have been previously qualified by tests as prescribed by the Structural Welding Society to perform the type of work required. Show proof of certification when requested by the OWNER. Certification shall not be more than 6 months old from the date the work is to be performed.

B. Requirements of Regulatory Agencies:
1. The OWNER has obtained permission from the applicable authorities for locating the pipeline under the facilities. The CONTRACTOR shall comply with all provisions of these permits at their own expense. All crossings shall

be as specified in the Florida Department of Transportation's "Utility Accommodation Manual."

2. The CONTRACTOR shall, in addition to paragraph 1 above, obtain all additional permits, provide insurance, bonds, and guarantees, and all else required by the governing authorities at no additional cost to the OWNER. The CONTRACTOR's responsibility under this paragraph may include, but is not limited to the following:
   a. Survey and existing utility locates.
   b Constructing and removing temporary facilities or structures.
   c. Providing details of construction methods
   d. Providing detailed construction schedules.
   e. Reimbursing the applicable authority for all expenses incurred by them in connection with the work.
   f. Traffic maintenance.
   g. Necessary clean-up and restoration.
   h. As-built survey documentation.

C. Tolerances:
   1. The casing pipes shall be installed on the lines and grades shown in the Drawings and within tolerances required to allow the pipeline to be installed in accordance with the lines and grades shown in the Drawings.
   2. The maximum allowable tolerances are as follows:
      a. Allowable horizontal tolerance (ft): 0.50
      b. Allowable vertical tolerance (ft): 0.1

D. Reference Standards – Comply with the relevant section of the latest revisions of the following standards:
   1. ASTM A139 Grade B, Electric-Fusion (ARC Welded) Steel Pipe.
   2. ASTM A153, Zinc-Coating (Hot Dip) on Iron and Steel Hardware.
   3. ASTM A 276 Standard for stainless and heat-resisting steel bars and shapes
   4. ASTM A307, Low-Carbon Steel Externally and Internally Threaded Standard Fasteners.
   5. ASTM A569, Hot-Rolled Carbon Steel Sheets and Strip, Commercial Quality.
   6. ASTM C 33 Standard specification for concrete aggregates
   7. ASTM C 579 Standard test method for compressive strength of chemical resistant mortars, grouts, monolithic surfacing and polymer concretes
   8. ASTM D 4161 Standard specification for "fiberglass" pipe joints using flexible elastomeric seals
   9. ASTM D 6783 Standard specification for polymer concrete pipe
   10. ASTM F 477 Specification for elastomeric seals (gaskets) for joining plastic pipe
   11. AASHTO, Interim Specification for Steel Tunnel Liner Plates.
   12. AREA Chpt. 1, Part 4, "Jacking Culvert Pipe through Fills."
   13. AREA Chpt. 1, Part 5, "Specification for Pipelines Conveying Non-Flammable

Substances."

14. AWS D1.1, Structural Welding Code.
15. ASTM S252, Welded and Seamless Steel Pipe Piles.
16. DIN 54815-1&2
17. OSHA.
18. State of Florida, Department of Transportation (FDOT) Standards, Utility Accommodation Manual, latest edition.

1.3 SUBMITTAL

A. Installation Methods: Submit surveyed drawings and descriptions showing methods and equipment for the installation of the casing pipes, including sizes and locations of the jacking and receiving pits; sequence of installation by location, etc. for approval by the ENGINEER. Prepare a report of subsurface information, dewatering methods, jacking pit elevations and profile of proposed bore. The report shall be submitted to the OWNER and ENGINEER.

B. Technical data, test reports, work schedules and other information required by the authority having jurisdiction.

C. Certificates: Certificate of Conformance in accordance with paragraph 21.1 of ASTM A139.

D. The CONTRACTOR must submit for approval the following documentation for review by the ENGINEER and any other regulatory agency for each crossing:
   1. Noise Reduction Program
   2. Solids Control and Drilling Procedures
   3. Carrier Pipe Installation, Hydrostatic Testing, and Pigging Procedures
   4. Contingency Plans including the CONTRACTOR's proposed responses to the following occurrences:
      a. Loss of returns/loss of circulation of drilling fluid
      b. Hydrofracture
      c. Obstructions encountered during drilling
      d. Broken drill/auger bit
      e. Pipe product collapse

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery:
   1. Exercise special care during delivery so as not to damage the casing pipe and carrier pipe.
   2. Damaged materials shall be rejected by the OWNER and/or ENGINEER and replaced by the CONTRACTOR at no additional cost to the OWNER.

3. Deliver materials to such locations so as to avoid excessive handling.

B. Storage:
   1. Store casing pipe and carrier pipe on blocking for protection from corrosion until incorporation into the Work in accordance with manufacturer's recommendation.
   2. Store in areas approved by the OWNER and ENGINEER.
   3. The ENGINEER and OWNER shall be permitted access to inspect the materials in storage areas

C. Handling:
   1. Handle materials in a manner so as to avoid damage.
   2. Materials damaged during handling shall be repaired or replaced as ordered by the ENGINEER.

1.5 JOB CONDITIONS

A. Site information: Refer to Division 0.

B. Protection: Provide guardrails, fences, signs, lights, barricades, barrels, and all other protective items necessary in accordance with the requirements of all applicable permits, laws, regulations, and ordinances, and as necessary to prevent damage or injury to private or public property or to workmen or the general public.

C. Adequately support and protect utilities and facilities that are encountered in, or may be affected by the work.

D. The CONTRACTOR shall observe all necessary and appropriated safety precautions when working on roadway right-of-way or property. To this end, the CONTRACTOR shall provide a qualified watchmen to warn workmen of the approach of any vehicles or other moving equipment upon the highway, and to keep all workmen or other persons, equipment and materials from the highway including any power, communication, and signal wires, so that there will be no contacts with vehicles. CONTRACTOR shall comply with all regulatory requirements.

E. Refer to Section 31 20 00, Earth Moving for additional excavation and dewatering requirements.

F. Maintain necessary air exchanges in the pipe, when hand excavating, in a condition suitable for the health of the workmen at all times.

G. Existing Structures: The Drawings show certain existing facilities and surface and underground structures located on or adjacent to the Work. This information has

been obtained from existing records. It is not guaranteed to be correct or complete and is shown for the convenience of the CONTRACTOR. The CONTRACTOR shall explore ahead of the required Work to determine the exact location of all structures. They shall be supported and protected from damage by the CONTRACTOR. If they are broken or damaged, they shall be restored immediately by the CONTRACTOR at no additional cost to the OWNER.

H. Existing Utilities: Locate existing underground utilities in the areas of Work. If utilities are to remain in place, provide adequate means of protection during all operations.
   1. Cooperate with the OWNER and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
   2. Do not interrupt existing active utilities except when permitted in writing by the OWNER or utility owner and then only after acceptable temporary utility services have been provided.
   3. Coordinate with utility companies in writing prior to proceeding with work activities. Any shut downs of services shall be in conformance with Section 01 51 05, Temporary Utilities.

1.6 GUARANTEE

A. Guarantee of work completed by the CONTRACTOR shall be as specified in the General Conditions, except that longer periods may be required where noted in the permits or specified by authorities have jurisdiction.

1.7 GENERAL PROCEDURES

A. Install welded steel pipe casings as shown or specified, in accordance with approved jacking and boring methods.

B. Attend all meetings and provide any necessary data, survey, reports, information, details, and construction schedules as requested by the OWNER.

C. The scheduling of all construction activities under the highway or railroad right-of-way shall consider traffic patterns in order to minimize the interruption of traffic. The CONTRACTOR shall include the cost for such procedures in the bid prices and shall not be entitled to any change in Contract Amount on account of such procedures.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Casing Pipe:

1. Casing pipe shall be new and unused steel pipe meeting the requirements of ASTM A139, Grade B, leakproof construction capable of withstanding AASHTO HS-20 wheel loading for all crossings at the depths shown. Impact factor shall be 1.5. Pipe shall be seamless or have not more than one longitudinal weld.

Carrier Pipe, Nominal Diameter (in):	Steel Casing Pipe, Nominal Diameter (in):	Casing Pipe Minimal Wall Thickness (in.)
4	12	0.188
6	14	0.188
8	18	0.250
12	24	0.469
16	30	0.505

2. If the casing pipe is furnished in sections and the casing pipe requires field welding, then the casing pipe shall be furnished with plain ends, mill beveled for field butt welding. Field welded joints shall be performed by AWS D.1.1 Certified Welders and shall be full penetration single-vee groove, butt type welds around the entire circumference of the pipe. All welding shall receive non-destructive testing. Copies of the test report shall be sent to the ENGINEER.
3. For all work performed within Florida Department of Transportation right-of-way, the casing pipe shall be a minimum of 40-foot lengths.
4. Coatings: The exterior and interior surfaces of the casing pipe shall receive surface preparation conforming to SSPC-SP6. One of the following coating systems shall be applied in the shop:
   a. Kop-Coat, Carboline Co.
      1) Primer: Kop-Coat 340 gold primer – 1 coat, 2 to 4 dry mils.
      2) Finish: Bitumastic 300M – 2 coats, 8 to 10 dry mils per coat.
   b. Tnemec:
      1) Primer: 37H Chem-Prime HS - 1 coat, 2.0 to 3.5 dry mils.
      2) Finish: Tneme-Tar – 2 coats, 8.0 to 10.0 dry mils per coat.
   c. Or approved equal.
5 CONTRACTOR may use a mechanical joint type pipe in lieu of welded joints. The pipe joint shall be flush with the inside and outside diameter. The joints shall be manufactured by Permalok or ENGINEER approved equal.
6. Casing pipe shall be in accordance with this Section.

B. Carrier Pipe:

1. Carrier pipe shall be as indicated on the Drawings and in this Section and in accordance with Section 33 05 05, Buried Piping Installation and Section 40 05 31, Thermoplastic Process Pipe.

C. Annular Spacers and End Seals:
   1. Carrier pipe within casings installed by microtunneling or bore/jack operations shall be supported within the steel casing by means of annular spacers.
   2. Annular spacers shall be a two piece prefabricated unit by a single manufacturer. All casing spacers in a single casing pipe crossing shall be by the same manufacturer. Casing spacers shall have a shell made from either 304 stainless steel, 14 gauge mild steel which has been heat fusion coated with PVC plastic, (PVC coating shall be .01 inch thick over the entire band including the runner studs) or high density polyethylene. Casing spacers on 16 inch and smaller carrier pipe shall have 8 inch wide steel bands and casing spacers on 18 inch and larger carrier pipe shall have 12 inch wide steel bands, except high density polyethylene spacers shall have high density polyethylene bands. All casing spacers for 14 inch and smaller pipe size shall have four 10 gauge or 14 gauge steel risers with runners and casing spacers for 16 inch and larger pipe shall have six 10 gauge or 14 gauge steel risers with runners (two top and four bottom), except high density polyethylene spacers shall have one riser for every diameter inch of carrier pipe. The runners (risers) shall be either glass reinforced plastic, UHMW polymer or high density polyethylene. All nuts, bolts and washers shall be 304 stainless steel. All risers over 2 inches in height shall be reinforced. Wooden skids are not an acceptable.
   3. The spacers shall be placed in 6 foot intervals. A spacer shall be placed such that it supports the carrier pipe within 2 feet of the casing ends and a minimum of three spacers per 20-foot pipe section. For pipe sections longer or shorter than 20 feet, follow the manufacturer's instructions and recommendations.
   4. The CONTRACTOR shall verify size, position, spacing, and configuration of spacers with manufacturer.
   5. The CONTRACTOR shall verify the tolerances of the casing spacer are compatible with the carrier pipes outside diameter including provisions for the pipe to be slightly out-of-round.
   6. Manufacturer: Spacers shall be manufactured by the following:
      a. PSI, C12G-2
      b. Casey Cascade, CCS-12" Width Minimum
      c. Or approved equal.
   7. Ends of casings shall be sealed around end seal made of 1/8" thickness rubber and stainless steel bands that will completely close both ends of the casings.
   8. End seals shall be manufactured by
      a. Public Works Marketing

b. PSI
c. Advance Products & Systems, Inc.
d. Casey Cascade
e. or approved equal

D. Sand Backfill
1. Sand shall be dry (water content no more than 6% or less than 3%), free from organic matter, and containing not over 5% by weight of deleterious substances. It shall be hard, dense, durable, clean, sharp, and graded evenly from fine to coarse as follows:

Sieve Size	Percent By Weight
3/8 inch	100
No. 4	97-100
No. 8	79 – 85
No. 16	60-78
No. 50	10-20
No. 100	0-4

2. Sand shall have a fineness modulus per ASTM C 136 of between 2.70 and 3.30.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation of the crossings shall be by jacking or boring and shall conform in all respects to the requirements contained herein and other applicable standards.

B. Lines and Grades: The CONTRACTOR shall be responsible for establishing and maintaining proper line and grade at each crossing.
1. The CONTRACTOR shall periodically check his line and grade to assure conformance with the line and grade shown on the Drawings.
2. Extra work required because of the CONTRACTOR'S failure to maintain the proper line and grade, as shown on the drawings, shall be performed, by the CONTRACTOR, at no additional cost to the OWNER.

3.2 INSPECTION

A. As required by the ENGINEER, OWNER, FDOT or regulatory agencies.

3.3 PREPARATION

A. Work pits at each end of the crossings shall be sufficiently large to permit

satisfactory installation of the casing pipe or direct jacking pipe. All excavation, backfill, sheeting, shoring, bracing, and dewatering shall comply with the applicable requirements of Section 31 20 00, Earth Moving and the requirements of the applicable authorities having jurisdiction.

B. The CONTRACTOR shall dispose of excess excavated material and drilling mud/cuttings in legal manner.

3.4 INSTALLATION

A. Installation of Casing Pipe by Jacking:
   1. Install in accordance with current Columbia County, and Florida Department of Transportation specifications, rules and requirements latest editions.
   2. Design bracing and backstops and use jacks of sufficient rating such that jacking can be accomplished in a continuous manner until the leading edge of the pipe reaches the final positions shown on the Drawings.
   3. If voids develop around the casing pipe as it is jacked, pump cement grout to fill all such voids.
   4. Fill all voids as specified hereafter as soon as possible after completion of jacking operation.
   5. The installation of pipe and fittings shall be in accordance with the project plans and specifications and the manufacturer's recommended practices.
   6. Textile slings, anchor lifting devices and/or a forklift are recommended.

B. Installation of Casing Pipe by Boring:
   1. The boring method shall consist of pushing the pipe into the fill with a boring auger rotating inside the pipe to remove the soil.
   2. Provide the front of the casing pipe with suitable mechanical arrangements or devices that will positively prevent the auger and cutting head from leading the pipe so that there will be no unsupported excavation ahead of the pipe.
   3. The equipment and mechanical arrangements or devices used to bore and remove the earth shall be removable from within the casing pipe in the event an obstruction is encountered.
   4. The face of the cutting edge shall be arranged to provide reasonable obstruction to the free flow of soft or poor soil.
   5. Do not use water or other liquids to facilitate casing emplacement or spoil removal.
   6. If voids develop around the casing pipe as it is bored, pump cement grout to fill all such voids.
   7. Fill all voids as specified hereafter as soon as possible after computation of boring operation.
   8. The installation of pipe and fittings shall be in accordance with the project plans and specifications and the manufacturer's recommended practices.
   9. Textile slings, anchor lifting devices and/or a forklift are recommended.

C. Obstruction: If an obstruction is encountered during installation to stop the forward action of the casing pipe, and it becomes evident that it is impossible to advance the pipe, the CONTRACTOR shall remove the obstruction at the leading end of the casing pipe. No blasting shall be permitted.

D. Installation of the Carrier Pipe:
   1. After completion of the casing pipe, the carrier pipe shall be installed and pressure tested by an approved method.
   2. Care shall be taken to prevent undue disturbances of the joints.
   3. The carrier pipe shall be laid on the line and grade shown on the Drawings.
   4. The CONTRACTOR shall repair, replace or take whatever action is deemed necessary by the ENGINEER to correct all disturbed joints at no additional cost to the OWNER.
   5. The carrier pipe shall be restrained its full length.
   6. The CONTRACTOR shall block the carrier pipe in place using casing spacers as shown on the Drawings and specified herein.

E. Annular Space: The annular space between the carrier pipe and casing pipe shall be filled with sand backfill.

F. End Seals:
   1. After the carrier pipe is installed in the steel casing and successfully pressure tested, construct end seals as shown on the Drawings and as specified herein.
   2. Prior to the installation of the end seals, the carrier pipe shall be properly and sufficiently secured against flotation and against all movement, which would disturb joints.
      a. The CONTRACTOR shall be responsible for all joints.
      b. The CONTRACTOR shall repair, replace, or take whatever action is deemed necessary by the ENGINEER to correct all disturbed joints at no additional expense to the OWNER.

++ END OF SECTION ++

SECTION 33 05 61

PRECAST CONCRETE MANHOLES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install precast concrete accessories as shown and specified.
   1. The extent of precast concrete accessory Work is shown on the Drawings.
   2. The types of precast concrete accessory Work includes the following:
      a. Precast Manholes
      b. Miscellaneous accessories.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. ACI 350, Code Requirements for Environmental Engineering Concrete Structures.
B. ASTM A82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
C. ASTM A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
D. ASTM A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
E. ASTM A497, Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
F. ASTM A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
G. ASTM A706, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
H. ASTM C33, Standard Specification for Concrete Aggregates.
I. ASTM C150, Standard Specification for Portland Cement.
J. ASTM C 260, Air-Entraining Admixtures for Concrete.
K. ASTM C494, Standard Specification for Chemical Admixtures for Concrete.
L. PCI MNL 116, Manual for Quality Control for Plants and Production of Structural Precast Concrete Products.
M. PCI MNL 120, PCI Design Handbook - Precast and Prestressed Concrete.
N. ASTM C 207, Specification for Hydrated Lime for Masonry Purposes.

O. ASTM C 478, Specification for Precast Reinforced Concrete Manhole Sections.

P. AWWA C302, Reinforced Concrete Pressure Pipe, Non-cylinder Type, for Water and Other Liquids.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Complete information for fabrication and installation of precast concrete units. Indicate member dimensions and cross-section; location, size and type of reinforcement.
2. Submit drawings showing design and construction details of all precast concrete and cast-in-place manholes and structures, including details of joints between the manhole bases and riser sections and stubs or openings for the connections.
3. The location and details of all items that are to be embedded in the precast units.
4. Details of sealing all joints against ground water intrusion.
5. Manufacturer's specifications, data and instructions for manufactured materials and products. Include manufacturer's certifications and laboratory test reports as required.
6. Design calculations signed and sealed by a Florida registered Professional Engineer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Firms that have successful experience in the fabrication of precast concrete Work, similar to units required for this project, will be acceptable. Fabricator must have sufficient production capacity to produce, transport, and deliver required units without causing delay in the Work.
2. If units are produced at locations other than precast concrete fabricating plants, maintain procedures and conditions for quality control equivalent to plant production.

B. Fabrication Tolerances:

1. Units shall be true to dimensions. Unit bow, as fabricated and installed, shall not exceed 1/8 inch per unit in the short dimension and 1/4 inch per unit in the long dimension. Step in alignment face and jog in alignment shall not exceed 1/4 inch.
2. Imperfections such as air bubbles, ripples, joint lines, warpage, stains, projections, honeycombs, uneven matrix plate and other imperfections not in the approved sample panel will not be acceptable.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:
   1. Deliver precast concrete units to project site in such quantities and at such times to assure continuity of installation.

B. Storage of Materials:
   1. Store units at project site in a manner that will prevent cracking, distortion, warping, staining, or other physical damage and so that precast copings are without damage at time of installation.

C. Handling of Materials:
   1. Lift and support units only at designated lifting or supporting points as shown on final Shop Drawings.

1.6 PERFORMANCE CRITERIA

A. Design Responsibility: The fabricator is responsible for structural design of the precast concrete item. Maintain general design concept shown without increasing or decreasing sizes or altering profiles and alignment shown. Design shall be by a Florida licensed professional engineer. Drawings and calculations including buoyancy calculations shall be signed and sealed by the fabricator design engineer.

B. Design Deviations: Design modifications may be made only as necessary to meet field conditions and to ensure proper fitting of the Work, and only as acceptable to ENGINEER.

C. Design Data:
   1. Lateral soil pressure above ground water surface: 60 pcf equivalent fluid pressure.
   2. Lateral soil pressure below ground water surface: 90 pcf equivalent fluid pressure.
   3. Design ground water surface at elevation at grade.
   4. Top slab live load: 300 psf or AASHTO HS-20 truck wheel loads, whichever causes the greater stress.
   5. Maximum allowable soil bearing pressure: 2000 psf.

D. Design shall meet the requirements of ACI 350, PCI MNL 120, and the 2007 Florida Building.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Formwork:
   1. Provide forms of metal, plastic, wood, or other acceptable material that is non-reactive with concrete and will produce required finish surfaces.
   2. Accurately construct forms, mortar-tight, and of sufficient strength to withstand pressures due to concrete placing operations, temperature changes, and pre-stressing, pre-tensioning, and de-tensioning operations. Maintain framework to provide completed precast concrete units of shapes, lines and dimensions indicated, within specified fabrication tolerances.

B. Reinforcing Materials:
   1. Reinforcing Bars: ASTM A 615, Grade 60, unless otherwise indicated.
   2. Low-Alloy Steel Reinforcing Bars: ASTM A 706.
   3. Steel Wire: ASTM A 82, plain, cold-drawn, steel, galvanized complying with ASTM A 153.
   4. Welded Wire Fabric: ASTM A 185, galvanized after fabrication complying with ASTM A 153.
   5. Welded Deformed Steel Wire Fabric: ASTM A 497, galvanized after fabrication complying with ASTM A 153.
   6. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing.
   7. Where legs of supports are in contact with forms, provide supports with legs of stainless steel.

C. Concrete Materials:
   1. Portland Cement: ASTM C 150, Type II.
      a. Use only one brand and type of cement throughout the project unless otherwise approved by ENGINEER and OWNER.
   2. Fine Aggregate: ASTM C 33, Natural silica sand, manufactured sand is not allowed
   3. Coarse Aggregate: ASTM C 33; hard, durable aggregate, carefully selected and graded; free of material causing staining or reacting with cement.
   4. Water: Potable.
   5. Air-Entraining Admixture: ASTM C 260.
   6. Water-Reducing Admixture: ASTM C 494, Type A.
   7. Calcium Chloride: Do not use calcium chloride in precast concrete.

2.2 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type of concrete required.

B. Design mixes may be prepared by an independent testing facility or by qualified precast manufacturing plant personnel, at precast manufacturer's option.

C. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each type of concrete required, complying with ACI 211.1 or ACI 211.2

D. Concrete Mix: Standard-weight concrete consisting of specified Portland Cement, pigments, aggregates, admixtures, and water to produce the following properties:
   1. Compressive Strength: 5,000 psi minimum at 28 days.
   2. Total Air Content: Not less than 4 percent nor more than 6 percent.

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Laboratory test data for revised mix designs and strength results must be submitted to and accepted by ENGINEER before using in the Work.

F. Admixtures: Use air-entraining admixture in strict compliance with manufacturer's directions. Admixtures to increase cement dispersion, or provide increased workability for low-slump concrete, may be used subject to ENGINEER'S acceptance.
   1. Use amounts as recommended by admixture manufacturer for climatic conditions prevailing at time of placing. Adjust quantities of admixtures as required to maintain quality control.

2.3 FABRICATION

A. General: Fabricate precast concrete units complying with manufacturing and testing procedures, quality control recommendations, and dimensional tolerances of PCI MNL-116, unless otherwise indicated. Keep bar sizes small, even where this will reduce the spacing of the bars.

B. Fabricate units straight, smooth, and true to size and shape, with exposed edges and corners provided with a 3/4-inch chamfer or 1x2-inch radius.
   1. Precast units that are warped, cracked, broken, spalled, stained, or otherwise defective will not be acceptable.

2.4 PRECAST CONCRETE MANHOLES:

A. Manholes shall meet the requirements of ASTM C 478 with the exceptions specified in this Section, and shall consist of precast reinforced concrete

riser sections, a monolithic base section, and Eccentric cones unless otherwise approved. Manholes shall be designed and constructed to withstand a minimum H-20 type loading. Cement shall meet the requirements of ASTM C 150, Type II. Reinforcing steel shall be as shown on the standard manhole detail. Concrete shall meet the minimum compressive strength requirements of 4000 psi at 28 days. Wall thickness shall be 5 inches minimum. The required minimum strength of concrete shall be confirmed by making and testing three standard cylinders at 7 days. Rings shall be custom made with openings to meet indicated pipe alignment conditions and invert elevations. Submit shop drawings consisting of the manufacturer's standard details of various sections for approval before placing an order for manholes. Drawings of individual manholes showing invert elevations, pipe sizes, and required construction details shall be submitted. Provide certification of proper cure period and Independent Testing Laboratory tests confirming concrete moisture less than 6%. Manhole interior walls, tables and inverts shall be a smooth surface free of voids, depressions, chips, rough edges and high spots. Lifting holes may be provided in each section for ease of handling.

1. Bases and Slabs: Precast circular concrete manholes shall be constructed with a precast monolithic base structure integral with the bottom manhole section. The minimum base thickness shall be 8-inches. The steel in the base shall be No. 5 reinforcement at 12-inches on center each way.
2. Joints: Joints shall be tongue and groove configuration formed with machined castings. Surfaces shall be exactly parallel with nominal 1/16-inch clearance. "RAM-NEK" sealing compound, conforming to Federal Specification SS S-00210 as manufactured by the Henry Company, El Segundo, CA or approved equal. Cement mortar joints will not be acceptable, except that each joint shall be wiped inside the manhole with cement mortar after assembly. Joints shall be water tight.
3. Exterior Joint Sealant Membrane: All exterior joints below the top cone section of precast concrete manholes (including base and risers sections) shall be sealed with one 6-inch wide (minimum) exterior joint sealant membrane centered on joint. The tape shall be capable of sealing manhole joints against groundwater and sand infiltration. The installation of the membrane shall be in conformance with the recommendations of the manufacturer. Surface must be smooth, clean, dry and free of voids, loose aggregate, dirt or other matter that will hinder the adhesion of the membrane. A primer shall be used in accordance with the recommendations of the membrane manufacturer. If recommended by the manufacturer, heat shall be applied to all areas being sealed.
4. Adjustment Rings (Manhole Collars): Adjustment rings shall be 8" wide (48" OD X 32" diameter opening) concrete. Concrete

adjustment rings shall be 4000 psi (minimum) concrete, Type II cement. Minimum height of rings shall be 2 inches. Rings shall be grouted in place. Concrete mortar (1/2" thick) shall be applied to the interior and exterior surfaces of the concrete adjustment rings. The interior of the concrete ring shall be coated as specified. High Density polyethylene (HDPE) rings may be utilized for manholes located in non-traffic areas only (not in streets, parking areas, drive ways etc.). HDPE adjustment rings shall be stackable and have a minimum height of 2 inches and be installed with silicone sealant as per the manufacturer's directions. Apply heavy amount (covering the entire joining surfaces) of silicone sealant between the manhole cone section and HDPE rings, between all stackable rings and between HDPE ring and manhole frame (note: do not use concrete grout during the assembly of HDPE rings). During the installation of HDPE rings, the contractor shall apply downward pressure on the rings to squeeze out the excess silicone (tight fit).

5. Portland Cement: Shall conform to ASTM C 150, Type II. Approved: Atlas; Florida; Lehigh; or equal.
6. Sand: Washed silica sand shall conform to ASTM C 144.
7. Mortar: Shall conform to ASTM C-270, type M.
8. Bricks: Shall be clay and conform to ASTM C-216, grade SW, and have the following dimensions of 3 1/2 inches wide by 8 inches long and 2 1/4 inches high.

B. Manhole Frames and Covers: Refer to the Drawings for manhole cover details. To be considered and approved equal, frame and cover must be interchangeable with approved frames and covers and meet applicable weight criteria.

C. Non-shrink Grout: All holes in manholes, provided for their handling, and the annular space between the wall and the pipe coupling adapter shall be thoroughly plugged with Embeco No. 167 Mortar, or approved equal non-shrinking mortar, applied and cured in strict conformity with the manufacturer's recommendations so there will be zero leakage through openings and around pipes. The mortar shall be finished smooth and flush with the adjoining interior and exterior manhole and/or wet well wall surfaces.

D. Manhole Steps shall be of aluminum or composite plastic steel construction. Minimum design live load of steps shall be a single concentrated load of 300 pounds. Steps shall have nonskid top surfaces, and shall be designed so that the foot cannot slip off the end. Steps shall have a minimum cross-sectional dimension of 1-inch, and a minimum width of 10 inches. Steps shall not descent over any pipe connection into the manhole. The uppermost step shall be built into the masonry not over 12 inches below the top of

manhole dome/cone and these steps shall be continued in alignment downward along the interior vertical side of the manhole to a point no lower than the crown of the largest sewer line. Steps shall be evenly spaced on 12-inch centers with each step embedded in the wall a minimum of 3 inches. Each step shall project a minimum of 4 inches from the wall as measured from the point of embedment. Steps shall be equal to M.A. Ind. Inc. #PS-1 or 3PS-1-PF.

E. Coating:
   1. General: All manhole exterior and interior surfaces shall be lined and coated as specified in this Section. The Contractor shall use an approved coating and lining subcontractor for all manhole preparation and application of coatings and/or linings.
   2. Exterior: The exterior manhole surfaces shall receive two (2) coats of Koppers Bitumastic Black Solution or approved equal.
   3. Interior:
      a. All manholes shall be HDPE lined with an Agru Sure Grip Liner, Green Monster Liner or approved equal, with a minimum thickness of 2 mm, mechanically anchored to the concrete and with all joints extrusion welded by certified welders. The Contractor shall submit shop drawings consisting of manufacturer's standard details of various sections, for approval, before placing order for manholes.

F. Flexible Manhole-to-Pipe Connector

   1. The manhole-to-pipe connector shall be manufactured from Neoprene EPDM. The connector shall be a minimum of 3/8-inch thick and shall conform to ASTM C443 and ASTM C923. The connector shall be resistant to ozone, weathering, aging, chemicals, animal and vegetable fats, oils, and petroleum products and designed to accommodate pipe movement up to 2 inches radically or 22 degrees angularly in any direction.
   2. The connector shall be sized for the specific type and size pipe entering and leaving each manhole. The connector shall be precast into the manhole by the manhole manufacturer in accordance with the connector manufacturer’s written instructions. A 304 stainless steel band and screw assembly shall be provided to seal the flexible neoprene connector against the pipe. During the invert construction stage, the interior annular space between the exterior of the pipe and the interior of the connector shall be filled with a Type II lean cement grout by the Contractor.
   3. Acceptable Manufacturers: Kor-N-Seal, or approved equal.

G. Backfill shall be as specified in Section 02321, Excavation and Backfill.

2.5 PIPE CONNECTIONS FOR INLET PIPING

A. Provide resilient watertight connectors between the precast structure and inlet piping in accordance with ASTM C923. Connections shall consist of a chemically resistant neoprene EPDM flexible boot, locking ring, and pipe clamp(s). The locking ring shall be 304 stainless steel and shall lock the boot into the pre-formed opening in the structure. The pipe clamp shall be 304 stainless steel. Alternatively, cast the flexible boot in the structure and eliminate the locking ring. Pipe connections for inlet gravity piping less than 12-inches in diameter shall be Kor-N-Seal (Trelleborg Pipe Seals), Z-Lok-XP (A-Lok Products, Inc.) or equal. Pipe connections for pressure or force main piping shall be a modular link seal manufactured by Link Seal (Model S-316) or equal.

2.6 VAULT FRAMES AND COVERS

A. Vault frames and covers shall be as shown on the Drawing and of such quality and composition as will make the metal of the casting strong, tough and of even grain. They shall be smooth, free from scale, lumps, blisters, and sand holes. No plugging or filling will be allowed. Covers shall be as shown on the Drawings. The vault frames and covers shall be set so that the top of the cover will be flush with the finished grade, unless shown otherwise on the Drawings. Frames and covers shall have the bearing surfaces machined to prevent rocking.

2.6 SPECIAL MATERIALS

A. Water Impermeable Membrane: Material shall be Wrapid Seal, or ENGINEER approved equal.

PART 3 – EXECUTION

3.1 INSPECTION

A. The CONTRACTOR and his installer shall examine the substrate and the conditions under which Work is to be performed and notify the OWNER of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the OWNER.

3.2 INSTALLATION

A. Do not install precast units until concrete has attained its design compressive strength.

B. Apply protective interior and exterior coatings to precast concrete structures as specified in Section 09 91 00, Painting.

C. Precast Sections:
   1. Set sections vertical with sections in true alignment. The base of the bell or groove end at joints between components shall be buttered with 1 to 2 cement-sand mortar to provide a uniform bearing between components. All joints shall be sealed with cement mortar inside and out and troweled smooth to the contour of the wall surface. Raised or rough joint finishes will not be accepted.
   2. Install sections, joints and gaskets in accordance with manufacturer's recommendations.
   3. Lifting holes shall be sealed tight with a solid rubber plug driven into the hole from the outside of the barrel and the remaining void filled with 1 to 2 cement-sand mortar.

D. Grading at precast units:
   1. All units in unpaved areas shall be built as shown or directed to an elevation higher than the original ground. The ground surface shall be graded to drain away from the unit. Fill shall be placed around the units to the level of the cover slab top, and the surface evenly graded on a 1 to 5 slope to the existing surrounding ground unless otherwise shown. The slope shall be covered with 4 inches of top soil, seeded and maintained until a satisfactory growth of grass is obtained.
   2. The CONTRACTOR shall be solely responsible for the proper height of all units necessary to reach the final grade at all locations. The CONTRACTOR is cautioned that the OWNER'S review of Shop drawings for precast unit components will be general in nature and the CONTRACTOR shall be responsible for meeting field conditions for final grading.

E. Bases
   1. Precast bases shall be set on a crushed stone or crushed gravel foundation as shown in drawings. Precast bases shall be set at the proper grade and carefully leveled and aligned. Refer to Section 31 20 00, Earth Moving.
   2. Use of Cast-In-Place bases will be subject to approval by ENGINEER and OWNER. When approved, bases shall be at least eight (8) inches in thickness and shall extend at least six (6) inches radially outside of the outside dimension of the structure. Reinforcement and connection to the riser

F. Precast Sections

1. Set sections vertical with steps and sections in true alignment. The base of the bell or groove end at joints between components shall be buttered with 1 to 2 cement-sand mortar to provide a uniform bearing between components. All joints shall be sealed with cement mortar inside and out and troweled smooth to the contour of the wall surface. Raised or rough joint finishes will not be accepted.
2. Install sections, joints and gaskets in accordance with manufacturers recommendations.
3. Lifting holes shall be sealed tight with a solid rubber plug driven into the hole from the outside of the barrel and the remaining void filled with 1 to 2 cement-sand mortar.

G. Manhole Channels

1. All invert channels through manholes and structures shall be constructed of Portland Cement Type II. Channels shall be properly formed to the sizes, cross sections, grades and shapes shown in the Drawings. Benches shall be built up to the heights shown or as directed by the OWNER or ENGINEER and given a uniform wood float finish. Care shall be taken to slope all benches for proper drainage to the invert channel.

H. Grading Rings

1. Grading rings or brick stacks shall be used for all precast and masonry manholes and structures, where required. Stacks or grade rings shall be a maximum of 12-inches in height, constructed on the roof slab or cone section on which the manhole frame and cover shall be placed. The height of the stack or grade rings shall be such as required to bring the manhole frame to the proper grade.
2. Each grade ring shall be laid in a full bed of mortar and shall be thoroughly bonded.

I. Stubs for Future Connections

1. As shown or required for connections, cast iron sleeves, bell end tile, ductile iron or reinforced concrete pipe stubs with approved watertight plugs shall be installed in manholes and structures. Where pipe stubs, sleeves or couplings for future connections are shown or directed by the OWNER or ENGINEER, CONTRACTOR shall provide all materials and labor in order to complete the Work.

J. Grading at Manholes and Structures

1. All manholes and structures in unpaved areas shall be built, as shown or directed by the OWNER or ENGINEER, to an elevation

higher than the original ground. The ground surface shall be graded to drain away from the manhole. Fill shall be placed around manholes to the level of the upper rim of the manhole frame, and the surface evenly graded on a 1 to 5 slope to the existing surrounding ground, unless otherwise shown or directed by the OWNER or ENGINEER. The slope shall be covered with 4-inches of topsoil, seeded and maintained until a satisfactory growth of grass is obtained.

2. Manholes and structures in paved areas shall be constructed to meet the final surface grade.
3. CONTRACTOR shall be solely responsible for the proper height of all manholes and structures necessary to reach the final grade at all locations. CONTRACTOR is cautioned that the ENGINEER's review of Shop Drawings for manhole components will be general in nature and CONTRACTOR shall provide an adequate supply of random length precast manhole riser sections to adjust any manhole to meet field conditions for final grading.
4. Pre-cast sections shall be placed and aligned to provide vertical alignment with a 1/4-inch maximum tolerance per five (5) feet of depth.

K. Connections and Leak Testing

1. Special care shall be taken to see that the openings through which pipes enter the structure are provided with watertight connections. Connections shall conform to ASTM C-923. Manhole connections and drop manhole connections shall conform in all respects to the Drawings.
2. All manholes and structures shall be free of visible leakage. Each manhole shall be tested for leaks and inspected, and all leaks shall be repaired in a manner subject to the ENGINEER'S approval.
3. Refer to Section 33 05 05, Buried Piping Installation for testing procedures.

L. Hatch Covers

1. Install hatches and panels in accordance with approved Shop Drawings.
2. The installer shall check as-built conditions and verify the manufacturer's details for accuracy to fit the application prior to fabrication. The CONTRACTOR shall comply with the manufacturer's installation instructions.
3. The CONTRACTOR shall furnish and install mechanical fasteners consistent with the manufacturer's instructions.

3.3 ADJUSTMENT AND CLEANING

A. In addition to above, in-place precast units may be rejected for any one of the following:
   1. Exceeding the specified installation tolerances.
   2. Damaged during construction operations.
   3. Exposed-to-view surfaces that develop surface finish deficiencies.
   4. Other defects as listed in PCI MNL-116.

B. Replace precast concrete units damaged for any reason or which fail to perform as specified until Final Acceptance by OWNER.

C. All newly constructed manhole and lift stations shall be cleaned of any accumulation of silt, debris, or foreign matter of any kind, and shall be free from such accommodation at the time of final inspection.

3.4 WELDING

A. All welding shall be performed in accordance with the published directives and procedures of the manufacturer and by welders certified by the manufacturer. Completion of welding will provide a one piece monolithic concrete protective liner system that will provide excellent resistance to hydrogen sulfide attack and will not pull off the wall in the event that infiltration occurs.

   The following welding techniques are acceptable:

   1. Extrusion Welding: Used to seal all seams inside structure, primary welding method.
   2. Butt Welding: Used to fuse flat sheets together to form one piece tube.
   3. Hot Air Welding: Used as a tack weld or only in triple pass method where extrusion welding is not possible.

B. Testing and supervision of the installation and welding shall be performed by qualified staff only and must be checked when completed by visually checking and by Spark Testing all welded joints.

C. Sample welds shall be taken from each jobsite during the field welding process and submitted to the quality assurance department for testing. The following tests are performed: Shear and Peel Test. Shear weld test results shall meet or exceed at least 80% strength of parent material in a destructive test, which pulls the sample apart to test the strength and integrity of the extrusion weld. The peel test pulls the weld apart from the

backside of the weld using a peeling type motion. The results of this test shall meet or exceed 70% of the value of the parent material.

+ + END OF SECTION ++

SECTION 40 05 05

EXPOSED PIPING INSTALLATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to install and test all exposed piping, fittings, and specials. The Work includes the following:
      a. All types and sizes of exposed piping, except where exposed piping installations are specified under other Sections.
      b. Unless otherwise shown or specified, this Section includes all piping beginning at the outside face of structures or structure foundations and extending into the structure. Piping embedded in concrete within a structure or foundation shall be considered as exposed and is included herein. Piping that is permanently or intermittently submerged, or installed in sub-aqueous environments, is considered as exposed and is included in this Section.
      c. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all Work required for a complete exposed piping installation.
      d. Supports, restraints, and other anchors.
      e. Field quality control, including testing.
      f. Cleaning and disinfecting.
      g. Incorporation of valves, meters, and special items shown or specified into the piping systems per the Contract Documents and as required

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before exposed piping Work.
   2. Coordinate with appropriate piping Sections of Division 40, Mechanical.

C. Related Sections:
   1. Section 09 91 00, Painting.
   2. Section 40 05 31, Thermoplastic Process Pipe.
   3. Section 40 05 19, Ductile Iron Process Pipe

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASME B31.3, Process Piping.
2. American Society for Non-Destructive Testing (ASNT), ASNT-TC-1A, Recommended Practice, Personnel Qualification, and Certification in Non-destructive Testing.
3. ASTM A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
4. ASTM B32, Specification for Solder Metal.
5. AWS D1.1/D1.1M, Structural Welding Code-Steel.
6. ANSI/AWWA C206, Field Welding of Steel Water Pipe.
7. ANSI/AWWA C606, Grooved and Shouldered Joints.
8. AWWA M11, Steel Pipe - A Guide for Design and Installation.
9. AWWA M23, PVC Piping - Design and Installation.
10. SAE J1227, Method for Assessing the Cleanliness Level of New Hydraulic Fluid.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements and recommendations of authorities having jurisdiction over the Work.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Detailed drawings in plan and, as applicable, section.
      b. Details of piping, valves, supports, accessories, specials, joints, harnessing, and main anchor supports, and connections to existing piping, structures, equipment, and appurtenances.
   2. Testing Plans, Procedures, and Testing Limitations
      a. Submit description of proposed testing methods, procedures, and apparatus, and obtain ENGINEER's approval prior to testing.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Submit a certificate, signed by manufacturer of each product, certifying that product complies with applicable referenced standards.
   2. Source Quality Control Submittals:
      a. Submit copies of testing report for each test.
   3. Site Quality Control Reports:
      a. Submit copies of testing report for each test.

C. Closeout Submittals: Submit the following:
   1. Record Documentation:

a. Maintain accurate and up-to-date record documents showing field and Shop Drawing modifications. Record documents for exposed piping Work shall show actual location of all piping and appurtenances on a copy of the Drawings, unless otherwise approved by ENGINEER.
b. Record documents shall show piping with elevations referenced to the project datum and dimensions from permanent structures. For straight runs of pipe provide offset dimensions as required to document pipe location.
c. Include section drawings with exposed piping record documents when the Contract Documents include section Drawings.
d. Conform to Section 01 78 39, Project Record Documents.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery:
1. Deliver products to Site to ensure uninterrupted progress of the Work.
2. Upon delivery, inspect pipe and appurtenances for cracked, gouged, chipped, dented, and other damage and immediately remove damaged products from Site.
3. Conform to requirements of Section 01 65 00, Product Delivery Requirements.

B. Storage:
1. Store products for convenient access for inspection and identification. Store products off the ground using pallets, platforms, or other supports. Protect packaged products from corrosion and deterioration.
2. Pipe and fittings other than thermoplastic materials may be stored outdoors without cover. Thermoplastic pipe and fittings stored outdoors shall be covered.
3. Conform to requirements of Section 01 66 00, Product Storage and Handling Requirements.

C. Handling:
1. Handle pipe, fittings, specials, and accessories carefully with approved handling devices. Do not drop or roll material of delivery vehicles. Do not otherwise drop, roll, or skid piping.
2. Avoid unnecessary handling of pipe.
3. Keep pipe interiors free of dirt and foreign matter.
4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage. Repair damaged coatings.
5. Conform to requirements of Section 01 65 00, Product Delivery Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Piping materials are specified in the Exposed Piping Schedule at the end of this Section. Piping materials shall conform to Specification for each type of pipe and piping appurtenances in applicable sections of Division 40, Process Integration.

B. Markings and Identification:
   1. Pipe Markings:
      a. Clearly mark each piece of pipe or fitting with a designation conforming to that shown on the approved Shop Drawings.
      b. Manufacturer shall cast or paint on each length of pipe and each fitting the pipe material, diameter, and pressure or thickness class.
   2. Pipe Identification Markers and Arrows: Refer to Section 10 14 00, Signage.

C. Appurtenances: Provide products that comply with:
   1. Section 40 05 07, Pipe Hangers and Supports.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
   1. Install piping as shown, specified and as recommended by the pipe and fittings manufacturer.
   2. If there is a conflict between manufacturer's recommendations and the Contract Documents, request in writing instructions from ENGINEER before proceeding.
   3. Provide pipe manufacturer’s installation specialist at Site as specified on this Section.

B. Temporary Blind Flanges, Plugs, Caps, and Bulkheads:
   1. Temporarily plug installed pipe at the end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
   2. Install standard plugs in all bells at dead ends, tees, and crosses. Cap all spigot and plain ends.

3. Fully secure and block blind flanges, plugs, caps, and bulkheads installed for testing, designed to withstand specified test pressure.
4. Where plugging is required for phasing of Work or subsequent connection of piping, install watertight, permanent type blind flanges, plugs, caps, or bulkhead acceptable to ENGINEER.

C. Piping Installation:
1. Conform to manufacturer's instructions and requirements of standards and manuals listed in this Section, as applicable:
   a. Ductile Iron Pipe: ANSI/AWWA C600, AWWA M41.
   b. Steel Pipe: ASME B31.3, ANSI/AWWA C206, AWWA M11.
   c. Thermoplastic Pipe: AWWA M23
   d. Polyethylene Pipe: AWWA
2. Install straight runs true to line and elevation.
3. Install vertical pipe truly plumb in all directions.
4. Install piping parallel or perpendicular to walls of structures. Piping at angles and 45 degree runs across corners of structures will not be accepted unless specifically shown on the Contract Documents or approved by the ENGINEER.
5. Install small diameter piping generally as shown when specific locations and elevations are not indicated. Locate such piping as required to avoid ducts, equipment, beams, and other obstructions.
6. Install piping to leave all corridors, walkways, work areas, and similar spaces unobstructed. Unless otherwise approved by ENGINEER provide a minimum headroom clearance under piping and pipe supports of 7.5 feet. Clearances beneath piping shall be measured from the outermost edge of piping, flanges or other type of joint that extends beyond the nominal outside diameter of piping.
7. Protect and keep clean interiors, fittings, and valves of pipe that will convey potable water, chemicals, and other pipe designated by ENGINEER.
8. Cutting: Cut pipe from measurements verified at Site. Field cut pipe, where required, with a machine specially designed for cutting type of pipe being installed. Make cuts carefully without damage to pipe, coating, or lining, and with a smooth end at right angles to axis of pipe. Cut ends of push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.
9. Place bell and spigot-type pipe so that bells face the direction of laying, unless otherwise approved by ENGINEER.
10. Deflections at joints shall not exceed 75 percent of amount allowed by pipe manufacturer, unless otherwise approved by the Engineer.
11. Additional General Requirements for Thermoplastic Piping:
    a. Utilize wide band supports as recommended by pipe manufacturer and approved by ENGINEER to minimize localized stresses.
    b. Provide piping passing through walls with a sleeve of wearing material to prevent abrasion damage to piping.

c. Provide anchored supports at elbows, valves, bends in piping, and at connections to equipment and tanks.
d. Spacing of supports shall be in accordance with the manufacturer's published recommendations at maximum design operating temperature of pipe.
e. Provide U-clamps with wide band circumferential contact.
f. Provide guides on long runs of piping to maintain alignment and reduce chance of elastic failure of pipe. Space guides as recommended by pipe manufacturer.
g. Provide anchored supports to restrain joints that allow expansion. Minimize use of bellows style joints. Where required and approved by the ENGINEER provide bellows style joints with low axial force to take up pipe expansion. Flexible connectors may be used to absorb thermal movement when approved in writing by ENGINEER.
h. Provide devices that will reduce hydraulic pulsation in piping, together with shut-off and drain valve on all discharge lines of positive displacement pumps to reduce hydraulic hammer, and provide flexible connectors to absorb vibration. Submit details for ENGINEER to review.

D. Jointing Pipe:
1. General:
a. Make joints in accordance with pipe manufacturer’s recommendations and Contract Documents.
b. Cut piping accurately and squarely and install without forcing or springing.
c. Ream out pipes and tubing to full inside diameter after cutting. Remove all sharp edges on end cuts.
d. Remove all cuttings and foreign matter from inside of pipe and tubing before installation. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.
2. Ductile Iron Mechanical Joint Pipe:
a. Wipe clean the socket, plain end and adjacent areas immediately before making joint. Make certain that cut ends are tapered and sharp edges are filed off smooth.
b. Lubricate plain end and gasket with soapy water or pipe manufacturer’s recommended pipe lubricant, per ANSI/AWWA C111, just prior to slipping gasket onto plain end of joint assembly.
c. Place gland on plain end with lip extension toward plain end, followed by gasket with narrow edge of gasket toward the plain end.
d. Insert pipe into socket and press gasket firmly and evenly into gasket recess. Keep joint straight during assembly.
e. Push gland toward socket and center it around pipe with the gland lip against the gasket.
f. Insert bolts and hand tighten nuts.
g. Deflect joint only after assembled when approved by ENGINEER.

h. Make deflection after joint assembly, if approved by ENGINEER, but prior to tightening bolts. Alternately tighten bolts 180 degrees apart to seat the gasket evenly. Bolt torque shall be:

Pipe Diameter (inches)	Bolt Diameter (inches)	Range of Torque (ft-lbs)
3	5/8	45 to 60
4 to 24	3/4	75 to 90
30 to 36	1	100 to 120
42 to 48	1.25	120 to 150

3. Ductile Iron Push-On Joint Pipe:
   a. Prior to assembling joints, thoroughly clean with a wire brush the last eight inches of exterior surface of spigot and interior surface of bell, except where joints are lined or coated with a protective lining or coating.
   b. Wipe clean rubber gaskets and flex gaskets until resilient. Conform to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold temperatures.
   c. Insert gasket into joint recess and smooth out entire circumference of gasket to remove bulges and to prevent interference with proper entry of spigot of entering pipe.
   d. Immediately prior to joint assembly, apply a thin film of pipe manufacturer's recommended lubricant to surface of gasket that will come in contact with entering spigot end of pipe, or apply a thin film of lubricant to outside of spigot of entering pipe.
   e. For assembly, center spigot in pipe bell and push pipe forward until spigot just makes contact with the rubber gasket. After gasket is compressed and before pipe is pushed or pulled in the rest of the way, carefully check gasket for proper position around the full circumference of joint. Final assembly shall be made by forcing spigot end of entering pipe past gasket until spigot makes contact with the base of the bell. When more than a reasonable amount of force is required to assemble the joint, remove spigot end of pipe to verify proper positioning of gasket. Do not use gaskets that have been scored or otherwise damaged.
   f. Maintain an adequate supply of gaskets and joint lubricant at Site when pipe jointing is in progress.
4. Ductile Iron and Steel Flanged Joints:
   a. Assemble flanged joints using ring-type gaskets, with thickness as recommended by pipe manufacturer but not less than 1/8-inch thick, for raised-face flanges. Use full-face gaskets for flat-face flanges, unless otherwise approved by ENGINEER or recommended by pipe manufacturer. Gaskets shall be suitable for the service intended in accordance with the manufacturer's ratings and instructions. Gaskets shall be properly centered.

b. Tighten bolts in a sequence that provides equal distribution of bolt loads.
c. Length of bolts shall be uniform. Bolts shall not project beyond the nut more than 1/4-inch or fall short of the nut when fully taken up. Machine-cut ends of bolts to be neatly rounded. Do not use washers.
d. Prior to assembly of flanged joints, lubricate bolt threads and gasket faces.
e. Alternately tighten bolts 180 degrees apart to compress the gasket evenly.
f. After assembly, coat all bolts and nuts, except stainless steel bolts and nuts, with same coating specified in Section 09 91 00, Painting, for material of pipe and fittings being joined.

5. Thermoplastic Pipe Joints:
   a. Solvent Cement Welded Joints:
      1) Bevel pipe ends and remove all burrs before making joint. Clean pipe and fittings thoroughly. Do not make solvent cement joints if temperature is below 40 degrees F. Do not make solvent cement welded joints in wet conditions.
      2) Use solvent cement supplied or recommended by pipe manufacturer.
      3) Apply joint primer and solvent cement and assemble joints in accordance with recommendations and instructions of manufacturer of joint materials and pipe manufacturer.
      4) Implement appropriate safety precautions when using joint primers and solvent cements. Allow air to circulate freely through pipelines to allow solvent vapors to escape. Slowly admit fluid when flushing or filling pipelines to prevent compression of gases within pipes.
   b. Threaded Joints:
      1) Cut pipe square and smooth and remove burrs or raised edges with a knife or file.
      2) Hold pipe firmly in a pipe vise. Protect pipe at the point of grip by inserting a rubber sheet or other material between pipe and vise.
      3) Thread pipe in accordance with pipe manufacturer's recommendations. Brush threads clean of chips and ribbons.
      4) After threading pipe, starting with second full thread, and continuing over thread length, wrap 100-percent virgin TFE (Teflon) thread tape in direction of threads. Overlap each wrap by one-half width of tape.
      5) After application of the TFE thread tape, screw fitting or coupling onto the pipe end to be joined and tighten by hand. Using a strap wrench only, further tighten connection an additional one to two threads past hand tightness.
   c. Bell and Spigot Joints:
      1) Bevel pipe ends, remove all burrs, and provide a reference mark at correct distance from pipe end before making joint.

2) Clean spigot end and bell thoroughly before making the joint. Insert O-ring gasket while ensuring that gasket is properly oriented. Lubricate spigot with manufacturer's recommended lubricant. Do not lubricate bell and O-ring. Insert spigot end of pipe carefully into bell until reference mark on spigot is flush with bell.

6. Mechanical Coupling Joints:
   a. Mechanical couplings include: sleeve-type flexible couplings, split flexible couplings, ANSI/AWWA C606 grooved or shouldered end couplings, plasticized PVC couplings, and other mechanical couplings used.
   b. Prior to installing and assembling mechanical couplings, thoroughly clean joint ends with a wire brush to remove foreign matter.
   c. For mechanical couplings that incorporate gaskets, after cleaning apply lubricant to rubber gasket or inside of coupling housing and to joint ends. After lubrication, install gasket around joint end of previously installed piece and mate joint end of subsequent piece to installed piece. Position gasket and place coupling housing around gasket and over grooved or shouldered joint ends. Insert bolts and install nuts tightly by hand. Tighten bolts uniformly to produce an equal pressure on all parts of housing. When housing clamps meet metal to metal, joint is complete and further tightening is not required.
   d. For plasticized PVC couplings, loosen the stainless steel clamping bands and remove the clamps from the coupling. Slide the coupling over the plain ends of the pipes to be joined without using lubricants. Place clamps over each end of coupling at grooved section and tighten with a torque wrench to torque recommended by manufacturer.
7. HDPE Pipe Joints:
   a. Bell and Spigot Joints:
      1) Remove all burrs and provide a reference mark at correct distance from pipe end. Place mark such that no more than 1/2-inch of machined spigot surface will be visible outside of bell after pipe has been joined.
      2) Clean spigot end and bell thoroughly with soap and water before positioning gasket.
      3) Lubricate spigot groove with manufacturer's recommended lubricant. Thoroughly clean gasket and place in spigot groove starting at bottom, ensuring that gasket fins face backwards toward pipe.
      4) Thoroughly lubricate gasket with manufacturer's recommended lubricant and equalize stretch in the gasket by running a screwdriver under gasket around its entire circumference three times. Reposition gasket in groove after stretching.
      5) Thoroughly clean and lubricate the receiving bell. Align pipe as straight as possible and insert spigot end of pipe carefully into

bell until reference mark on spigot is flush with bell.

6) If mechanical means are used to insert spigot end, protect with wood the end of pipe being pushed, to ensure even distribution of pressure.

E. Installing Valves and Accessories:
   1. Provide supports for large valves, flow meters, and other heavy items as shown or required to prevent strain on adjoining piping.
   2. Position flow measuring devices in pipe lines so that they have the amount of straight upstream and downstream runs recommended by the flow measuring device manufacturer, unless specific location dimensions are shown.
   3. Position swing check valves and butterfly valves so that they do not conflict with upstream and downstream elements of the piping system.

F. Unions:
   1. Install dielectric unions as specified in Section 40 05 06, Couplings, Adapters, and Specials for Process Piping**,** where dissimilar metals are connected, except for bronze or brass valves in ferrous piping.
   2. Provide a union downstream of each valve with screwed connections.
   3. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.

G. Transitions from One Type of Pipe to Another:
   1. Provide all necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

H. Closures:
   1. Provide closure pieces, such as blind flanges and caps, shown or required to complete the Work.

3.3 THRUST RESTRAINT

A. Provide thrust restraint on all pressure piping systems and where otherwise shown or specified.

B. Thrust restraints shall be designed for axial thrust exerted by test pressure specified in the Exposed Piping Schedule at end of this Section.

C. Restrained Pipe Joints:
   1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.
      a. Ductile Iron, Push-on Joints and Mechanical Joints: Restrain with a proprietary restrained joint system as specified in Section 40 05 19. Ductile iron pipe, lugs, and tie rods, or other joint restraint systems

approved by ENGINEER. Restrain ductile iron pipe connected by flexible couplings or flanged coupling adapters by harnessing across the coupling or adapter using tie rods or extended bolts connecting between flanges.

b. Thermoplastic Joints: Where bell and spigot-type or other non-restrained joints are utilized, provide tie rods across the joint or other suitable joint restraint system, subject to approval of ENGINEER.

3.4 WORK AFFECTING EXISTING PIPING

A. Location of Existing Piping:
   1. Locations of existing piping shown on Drawings is approximate.
   2. Determine the true location of existing piping to which connections are to be made, crossed, and that could be disturbed, and determine location of other facilities that could be affected by the Work.

B. Taking Existing Pipelines Out of Service:
   1. Conform to Section 01 14 16, Coordination with Owner's Operations.

C. Work on Existing Pipelines:
   1. Cut or tap pipes as shown or required with machines and tools specifically designed for cutting or tapping pipelines.
   2. Install temporary plugs to prevent entry of mud, dirt, water, and debris into pipe.
   3. Provide necessary adapters, sleeves, fittings, pipe, and appurtenances required to complete the Work.
   4. Conform to applicable requirements of Section 01 14 16, Coordination with Owner's Operations and Section 01 73 24, Connections to Existing Facilities.

3.5 PAINTING

A. Field painting shall conform to Section 09 91 00, Painting.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Installation Specialist:
   1. Provide services of a competent installation specialist of the pipe manufacturer when pipe installation commences for:
      a. Ductile Iron Pipe
      b. Thermoplastic pipe.
   2. Retain installation specialist at Site for a minimum of 2 days (eight hours per day at the Site) or until competency of the pipe installation crew has been satisfactorily demonstrated to ENGINEER.

B. Testing, General:

1. Test all piping, except as exempted in the Exposed Piping Schedule.
2. Notification:
    a. Notify ENGINEER at least 48 hours prior to testing.
    b. When authorities having jurisdiction are to witness tests, notify ENGINEER and authorities having jurisdiction in writing at least 48 hours in advance of testing.
3. Conduct all tests in presence of ENGINEER.
4. Remove or protect pipeline-mounted devices that could be damaged by testing.
5. Provide all apparatus and services required for testing, including:
    a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain OWNER's operations.
    b. Temporary bulkheads, bracing, blocking, and thrust restraints.
6. Provide air if an air test is required, power if pumping is required, and gases if gases are required.
7. Unless otherwise specified, OWNER will provide fluid required for hydrostatic testing. CONTRACTOR shall provide means to convey fluid for hydrostatic testing into the pipe being tested. CONTRACTOR shall provide fluid for other types of testing required.
8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.

C. Test Schedule:
1. Refer to the Exposed Piping Schedule for type of test required and required test pressure.
2. Unless otherwise specified, the required test pressures are at lowest elevation of pipeline segment being tested.
3. For piping not listed in Exposed Piping Schedule:
    a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig. Provide process air pipe test for pipe that will convey air or gas under pressure or vacuum, except chlorine gas, which requires a separate test.
    b. Disinfect for bacteriological testing piping that conveys potable water.
4. Test Pressure:
    a. Use test pressures listed in Exposed Piping Schedule.
    b. If test pressure is not listed in Exposed Piping Schedule, or if a test is required for piping not listed in the Exposed Piping Schedule, test pressure will be determined by the ENGINEER based on the maximum anticipated sustained operating pressure and the methods described in the applicable ANSI/AWWA manual or standard that applies to the piping system.

D. Hydrostatic Testing:
1. Preparation for Testing:

a. For thermoplastic pipe, follow procedures described in Section 7 of ANSI/AWWA Standard C605.
b. For steel pipe, follow procedures described in AWWA Manual M11. Wetting period is not required for pipe that is not cement-lined.
c. For other piping follow procedures described in AWWA Manual M9. A wetting period is not required for pipe that is not cement mortar-lined.
d. Prior to testing, ensure that adequate thrust protection is in place and all joints are properly installed.

2. Test Procedure:
   a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in the pipe being tested.
   b. Expel air from pipe as required. Obtain approval of ENGINEER prior to tapping pipe for expelling air.
   c. Examine joints and valves, and make repairs to eliminate visible leakage.
   d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
   e. Timed test period shall not begin until after the pipe has been filled, exposed to the required wetting period, air has been expelled, and pressure stabilized.
   f. Timed Test Period: After the stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure. For HDPE pipe, after three hour expansion phase, reduce test pressure by ten psig and do not add liquid. The test pressure shall then remain steady for one hour, indicating no leakage.
   g. Pump from a test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at fifteen minute intervals for duration of test.

3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of the test pressure during timed test period. Allowable leakage rates for piping are:
   a. No Leakage: Pipe with flanged, welded, fused, threaded, soldered, or brazed joints.
   b. Rates based on formula or table in AWWA Manual M41:
      1) Metal pipe joined with rubber gaskets as sealing members, including the following joint types:
         a) Bell and spigot and push-on joints.
         b) Mechanical joints.
         c) Bolted sleeve type couplings.
         d) Grooved and shouldered couplings.
   c. Rates based on formula or table in ANSI/AWWA C605:
      1) Plastic pipe joined with O-ring gasket sealing members.

E. Process Air Pipe Testing:
   1. General:
      a. Required test pressure is listed in Exposed Piping Schedule.
   2. Preparation for Testing:
      a. Provide temporary tie rods at expansion joints as required.
      b. Verify that pipe supports, where present, are secure.
      c. Test one pipe segment at a time. Use temporary blind flanges and isolators as required.
      d. Install corporation cocks for filling and relieving air. Provide temporary automatic pressure relief valve and pressure gauge with range suitable for test pressure.
   3. Test Procedure:
      a. Pressurize pipe segment being tested with air to the required test pressure. Maintain pressure for at least two hours.
      b. Apply a soapy water solution to all joints to check for leakage, indicated by presence of bubbles, while test pressure is maintained.
      c. Allowable Leakage: Zero
   4. Repair and retest pipelines that fail the test.
   5. After testing is complete remove temporary measures provided for testing and provide Type 304 stainless steel threaded plugs at taps used for testing.

F. Examination of Welds:
   1. Personnel performing examination of welds shall be qualified to at least Level II, in accordance with ASNT SNT-TC-1A.
   2. Conform to ASME Boiler and Pressure Vessel Code Section V and applicable articles for examination of welds.
   3. Visually examine all welds, Category D Fluid Service, in conformance with ASME B31.3.
   4. Examine at least ten percent of welds using liquid penetrant examination.
   5. If a defect is detected, all welds shall be examined by liquid penetrant examination.
   6. At conclusion of liquid penetrant examination, remove penetrant test materials by flushing, washing, or wiping clean with applicable solvents.

3.7 CLEANING

A. Cleaning, General: Clean pipe systems as follows:
   1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in a manner approved by ENGINEER, prior to placing in service.
   2. For piping that requires disinfection and has not been kept clean during storage or installation, swab each section individually before installation with a five percent hypochlorite solution.

B. Cleaning of Air Piping:

1. Unless otherwise specified, air system piping 6-inch diameter and smaller shall be blown out, using air
2. After connecting to equipment, blow out pipe using the equipment.
3. Upon completion of cleaning, piping shall be drained and dried with blown air.

3.8 EXPOSED PIPING SCHEDULE

A. The schedules listed below, following the "End of Section" designation, are a part of this Specification section.
   1. Table 40 05 05-A, Exposed Piping Schedule.

+ + END OF SECTION + +

TABLE
40 05 05-A, EXPOSED PIPING SCHEDULE

Service	Diameter (inch)	Material	Interior Lining	Exterior Coating	Pressure Class/ Thickness	Test	Remarks
INF	4	DIP	CE	P	150 psi	HYD (125)	
EFF	6	DIP	--	P	150 psi	HYD (125)	
PA	1.25	SS	--	-	316	PA (110)	
PW	1.0 - 1.5	PVC	--	-	Schedule 80	HYD (125)	

The following abbreviations are used in the Exposed Piping Schedule.

A. Service Abbreviations

Service	Abbrev.
Potable Water	PW
Process Air	PA
Influent	INF
Effluent	EFF

B. Material Abbreviations

Material	Abbrev
Polyvinyl Chloride	PVC
Stainless Steel	SS
Steel Cylinder Pipe	SCP

C. Lining/Coating Abbreviations

Coating	Abbrev.
Painted	P
Galvanized	Galv
Ceramic Epoxy	CE

E. Test Abbreviations

Test	Abbrev
Hydrostatic Test (test pressure in psig)	HYD ( )
Process Air Pipe Test (test pressure in psig)	PA ( )

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SECTION 40 05 19

DUCTILE IRON PROCESS PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish ductile iron pipe and fittings.
   2. Extent of piping is shown on the Drawings. Piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, specify pipe service, diameter, material, lining, coating, pressure rating, joint type, and testing required.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before ductile iron pipe Work.

C. Related Sections:
   1. Section 09 91 00, Painting.
   2. Section 33 05 05, Buried Piping Installation.
   3. Section 40 05 05, Exposed Piping Installation.
   4. Section 40 05 31, Thermoplastic Process Pipe.
   5. Section 05 50 13, Miscellaneous Metal Fabrications.

1.2 REFERENCES

A. Standards referenced in this section:
   1. ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series.
   2. ANSI B18.2.2, Square and Hex Nuts. (Inch Series).
   3. ASTM A193, Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service
   4. ASTM A194, Specification for Carbon Steel and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
   5. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
   6. ASTM A354, Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners.
   7. ASTM A563, Specification for Carbon and Alloy Steel Nuts.

8. ASTM B117, Practice for Operating Salt Spray (Fog) Apparatus.
9. ASTM C283, Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
10. ASTM D714, Test Method for Evaluating Degree of Blistering of Paints.
11. ASTM D792, Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
12. ASTM D5162, Discontinuity (Holiday) Testing of Non-Conductive Protective Coating on Metallic Substrates.
13. ASTM E96, Test Methods for Water Vapor Transmission of Materials.
14. ASTM G14, Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test).
15. ASTM G62, Test Methods for Holiday Detection in Pipeline Coatings.
16. ASTM 95, Test Methods for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method).
17. ANSI/AWWA C104, Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
18. ANSI/AWWA C110, Ductile Iron and Gray Iron Fittings for Water.
19. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
20. ANSI/AWWA C115, Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.
21. ANSI/AWWA C116, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings for Water Service.
22. ANSI/AWWA C151, Ductile Iron Pipe, Centrifugally Cast, for Water.
23. ANSI/AWWA C153, Ductile Iron Compact Fittings, 3 inch through 24 inch and 54 inch through 64 inch for Water Service.
24. ANSI/AWWA C606, Grooved and Shouldered Type Joints.
25. European Standard (EN), EN 598: Ductile Iron Pipe, Fittings, Accessories and Their Joints for Sewerage Applications.
26. MSS-SP 60, Connecting Flange Joint Between Tapping Sleeves and Tapping Valves.
27. NACE RP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
28. NAPF 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.
29. NSF/ANSI 61, Drinking Water System Components - Health Effects.
30. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
31. SSPC Painting Manual, Volume 1, Para. XIV.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:

a. Manufacturer shall have a minimum of five years successful experience producing ductile iron pipe and fittings and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.

b. Lining and coating products shall be manufactured by a firm with a minimum of five years successful experience in protecting pipelines exposed to the specified service conditions , and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.

c. When not applied by the manufacturer, lining and coating Subcontractor shall have a minimum of five years successful experience in the application of the specified linings and coatings for similar applications for the specified service, and shall be able to show evidence of at least five installations in satisfactory operation in the United States.

B. Supply and Compatibility:

1. Unless otherwise approved, obtain all pipe, fittings, and appurtenances included in this Section from a single ductile iron pipe manufacturer.
2. Ductile iron pipe manufacturer shall review and approve or prepare all Shop Drawings and other submittals for pipe, fittings, and appurtenances furnished under this Section.
3. Pipe, fittings, and appurtenances shall be suitable for the specified service and shall be integrated into overall piping system by ductile iron pipe manufacturer.
4. Ductile iron pipe manufacturer shall be responsible for all products and all factory-applied linings and coatings, whether installed at pipe manufacturer's facility or at manufacturer's Supplier's facility.

C. Regulatory Requirements:

1. Pipe and fittings, including linings and coatings, that will convey potable water or water that will be treated to become potable, shall be certified by an accredited organization in accordance with NSF/ANSI 61 as being suitable for contact with potable water, and shall comply with requirements of authorities having jurisdiction at Site.

1.4 SUBMITTALS

A. Action Submittals: Submit the following with Shop Drawings required under Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation:

1. Shop Drawings:
   a. Certified detailed drawings and data for pipe, fittings, gaskets, appurtenances, linings, and coatings including the laying schedule and marking diagrams which indicate the specific number of each pipe and

fitting, the location and direction of lay of each pipe and fitting in the completed line.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Submit certificate signed by manufacturer of each product that product conforms to applicable referenced standards and the Contract Documents.
      b. Submit certificate signed by applicator of the linings and coatings stating that product to be applied conforms to applicable referenced standards and that the applicator shall conform to the Contract Documents.
   2. Source Quality Control Submittals:
      a. Submit results of specified shop tests for pipe, fittings, linings, and coatings.
      b. Lining and coating test coupons.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

B. Store pipes with wood lagging between pipes such that pipes do not make contact with one another

C. Handling of Pipe and Fittings Lined with Ceramic Epoxy, Fusion Bonded Epoxy, or Glass: Lifting devices shall not come into contact with lined surfaces. Use hooks, forks, chains, straps, and other lifting devices only on exterior of pipe and fittings. Pipe and fittings with damaged lining shall be replaced regardless of cause of damage.

D. Handling of Fittings Coated with Fusion Bonded Epoxy: Hooks, forks, chains, straps, and other lifting devices shall be rubber-coated and be used only on exterior of fittings in manner to avoid damaging coating. If coating becomes damaged, notify pipe and coating manufacturer to determine if repair of damaged area or re-coating is required. Perform repairs using recommended procedures and materials provided by manufacturer, as accepted by ENGINEER. Pipe and fittings requiring re-coating shall be removed from Site and returned to manufacturer's facility. Repaired or re-coated pipe and fittings shall comply with requirements of this Section.

PART 2 – PRODUCTS

2.1 MATERIALS

A. General:
   1. Piping systems shall be suitable for their intended use.
   2. Buried ductile pipe shall be encased with polyethylene sleeves as specified by AWWA C105 minimum 8 mil thick. For pipe 16" through 42"in diameter, two 8-mil layers shall be provided. Only prefabricated sleeves secured by 4-inch polyethylene tape will be allowed. Polyethylene sleeves shall be blue in color, manufactured, with ultraviolet inhibitors and installed by Method A in AWWA C105.
   3. Pipe shall be supplied in lengths not in excess of 20 feet.
   4. Joints shall be as specified in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation. If not specified, provide flanged joints for exposed piping and push-on or mechanical joints for buried piping. Provide couplings on pipe with plain or grooved ends where shown or where approved by ENGINEER.

B. Ductile Iron Pipe, Joints, and Fittings:
   1. Flanged Pipe: Fabricate in accordance with ANSI/AWWA C115.
      a. Pressure Rating: As specified in piping schedule in Section 40 05 05, Exposed Piping Installation. If not otherwise specified, use Special Thickness Class 53 for three-inch to 54-inch diameter pipe and Pressure Class 350 for 60-inch and 64-inch diameter pipe.
   2. Non-Flanged Pipe: Conform to ANSI/AWWA C151 for material, pressure, dimensions, tolerances, tests, markings, and other requirements.
      a. Pressure Class: As specified in piping schedules in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation. If not otherwise specified, use Pressure Class 150.
      b. Special Thickness Class: As specified in piping schedules in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation.
   3. Pipe Joints:
      a. Flanged Joints: Conform to ANSI/AWWA C110 and ANSI/AWWA C111 capable of meeting the pressure rating or special thickness class, and test pressure specified in piping schedule in Section 40 05 05, Exposed Piping Installation.
         1) Gaskets: Unless otherwise specified, gaskets shall be at least 1/8-inch thick, ring or full-face as required for the pipe, of synthetic rubber compound containing not less than 50 percent by volume nitrile or neoprene, and shall be free from factice, reclaimed rubber, and other deleterious substances. Gaskets shall be suitable for the service conditions specified, specifically designed for use with ductile iron pipe and fittings.
         2) Bolts: Comply with ANSI B18.2.1.
            a) Exposed: ASTM A307, Grade B.
            b) Buried or Submerged: ASTM A193, Grade B8M, Class 2, Heavy hex, Type 316 stainless steel.
         3) Nuts: Comply with ANSI B18.2.2.

a) Exposed: ASTM A563, Grade A, Heavy hex.
b) Buried or Submerged: ASTM A194, Grade B8M, Heavy hex, Type 316 stainless steel.

b. Mechanical Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure rating or special thickness class, and test pressure specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
1) Glands: Ductile iron.
2) Gaskets: Plain tip.
3) Bolts and Nuts: High strength, low alloy steel.
4) Manufacturers: Provide products of one of the following:
a) Clow Water Systems Company
b) Atlantic States Cast Iron Pipe Company
c) Canada Pipe Company, Ltd.
d) McWane Cast Iron Pipe Company
e) Pacific States Cast Iron Pipe Company
f) Griffin Pipe Products Co.
g) American Cast Iron Pipe Co.
h) U.S. Pipe and Foundry Co.
i) Or equal.

c. Push-On Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure class or special thickness class, and test pressure specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
1) Gaskets: Vulcanized SBR, unless otherwise specified.
2) Stripes: Each plain end shall be painted with a circular stripe to provide a guide for visual check that joint is properly assembled.
3) Products and Manufacturers: Provide one of the following:
a) Tyton or Fastite Joint by Clow Water Systems, Atlantic States Cast Iron Pipe Company, Canada Pipe Company, Ltd., McWane Cast Iron Pipe Company, Pacific States Cast Iron Pipe Company, and Griffin Pipe Products Company.
b) Fastite Joint by American Cast Iron Pipe Company.
c) Tyton Joint by U.S. Pipe and Foundry Company.
d) Or equal.

d. Grooved End Joints: Comply with ANSI/AWWA C606.
1) Gaskets: Flush seal type designed for ductile iron that complies with or exceeds requirements of ASTM D2000
2) Bolts and nuts: As specified for flanged joints.
3) Unless otherwise specified, grooved end couplings shall be rigid joint for exposed service and flexible joint for buried service.
4) Products and Manufacturers: Provide one of the following:
a) Victaulic, Style 31.
b) Or equal.

e. Restrained Joints: Restrained push-on joints shall be capable of being deflected after full assembly. Field cuts of restrained pipe are not allowed without approval of ENGINEER.
   1) Products and Manufacturers: Provide restrained joints for mechanical joint piping by one of the following:
      a) Megalug, Series 1100, by EBBA Iron Sales, Inc.
      b) MJ Coupled Joint, by American Cast Iron Pipe Co.
      c) MJ Field Lok, by U.S. Pipe and Foundry Co.
      d) Or equal.
   2) Products and Manufacturers: Provide restrained joints for push-on joint piping by one of the following:
      a) Super-Lock Joint Pipe, by Clow Water Systems, a division of McWane, Inc.
      b) Lok-Ring Joint, or Flex-Ring Joint, by American Cast-Iron Pipe Company.
      c) TR Flex Joint, by U.S. Pipe and Foundry Company.
      d) Snap-Lok, by Griffin Pipe Products Company.
      e) Or equal.

4. Flanged and Push-On Joint Fittings: Comply with ANSI/AWWA C110 and ANSI/AWWA C111.
   a. Material: Ductile iron.
   b. Pressure rating, gaskets, bolts, and nuts shall be as specified for flanged joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of the connected pipe.
5. Mechanical Joint Fittings: Comply with ANSI/AWWA C110 and ANSI/AWWA C111.
   a. Material: Ductile iron.
   b. Glands: Ductile iron.
   c. Pressure rating, gaskets, bolts, and nuts shall be as specified for mechanical joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of connected pipe.

6. SLEEVE-TYPE COUPLINGS
   a. General
      1) Provide sleeve-type couplings where indicated.
      2) The CONTRACTOR will not be allowed to substitute a sleeve-split coupling, or any other type in lieu of sleeve coupling unless approved by the ENGINEER.
   b. Construction
      1) Sleeve couplings shall be in accordance with AWWA C219 - Standard for Bolted Sleeve-Type Couplings for Plain-End Pipe.
      2) Couplings shall be constructed of steel with steel bolts, without pipe stop.
      3) Couplings shall be of sizes to fit the indicated pipe and fittings.

4) The middle ring shall be not less than 1/4-inch thick or at least the same wall thickness as the pipe to which the coupling is connected.
5) If the strength of the middle ring material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe.
6) The coupling shall be either 5 or 7 inches long for sizes up to and including 30-inch and 10 inches long for sizes greater than 30-inch, for standard steel couplings, and 16 inches long for long-sleeve couplings.
7) The followers shall be single-piece contoured mill sections welded and cold· expanded as required for the middle rings, and of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling.
8) The shape of the follower shall be of such design as to provide positive confinement of the gasket.
9) Bolts and nuts shall be in accordance with the requirements of Section 05 50 13 - Miscellaneous Metal Fabrications.
10) Buried sleeve-type couplings shall be epoxy-coated at the factory as indicated.

c. Pipe Preparation
1) Where indicated, prepare the ends of the pipe for flexible steel couplings.
2) Plain ends for use with couplings shall be smooth and round for a distance of 12 inches from the ends of the pipe, with an outside diameter not more than 1/64 inch smaller than the nominal outside diameter of the pipe.
3) The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, in order to proof-test the weld to the strength of the parent metal.
4) The weld of the middle ring shall be subjected to air test for porosity.

d. Gaskets
1) Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions.
2) Gaskets for wastewater and sewerage applications shall be composed of Buna N, Grade 60, or equivalent suitable elastomer.
3) The rubber in the gasket shall meet the following specifications:
   a) Color: jet black
   b) Surface: non-blooming
   c) Durometer Hardness: 74, plus and minus 5
   d) Tensile Strength: 1000 psi minimum
   e) Elongation: 175 percent minimum
4) The gaskets shall be immune to attack by impurities normally found in water or wastewater.

5) Gaskets shall meet the requirements of ASTM D 2000 - Classification System for Rubber Products in Automotive Applications, AA709Z, meeting Suffix 813 Grade 3, except as indicated above.
6) Where sleeve couplings are used in water containing chloramine or other fluids which attack rubber materials, gasket material shall be compatible with the piping service and fluid utilized.
7) Gasket materials used in water with chloramines shall be: Gylon Style 3500 by Garlock; by Crane; or equal.

e. Piping Connection to Equipment
1) Where piping connects to mechanical equipment such as pumps, compressors, and blowers, bring the piping to the equipment connection aligned and perpendicular to the axis of the flange or fitting for which the piping is to be connected.
2) The piping shall not impose excessive stress to the equipment connection to cause misalignment of the equipment.
3) The CONTRACTOR shall assign the responsibility to the equipment manufacturer to review the piping connection to the equipment and submit any modifications to the ENGINEER for review.

f. Insulating Sleeve Couplings
1) Where insulating couplings are required, both ends of the coupling shall be provided with a wedge-shaped gasket, which assembles over a sleeve of an insulating compound material compatible with the fluid service in order to obtain insulation of coupling metal parts from the pipe.

g. Restrained Joints
1) Sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means.
2) Harnesses shall be designed by the pipe manufacturer in accordance with AWWA Manual M11, or as indicated.
3) Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed.
4) Where harness sets are installed near the suction and discharge of the pump, harness bolts shall have zero elongation in order to prevent misalignment of the pump imparted by the thrust within the piping system.

h. Sleeve-Type Couplings Manufacturer, or Equal
1) Dresser, Style 38
2) Ford Meter Box Co., Inc., Style FC1or FC3
3) Smith-Blair, Style 411

7. FLANGED COUPLING ADAPTERS
a. Provide flanged coupling adapters where indicated.
b. The CONTRACTOR will not be allowed to substitute any other type in lieu of flange coupling adapter unless approved by the ENGINEER.
c. The coupling shall be rated as indicated.

d. Construction
   1) Flanged coupling adapter bodies shall be fabricated from steel,ASTM A 512 - Cold- Drawn Buttweld Carbon Steel Mechanical Tubing or A 513 - Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing with steel bolts, without pipe stop.
   2) Provide flanges in conformance with AWWA C207.
   3) Couplings shall be of sizes to fit the indicated pipe and fittings.
   4) The body shall be not less than 1/4 inch thick or at least the same wall thickness as the pipe to which the coupling is connected.
   5) If the strength of the body materialis less than the strength of the pipe material,the thickness of the middle ring shall be increased to have the same strength as the pipe.
   6) The follower flange shall be fabricated from steel, ASTM A 576 - Steel Bars, Carbon, Hot Wrought, Special Quality or AISI C1012.
   7) The shape of the follower shall be of such design as to provide positive confinement of the gasket.

   8) Restraint
      a) For flanged coupling adapters installed in piping system rated for positive pressure, the coupling shall be restrained with harness bolts or tie rods.
      b) Other means of restraining the coupling such as set screws will not be accepted.·
   9) Bolts and nuts shall be in accordance with the requirements of Section 05 50 13 - Miscellaneous Metal Fabrications.
   10) Buried couplings shall be epoxy-coated at the factory as indicated.

e. Gaskets
   1) Gaskets for flange coupling adapters shall be composed of a rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions.
   2) Gaskets for wastewater and sewerage applications shall be composed of Buna N, Grade 60, NSF-approved, or equivalent suitable elastomer.
   3) The rubber in the gasket shall meet the following specifications:
      a) Color: jet black
      b) Surface: non-blooming
      c) Durometer Hardness: 74, plus and minus 5
      d) Tensile Strength: 1000 psi minimum
      e) Elongation: 175 percent minimum
   4) The gaskets shall be immune to attack by impurities normally found in water or wastewater.
   5) Gaskets shall meet the requirements of ASTM D 2000 - Classification System for Rubber Products in Automotive Applications, AA709Z, meeting Suffix 813 Grade 3, except as noted above.

6) Where flanged coupling adapters are used in water containing chloramine or other fluids which attack rubber materials, the gasket material shall be compatible with the piping service and fluid utilized.
7) Gasket materials used in water with chloramines shall be Gylon Style 3500 by Garlock; by Crane; or equal.

f. Piping Connections to Equipment
1) Where piping connects to mechanical equipment such as pumps, compressors, and blowers, bring the piping to the equipment connection aligned and perpendicular to the axis of the flange or fitting for which the piping is to be connected.
2) The piping shall not impose excessive stress to the equipment connection to cause misalignment of the equipment.
3) The CONTRACTOR shall assign the responsibility to the equipment manufacturer to review the piping connection to the equipment and submit any modifications to the ENGINEER for review.

g. Restrained Joints
1) Flange coupling adapters on pressure lines shall be harnessed unless thrust restraint is provided by other means.
2) Harnesses shall be designed by the pipe manufacturer in accordance with AWWA Manual M11,or as indicated.
3) Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed.
4) Where harness sets are installed near the sucti9n and discharge of the pump, harness bolts shall have zero elongation in order to prevent misalignment of the pump imparted by the thrust within the piping system.

h. Flanged Couplings Adapter Manufacturer,or Equal
1) Smith-Blair, Model 975
2) JCM,Model 309

8. FLEXIBLE CONNECTORS
a. Low-Temperature
1) Flexible connectors shall be installed in piping connections to engines, blowers, compressors, and other vibrating equipment, and where indicated.
2) Flexible connectors for service temperatures up to 180 degrees F shall be flanged- reinforced neoprene or butyl spools, rated for a working pressure of 40 to 150 psig, or reinforced flanged duck and rubber, as best suited for the application.
3) Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for a minimum 150-psig working pressure, unless otherwise indicated.
4) The connectors shall be a minimum of 9 inches long and provided with face-to-face flanges, unless otherwise indicated.

5) The final material selection shall be approved by the manufacturer.
6) The CONTRACTOR shallsubmit Shop Drawings and calculations.

b. High-Temperature
1) Install flexible connectors in engine exhaust piping and where indicated.
2) Connectors shall be sufficient to compensate for thermal expansion and contraction and to isolate vibration between the engine and the exhaust piping system.
3) Connectors shall be stainless steel bellows-type, flanged, and rated for minimum 150 psig, 2000 degrees F.

9. EXPANSION JOINTS
a. Piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement without exertion of undue forces to equipment or structures, accomplished with expansion loops, bellow-type expansion joints, or sliding- type expansion joints.
b. Expansion joints shall be provided with flanged ends and constructed of stainless steel, Monel, rubber, or other materials best suited for each individual service.
c. Submit detailed calculations and manufacturer's Shop Drawings of proposed expansion joints, piping layouts, and anchors and guides, including information on materials, temperature, and pressure ratings

10. MODULAR MECHANICAL SEALS FOR PIPING PENETRATIONS
a. Where indicated and where required in order to prevent flow of water or air, the passages of piping through wall sleeves and cored openings shall be sealed with modular interlocking link mechanical closures.
b. Individual links shall be constructed of EPDM rubber, be suitable for temperatures between minus 40 and plus 250 degrees F, and be shaped to fill the annular space between the outside of the pipe and the inside of the wall sleeve or cored opening.
c. Assemble the links using Type 316 stainless steel bolts and nuts to form a continuous rubber belt around the pipe.
d. Pressure plates under each bolt and nut shall be fabricated of a corrosion-resistant composite material.
e. After the seal assembly is positioned in the sleeve, tighten the bolts against the pressure plates to expand the rubber links and form the watertight seal.
f. Sizing and installation of sleeves and assemblies shall be in accordance with the manufacturer's recommendations.
g. Modular Mechanical Seals Manufacturer, or Equal
1) Thunderline Corporation,Link.Seal

C. Lining, General:
1. See Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
2. Surface Preparation:

a. Initial Surface Inspection: Surface to be lined shall be inspected by pipe and fitting manufacturer and applicator, if applicator is other than pipe and fitting manufacturer. Inspecting parties shall inspect surface to be coated and mutually determine recommended surface preparation method.
b. Surface Preparation: Prepare surface in accordance with recommended method.
c. Finished Surface Inspection: Lining applicator shall inspect finished surface prior to application to determine acceptability. If surface is unacceptable, repeat surface preparation as necessary.

D. Cement-mortar Lining:
1. Where specified in piping schedules included with Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation, pipe and fittings shall be lined with bituminous seal coated cement-mortar lining in accordance with ANSI/AWWA C104.

E. Ceramic Quartz-Filled, Amine-Cured Novalac Epoxy Lining:
1. Where specified in piping schedules included with Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation, pipe and fittings shall be factory lined with a quartz-filled, amine-cured, novalac, epoxy containing at least twenty percent by volume of ceramic quartz pigment.
2. Ceramic epoxy lining shall have a permeability rating of zero when tested according to Method A of ASTM E96, Procedure A, with a test duration of thirty days.
3. Conduct the following tests on coupons from factory lined ductile iron pipe:
a. ASTM B117 Salt Spray (scribed panel): Results to equal zero undercutting after two years.
b. ASTM G95 Cathodic Disbondment 1.5 volts at 77 degrees F: Results to equal no more than 0.5 mm undercutting after thirty days.
c. Immersion Testing rated using ASTM D714.
1) Twenty Percent Sulfuric Acid: No effect after two years.
2) Twenty-five Percent Sodium Hydroxide at 140 degrees F: No effect after two years.
3) Distilled Water at 160 degrees F: No effect after two years.
4) Tap Water at 120 degrees F (scribed panel): Zero undercutting after two years, with no effect.
4. Ceramic epoxy lining shall have abrasion resistance of no more than four mils loss after one million cycles, in accordance with ES EN 598, Section 7.8, Abrasion Resistance.
5. Within eight hours of surface preparation, interior of pipe and fittings shall receive 40 mils dry film thickness, utilizing method recommended by lining manufacturer that will comply with requirements of this Section. Number of coats applied shall be as recommended by lining manufacturer.

Minimum substrate and ambient temperature for lining application shall be 40 degrees F.

6. Inspection and Certification:
   a. Check all ductile iron pipe and fitting linings for thickness using magnetic film thickness gage in accordance with method in SSPC PA 2 Film Thickness Rating.
   b. Test interior lining of pipe barrels and fittings for pinholes with non-destructive, 2,500-volt test. Defects found shall be repaired in accordance with lining manufacturer's recommendations prior to shipment from lining applicator's factory.
   c. Mark each pipe and fitting with date of application and its numerical sequence of application.
7. Products and Manufacturers: Provide one of the following:
   a. Protecto 401 Ceramic Epoxy.
   b. Or equal.

F. Specials:
   1. Transition Pieces:
      a. Provide suitable transition pieces (adapters) for connecting to existing piping.
      b. Unless otherwise shown or indicated, expose existing piping to determine material, dimensions, and other data required for transition pieces.
   2. Taps:
      a. Provide taps where shown or required for small-diameter piping or instrumentation connections.
      b. Where pipe wall thickness or tap diameter will not allow engagement of full threads, provide tapping saddle with outlet joints conforming to requirements of Paragraph 2.1.B.3.a of this Section for four-inch through 12-inch diameter pipe, and Paragraph 2.1.B.3.b. for 14-inch through 54-inch diameter pipe.
      c. For flanged connections on tapping saddle outlet branch, counterbore flange in accordance with MSS SP-60 dimensions. Inside diameter of outlet shall be 1/4-inch greater than nominal diameter.

2.2 MARKING FOR IDENTIFICATION

A. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify push-on joint and mechanical joint pipe with:
   1. Name or trademark of manufacturer.
   2. Weight, class or nominal thickness, and casting period.
   3. Country where cast.
   4. Year the pipe was produced.
   5. Letters "DI" or "Ductile" shall be cast or metal stamped

B. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify flanged pipe with:
   1. Flange manufacturer's mark, size, and letters "DI" cast or stamped on the flanges.
   2. Fabricator's mark if other than flange manufacturer.
   3. Length and weight.

C. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify fittings with:
   1. Manufacturer's identification.
   2. Pressure rating.
   3. Nominal diameters of openings.
   4. Country where cast.
   5. Number of degrees or fraction of the circle on bends.
   6. Letters "DI" or "Ductile" cast on them.

2.3 EXTERIOR SURFACE PREPARATION AND COATINGS

A. General Coating Requirements:
   1. Coating types are specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

B. Exposed Pipe and Fittings:
   1. Surface Preparation:
      a. Initial Surface Inspection: Pipe and fitting manufacturer and coating applicator shall inspect surface to be coated and mutually determine recommended NAPF 500-03 surface preparation method.
      b. Surface Preparation: Prepare surface in accordance with recommended NAPF 500-03 method.
      c. Finished Surface Inspection: Prepared surfaces shall be inspected by coating applicator prior to application to determine acceptability of finished surface. If surface is unacceptable, repeat surface preparation and re-application as necessary.
   2. After recommended surface preparation, prime coat exterior ferrous metal surfaces of pipe and fittings in the shop in accordance with Section 09 91 00, Painting.
   3. Field painting shall comply with Section 09 91 00, Painting.

C. Buried Pipe and Fittings:
   1. Asphaltic Coating: Where specified in piping schedule in Section 33 05 05, Buried Piping Installation, coat pipe and fittings with an asphaltic coating approximately one-mil thick, in accordance with

ANSI/AWWA C151, ANSI/AWWA C115, ANSI/AWWA C110, and ANSI/AWWA C153, as applicable.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect piping to assure that piping is free from defects in material and workmanship. Verify compatibility of pipe, fittings, gaskets, linings, and coatings.

3.2 INSTALLATION AND FIELD QUALITY CONTROL

A. For buried piping installation and testing, refer to Section 33 05 05, Buried Piping Installation.

B. For exposed piping installation and testing, refer to Section 40 05 05, Exposed Piping Installation.

+ + END OF SECTION + +

SECTION 40 05 31

THERMOPLASTIC PROCESS PIPE (PVC)

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install thermoplastic piping and fittings.
   2. Extent of piping is shown and shall be in accordance with piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before thermoplastic piping Work.

C. Related Sections:
   1. Section 33 05 05, Buried Piping Installation.
   2. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. AASHTO, Standard Specifications for Highway Bridges.
   2. ASTM D1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
   3. ASTM D1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
   4. ASTM D2464, Specification for Threaded Poly (Vinyl Chlorinated) (PVC) Plastic Pipe Fittings, Schedule 80.
   5. ASTM D2466, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
   6. ASTM D2467, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   7. ASTM D2564, Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
   8. ASTM D2665, Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
   9. ASTM D683, Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

10. ASTM D3034, Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
11. ASTM D3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
12. ASTM D3212, Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
13. ASTM D3311, Specification for Drain, Waste and Vent (DWV) Plastic Fittings Patterns.
14. ASTM D3350, Specification for Polyethylene Plastic Pipe and Fittings Materials.
15. ASTM D4101, Specification for Polypropylene Injection and Extrusion Materials.
16. ASTM F477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
17. ASTM F656, Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
18. ASTM F679, Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
19. ASTM F714, Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
20. ASTM F1055, Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
21. ASTM F1336, Specification for Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings.
22. ASTM F1674, Standard Test Method for Joint Restraint Products for Use with PVC Pipe.
23. ASTM F1760, Specification for Coextruded Poly (Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content.
24. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In.-12 In. (100 mm-300 mm), for Water Transmission and Distribution
25. AWWA C907, Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm).
26. NSF 14, Plastic Piping Systems Components and Related Material.
27. ANSI/NSF 61, Drinking Water System Components - Health Effects.
28. Standards of U.S. Food and Drug Administration.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Shall have a minimum of five years experience producing thermoplastic pipe and fittings substantively similar to the materials specified, and shall be able to submit documentation of satisfactory service in at least five completed installations in operation for at least five years each.
   2. Installer:

a. Engage a single pipe installer who shall be responsible for all thermoplastic pipe Work, and who shall employ only tradesmen with specific skills and experience in the type of Work required.
b. Installer shall have a minimum of five years experience installing thermoplastic pipe and fittings substantively similar to the materials specified and substantively similar to or larger than the scope of thermoplastic piping Work on the Project, and shall be able to submit documentation of satisfactory experience in at least five completed installations in operation for at least five years each.

B. Component Supply and Compatibility:
1. Obtain all materials included in this Section, regardless of component Supplier, from a single thermoplastic pipe Supplier. All pipe of each material type shall be furnished by the same manufacturer.
2. Thermoplastic pipe Supplier shall review and approve to prepare all Shop Drawings and other submittals for all materials furnished under this Section.
3. Materials shall be suitable for specified service conditions and shall be integrated into overall assembly by thermoplastic pipe Supplier.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
a. Submit piping layout Shop Drawings in accordance with Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
2. Product Data:
a. Submit product data on pipe, fittings, gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract Documents.

B. Informational Submittals: Submit the following:
1. Certificates:
a. Submit manufacturer's certificate of compliance standards referenced in this Section.
2. Source Quality Control Submittals:
a. When requested by ENGINEER, submit results of source quality control tests.
3. Qualifications Statements:
a. Submit qualifications of manufacturer when requested by ENGINEER.
b. Submit qualifications of installer when requested by ENGINEER.

1.5 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 SERVICE CONDITIONS

A. General:
   1. Pipe materials shall be suitable for services intended. Refer to piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
   2. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, and other defects. Unless otherwise shown or indicated, pipe shall be uniform in color, opacity, density, and other physical properties.
   3. Comply with NSF 14.
   4. Buried pipe shall be capable of withstanding external live load, including impact, equal to AASHTO H-20 loading, with cover shown or indicated on the Drawings.

2.2 POLYVINYL CHLORIDE (PVC) PIPING

A. PVC Pipe – General Applications: Unless otherwise shown or indicated, PVC pipe shall comply with the following:
   1. Manufacturers: Provide products of one of the following:
      a. Ipex, Inc.
      b. Spears Manufacturing Company.
      c. JM Eagle.
      d. Or approved equal.
   2. Material: Unless otherwise specified, comply with the following:
      a. Type and Grade: Type 1, Grade 1.
      b. Wall Thickness: Schedule 80 complying with ASTM D1784 and ASTM D1785, and US Product Service PS 21-70 as having same outside diameter dimension as cast-iron pipe.
      c. Temperature Rating: Rated for temperature to 140 degrees F.
      d. Color: Gray.
   3. Fittings: Type, grade, schedule, and color of fitting shall match the associated pipe.
      a. Solvent Weld: Comply with ASTM D2467.
      b. Threaded: Threaded fittings shall comply with ASTM D2464.
      c. Flanged: Provide flanged fittings with Neoprene gaskets.
   4. Joints:
      a. Solvent Weld: Use primer and solvent cement recommended by PVC pipe manufacturer for the application. Primer shall be in accordance with ASTM F656, and solvent cement shall be in accordance with ASTM D2564.

b. Threaded: Use 100 percent virgin polytetrafluoroethylene (Teflon or PTFE) tape for threaded fittings. Pipe shall not be threaded.
c. Flanged: Provide with backup flange minimum 1/8-inch thick. Backup flanges and connecting bolts shall be Type 304 stainless steel.

B. Buried PVC Pressure Pipe:
1. Manufacturers: Provide products of one of the following:
a. Ipex, Inc.
b. Diamond Plastics Corp.
c. JM Eagle.
d. Or approved equal.
2. Material:
a. Pipe shall comply with AWWA C900 or AWWA C905 (as applicable).
b. Material shall comply with ASTM D1784.
c. Wall Thickness: SDR 18.
d. Fabricate pipe with cast-iron pipe equivalent outside diameter.
3. Fittings:
a. Fittings shall be ductile iron, mechanical joint meeting ANSI/AWWA C153AA21/53 with protective interior ceramic coating as specified herein.
b. Lining:
a) Surface Preparation
1) Initial Surface Inspection: Surface to be lined shall be inspected by pipe and fitting manufacturer and applicator, if applicator is other than pipe and fitting manufacturer. Inspecting parties shall inspect surface to be coated and mutually determine recommended surface preparation method.
2) Surface Preparation: Prepare surface in accordance with recommended method.
3) Finished Surface Inspection: Lining applicator shall inspect finished surface prior to application to determine acceptability. If surface is unacceptable, repeat surface preparation as necessary.
b) Ceramic Quartz-Fille, Amine-Cured Novalac Epoxy Lining:
1) Where specified in piping schedules included with Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation, pipe and fittings shall be factory lined with a quartz-filled, amine-cured, novalac, epoxy containing at least twenty percent by volume of ceramic quartz pigment.
2) Ceramic epoxy lining shall have a permeability rating of zero when tested according to Method A of ASTM E96, Procedure A, with a test duration of thirty days.
3) Conduct the following tests on coupons from factory lined ductile iron pipe:

a. ASTM B117 Salt Spray (scribed panel): Results to equal zero undercutting after two years.
b. ASTM G95 Cathodic Disbondment 1.5 volts at 77 degrees F: Results to equal no more than 0.5 mm undercutting after thirty days.
c. Immersion Testing rated using ASTM D714.
1) Twenty Percent Sulfuric Acid: No effect after two years.
2) Twenty-five Percent Sodium Hydroxide at 140 degrees F: No effect after two years.
3) Distilled Water at 160 degrees F: No effect after two years.
4) Tap Water at 120 degrees F (scribed panel): Zero undercutting after two years, with no effect.

4) Ceramic epoxy lining shall have abrasion resistance of no more than four mils loss after one million cycles, in accordance with ES EN 598, Section 7.8, Abrasion Resistance.
5) Within eight hours of surface preparation, interior of pipe and fittings shall receive 40 mils dry film thickness, utilizing method recommended by lining manufacturer that will comply with requirements of this Section. Number of coats applied shall be as recommended by lining manufacturer. Minimum substrate and ambient temperature for lining application shall be 40 degrees F.
6) Inspection and Certification:
a. Check all ductile iron pipe and fitting linings for thickness using magnetic film thickness gage in accordance with method in SSPC PA 2 Film Thickness Rating.
b. Test interior lining of pipe barrels and fittings for pinholes with non-destructive, 2,500-volt test. Defects found shall be repaired in accordance with lining manufacturer's recommendations prior to shipment from lining applicator's factory.
c. Mark each pipe and fitting with date of application and its numerical sequence of application.
7) Products and Manufacturers: Provide one of the following:
a. Protecto 401 Ceramic Epoxy.
b. Or equal.

c. Coating
1) Asphaltic Coating: Where specified in piping schedule in Section 33 05 05, Buried Piping Installation, coat pipe and fittings with an asphaltic coating approximately one-mil

thick, in accordance with ANSI/AWWA C151, ANSI/AWWA C115, ANSI/AWWA C110, and ANSI/AWWA C153, as applicable.

4. Joints:
   a. Provide bell and spigot joints. Bell shall consist of an integral wall section to hold securely in place (and prevent displacement during assembly of joint) elastomeric O-ring gasket.
   b. Jointing lubricant shall be as recommended by pipe manufacturer.
   c. Provide elastomeric gaskets complying with ASTM F477 and ASTM D3139.
   d. Restrained Joints: Provide restrained joints where shown or indicated.
      1) Comply with Section 33 05 05, Buried Piping Installation.
      2) Proprietary Joint Systems: Comply with ASTM F1674. Provide restrained joint system by one of the following for bell and spigot joint PVC piping:
         a) Ebaa Iron Sales, Inc.: Series 1500 and Series 1600 Restraint Harness for C900 Pipe; Megalug Series 2500, 2800, and 1100HV Restraint Harness for C905 Pipe.
         b) PV-LOK Series, by Sigma Corp.
         c) Or equal.

C. PVC Drain, Waste, and Vent (PVC-DWV) Pipe.
   1. Manufacturers: Provide products of one of the following:
      a. Chemtrol, manufactured by Nibco, Inc.
      b. Spears Manufacturing Company.
      c. Or equal.
   2. Material: In accordance with ASTM D1784. Unless otherwise shown or indicated, PVC-DWV pipe shall be:
      a. Type and Grade: Type 1, Grade 1.
      b. Wall Thickness: Schedule 40.
      c. Color: White.
   3. Fittings: Manufactured in accordance with ASTM D2665 and ASTM D3311.
      a. Solvent weld.
      b. Spigot.
   4. Joints:
      a. Solvent weld.
      b. Threaded.

2.3 IDENTIFICATION

A. Pipe material identification requirements are in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

2.4 SOURCE QUALITY CONTROL

A. Shop Tests:
   1. Pipe manufacturer shall maintain continuous quality control program.
   2. Where applicable and when requested by ENGINEER, submit results of source quality control tests specified in reference standards.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect pipe materials for defects in material and workmanship. Verify compatibility of pipe and fittings.

3.2 INSTALLATION

A. For buried piping installation, refer to Section 33 05 05, Buried Piping Installation.

B. For exposed piping installation, refer to Section 40 05 05, Exposed Piping Installation.

+ + END OF SECTION + +

SECTION 40 05 33

HIGH DENSITY POLYETHYLENE PROCESS PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, test, and place in satisfactory service the High Density Polyethylene (HDPE) process pipe and fittings as shown.
   2. The extent of HDPE pipe and fittings to be furnished is shown and in the piping schedules included in Section 33 05 05, Buried Piping Installation.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, the HDPE process pipe Work.

C. Related Sections:
   1. Section 31 20 00, Earth Moving.
   2. Section 03 00 05, Concrete.
   3. Section 09 91 00, Painting.
   4. Section 33 05 05, Buried Piping Installation.
   5. Section 40 05 53, Process Valves, 4-inch Diameter and Larger.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Society for Testing and Materials, Inc., (ASTM).
      a. ASTM D 638, Test Method for Tensile Properties of Plastics.
      b. ASTM D 696, Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics between - 30°C and 30°C with a Vitreous Silica Dilatometer.
      c. ASTM D 746, Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
      d. ASTM D 790, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
      e. ASTM D 1238, Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.

f. ASTM D 1248, Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
g. ASTM D 1505, Test Method for Density of Plastics by the Density-Gradient Technique.
h. ASTM D 1525, Test Method for Vicat Softening Temperature of Plastics.
i. ASTM D 1598, Test Method for Time-to-Failure of Plastic Pipe under Constant Internal Pressure.
j. ASTM D 1599, Test Method for Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings.
k. ASTM D 1603, Test Method for Carbon Black in Olefin Plastics.
l. ASTM D 1693, Test Method for Environmental Stress-Cracking of Ethylene Plastics.
m. ASTM D 2122, Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
n. ASTM D 2240, Test Method for Rubber Property-Durometer Hardness.
o. ASTM D 2290, Test Method for Apparent Hoop Tensile Strength of Plasticor Reinforced Plastic Pipe by Split Disk Method.
q. ASTM D 2412, Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
r. ASTM D 2657, Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
s. ASTM D 2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
t. ASTM D 2837, Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
u. ASTM D 3035, Specification for Polyethylene (PE) Plastic Pipe (DR-PR), Based on Controlled Outside Diameter.
v. ASTM D 3261, Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
w. ASTM D 3350, Specification for Polyethylene Plastics Pipe and Fittings Materials.
x. ASTM F 412, Terminology Relating to Plastic Piping Systems.
y. ASTM F 714, Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
z. ASTM F 1248, Test Method for Determination of Environmental Stress Crack Resistance (ESCR) of Polyethylene Pipe.

2. American Water Works Association, (AWWA).
   a. AWWA C901, Polyethylene (PE) Pressure Pipe and Tubing, 1/2-inch through 3-inch, for Water Service.
   b. AWWA C906, Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch, for Water Distribution.
3. National Science Foundation, (NSF).
   a. NSF 14, Plastics Piping Components and Related Materials.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years experience producing substantial similar type materials and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
   2. HDPE process pipe and fittings shall be the product of a single manufacturer.
   3. The HDPE process pipe and fittings manufacturer shall have an established Quality Assurance Program responsible for inspecting incoming and outgoing materials.
   4. The HDPE process pipe and fittings manufacturer shall have an established Quality Assurance program responsible for assuring the long-term performance of materials and products.
   5. The HDPE process pipe and fitting manufacturer shall maintain permanent Quality Assurance/Quality Control (QA/QC) records.

B. Installer's Qualifications:
   1. Engage a single installer regularly engaged in HDPE process piping installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
   2. Engage a single installer for the entire HDPE process piping system with undivided responsibility for performance and other requirements.

C. Component Supply and Compatibility:
   1. The HDPE process pipe and fittings manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
   2. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the HDPE process pipe and fittings manufacturer.

1.4 SUBMITTALS

A. Submit these with Shop Drawings required under Section 33 05 05, Buried Piping Installation.

B. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Details of piping system including location of supports, restraints, fittings, anchors, vents, low-point drains, termination assemblies and all accessories necessary for piping system.
      b. Pipe laying schedules.

2. Product Data:
    a. Details of construction, fabrication, and pipe materials.
    b. Detailed procedures to be used in joining and installing piping system, including manufacturer's recommendations.
3. Testing Plans, Procedures, and Testing Limitations:
    a. Pipe testing procedures.

C. Informational Submittals:
1. Certificates:
    a. Materials Certificates of Conformance: Submit certificates of conformance with Referenced Standards as required in Article 2.4, below.
    b. Upon shipment, CONTRACTOR shall furnish the HDPE pipe manufacturer's Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the Project are in accordance with the requirements of this Section and a manufacturer's warranty covering materials and workmanship of the HDPE piping.
2. Suppliers Instructions:
    a. Detailed procedures to be used in joining and installing piping system, including manufacturer's recommendations.
3. Qualifications Statements:
    a. Installer's qualifications.

1.5 DELIVERY, STORAGE AND HANDLING

A. Refer to Sections 33 05 05, Buried Piping Installation.

PART 2 - PRODUCTS

2.1 SYSTEM PERFOMANCE

A. HDPE piping system shall be specifically designed, constructed, and installed for the service intended and shall comply with the following service conditions.

B. Design Criteria:

Usage:	Force Main
Nominal Pipe Size (in)	4
Pipe Size Type:	IPS

Average O.D. (in)	4.5
Dimension Ratio (DR):	17
Average I.D. (in)	3.94
Working Pressure Rating (psi)	125
Maximum Force Main Pressure (psi)	45
Joint Length (ft)	Continuous Roll
Flow (gpm)	80
Fluid Composition	Wastewater

2.2 PHYSICAL PROPERTIES

A. Materials used for the manufacture of polyethylene pipe and fittings shall meet the following physical property requirements:

	Property	Unit	Test Procedure	Value
1.	Material Designation	-	PPI/ASTM	-
2.	PPI Material Listing	-	PPI TR-4	PE 4710
3.	Material Classification	-	ASTM D 1248	III C 5 P34
4.	Cell Classification	-	ASTM D 3350	345434C or 355434C
5.	Density	g/cm3	ASTM D 1505	>0.941
6.	Melt Index (E)	g/10 min	ASTM D 1238	<0.15
7.	Flexural Modulus	psi	ASTM D 790	>110,000
8.	Tensile Strength	psi	ASTM D 638	<160,000
9.	ESCR (C)	hours	ASTM D 1693	3,000 to 3,500
10.	HDB	psi	ASTM D 2837	1,600 @ 23°C
11.	UV Stabilizer (C)	percent carbon black	ASTM D 1603	2 to 3
12.	Elastic Modulus	psi	ASTM D 638	110,000
13.	Brittleness Temperature	F	ASTM D 746	<-180
14.	Vicat Softening Temp	F	ASTM D 1525	255
15.	Thermal Expansion	in/in/ F	ASTM D 696	8 x 10E-5
16.	Hardness	Shore D	ASTM D 2240	64
17.	Molecular Weight Category	-	-	Extra-High

B. There shall be no evidence of splitting, cracking or breaking when the pipe is tested in accordance with Article 2.4, below.

C. Ring Stiffness Constant (RSC) values for the pipe can be directly related to the pipe's class designation. (Nominal RSC of Class 40 pipe = 40, etc.). The minimum RSC is 90 percent of the nominal.

D. The HDPE pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density and other physical properties.

E. Clean rework or recycled material generated by the manufacturer's own production may be used as long as the pipe or fittings produced meet all the requirements of this Section.

2.3 PIPE AND FITTINGS

A. Dimensions:
   1. Pipe Dimensions: The nominal inside diameter of the pipe shall be true to the specified pipe size in accordance with AWWA C901 and AWWA C906.
   2. Fitting Dimensions: Fittings such as couplings, wyes, tees, adapters, etc. for use in laying pipe shall have standard dimensions that conform to ASTM D 3261.

B. Fittings shall be ductile iron material in accordance with Section 40 05 19, Ductile Iron Process Pipe.

C. Pipe and fittings shall be pressure rated to meet the service pressure requirements specified by ENGINEER. Whether molded or fabricated, fittings shall be fully pressure rated to at least the same service pressure rating as the pipe to which joining is intended.

D. Reducing tees with branch diameters of 16-inches or less shall be saddle tees.

E. Marking:
   1. Each standard and random length of pipe and fitting in compliance with this standard shall be clearly marked with the following information.
      a. ASTM or AWWA Standard Designation.
      b. Pipe Size.
      c. Class and Profile Number.
      d. Production Code.
      e. Standard Dimension Ratio (SDR).

2.4 SOURCE QUALITY CONTROL

A. At a minimum, incoming polyethylene materials shall be inspected for density in accordance with ASTM D 1505 and melt flow rate in accordance with ASTM D

1238. All incoming polyethylene materials shall be certified by the supplier. Certification shall be verified by CONTRACTOR and ENGINEER. Incoming materials shall be approved by Manufacturer's Quality Assurance Program before processing into finished goods.

B. Representative samples of polyethylene materials shall be tested against the physical property requirements required herein. Each extrusion line and molding machine shall be qualified to produce pressure rated products by taking representative production samples and performing sustained pressure tests in accordance with ASTM D 1598.

C. Quality Assurance test for representative pipe and fitting samples shall include:

Test	Standard	Pipe	Fittings
Ring ESCR	ASTM F 1248	Yes	Not Applicable
Sustained pressure at 176°F/725 psi hoop stress: (f_o>100 h)	ASTM D 1598	Yes	Yes
Sustained pressure at 73°F/1,600 psi hoop stress: (f_o>1000 h)	ASTM D 1598	Yes	Yes

D. The HDPE pipe and fitting manufacturer shall certify that samples of their production pipe have undergone stress regression testing, evaluation, and validation in accordance with ASTM D 2837 and PPI TR-3. Under these procedures, the minimum hydrostatic design basis shall be certified by the pipe and fitting manufacturer to be 1,600 psi at 73.4°F and 800 psi at 140°F.

E. Material shall be listed in the name of the HDPE pipe and fitting manufacturer as required by the Plastics Pipe Institute (PPI) in PPI TR-4 with the following Standard Grade ratings:

	73.4°F	140°F
1. Hydrostatic Design Basis (HDB)	1,600 psi	800 psi
2. Hydrostatic Design Stress (HDS)	800 psi	400 psi

PPI material listing in the name of the resin supplier is not acceptable in meeting this requirement.

F. Inspection Requirements:
1. Notification: The HDPE pipe and fitting manufacturer shall notify CONTRACTOR in advance of the date, time, and place of testing of the pipe in order that CONTRACTOR may be represented at the test.

2. Access: The OWNER'S representative shall have free access to the Inspection area of the manufacturer's plant. The manufacturer shall make available to the OWNER'S representative, without charge, all reasonable facilities for determining whether the pipe meets the requirements of this Section.
3. Certification: As the basis of the acceptance of the material, the manufacturer will furnish a certificate of conformance of these Specifications upon request. When prior agreement is being made in writing between ENGINEER, CONTRACTOR and the manufacturer, the manufacturer will furnish other conformance certification in the form of affidavit of conformance, test results, or copies of test reports.
4. All outgoing materials shall be inspected for diameter, wall thickness, length, straightness, out-of-roundness, concentricity, toe-in, inside and outside surface finish, markings, and end cut. Manufacturer's Quality Control Program shall perform tests of density, melt flow rate, carbon content, and carbon dispersion. In addition, samples of the pipe provided shall be tested for hoop tensile strength and ductility by either quick burst in accordance with ASTM D 1599 or ring tensile strength in accordance with ASTM D 2290. Molded fittings shall be subject to x-ray inspection for voids, and tests for knit line strength. All fabricated fittings shall be inspected for fusion quality and alignment.

G. Physical Test Requirements:
1. Sampling: The selection of the sample of pipe shall be as agreed upon by the ENGINEER, CONTRACTOR and the manufacturer. In case of no prior agreement, any sample selected by the manufacturer shall be deemed adequate.
2. Sample size for flattening test will be one sample for each size and class of pipe for the Project.
3. Conditioning: Conditioning of samples prior to and during test shall be as agreed upon by the ENGINEER, CONTRACTOR and manufacturer. In case of no prior agreement, the conditioning procedure used by the manufacturer shall be deemed adequate.

H. Test Methods:
1. Flattening: Three specimens of pipe, a minimum of 12-inches long, shall be flattened between parallel plates in a suitable press until the distance between the plates is 40 percent of the outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed within two to five minutes. Remove the load, and examine the specimens for splitting cracking or breaking.
2. Pipe Ring Stiffness Constant: The pipe ring stiffness constant shall be determined utilizing procedures similar to those outlined in ASTM D 2412. The stiffness of HDPE pipe is defined in terms of the load, applied between parallel plates, which causes one percent reduction of pipe diameter. Test

specimens shall be a minimum of two pipe diameters or four feet in length, whichever is less.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Pipe may be rejected for failure to conform to these Specifications or following:
   1. Fractures or cracks passing through pipe wall, except single crack not exceeding 2-inches in length at either end of pipe which could be cut off and discarded. Pipes within one shipment shall be rejected if defects exist in more than five percent of shipment or delivery.
   2. Cracks sufficient to impair strength, durability or serviceability of pipe.
   3. Defects indicating improper proportioning, mixing, and molding.
   4. Damaged ends, where such damage prevents making satisfactory joint.
   5. Gouges or scrapes exceeding ten percent of the specified wall thickness.

B. Acceptance of fittings, stubs or other specifically fabricated pipe sections shall be based on visual inspection at Site and documentation of conformance to these Specifications.

C. CONTRACTOR to provide as-built of pipe end point and angle point coordinates and elevations prior to backfilling trench.

3.2 INSTALLATION

A. Refer to Section 33 05 05, Buried Piping Installation.

B. Heat Fusion of Pipe:
   1. HDPE pipe and fittings joints shall be heat fused by a qualified technician; trained by the manufacturer’s representative in accordance with the manufacturer’s recommended fusion procedures. Training must have occurred within the previous 12 months, or submittals verifying experience within the previous 12 months for all technicians performing heat fusion on polyethylene pipe and fittings.
   2. Weld in accordance with manufacturer's recommendation for butt fusion methods. Personnel operating fusion equipment shall be certified by the HDPE pipe manufacturer.
   3. The first butt fusion weld of each day’s production welding and for each separate operator shall be tested by bent strap test method. No production welds shall be performed until successful completion of bent strap test.
   4. Butt fusion equipment for joining procedures shall be capable of meeting conditions recommended by HDPE pipe manufacturer including, but not limited to, temperature requirements, alignment, and fusion pressures. The

equipment used for the heat fusion joints shall be capable of recording the heating and fusion pressures used to join the HDPE pipe, recording heater temperature, and storing this information for future retrieval (data logger). Each field fusion shall be recorded by such equipment and this information shall be made compiled into daily log reports. Log reports shall be submitted to CONTRACTOR and ENGINEER daily. Reports shall also include the results of the bent strap tests.

5. For cleaning pipe ends, solutions such as detergents and solvents, when required, shall be used in accordance with manufacturer's recommendations.
6. Do not bend pipe to greater degree than minimum radius recommended by manufacturer for type and grade. Shop Drawings shall address locations and deflections of required fittings to prevent installation that exceeds a greater degree of bending than the manufacturer's recommended minimum bending radius for each size and class of HDPE pipe.
7. Do not subject pipe to strains that will overstress or buckle piping or impose excessive stress on joints.
8. Branch saddle fusions shall be joined in accordance with manufacturer's recommendations and procedures. Branch saddle fusion equipment shall be of size to facilitate saddle fusion within trench.
9. Before butt fusing pipe, inspect each length for presence of dirt, sand, mud, shavings, and other debris or animals. Remove debris from pipe.
10. Cover open ends of fused pipe at the end of each day's Work. Cap to prevent entry by animals or debris.

C. Flange Jointing:
   1. Use on flanged pipe connection sections.
   2. Connect slip-on Type 316 stainless steel backup flanges with Type 316 stainless steel nuts and bolts.
   3. Butt fuse fabricated flange adapters to pipe.
   4. Observe following precautions in connection of flange joints.
      a. Align flanges or flange/valve connections to provide tight seal. Require nitrile-butadiene gaskets if needed to achieve seal. Integral flange adapters and gaskets are required for flange/valve connections.
      b. Place U.S. Standard round washers as may be required on some flanges in accordance with manufacturer's recommendations. Bolts shall be lubricated in accordance with manufacturer's recommendations.
      c. Tighten flange bolts in sequence and accordance with manufacturer's recommendations. CAUTION: Do not over-torque bolts.
   5. Pull bolt down by degrees to uniform torque in accordance with manufacturer's recommendation.
   6. Install electrofusion couplers, where used, in accordance with manufacturer's specifications.

D. Pipe Placement:

1. Grade control equipment shall be of type to accurately maintain design grades and slopes during installation of pipe.
2. Dewatering: Remove standing water in trench before pipe installation.
3. Unless otherwise specifically stated, install pipe in accordance with manufacturer's recommendations.
4. Maximum lengths of fused pipe to be handled as one section shall be placed according to manufacturer's recommendations as to pipe size, pipe SDR, and topography so as not to cause excessive gouging or surface abrasion, but shall not exceed 400 feet.
5. Cap pipe sections longer than single joining (usually 50 feet) on both ends during placement, except during fusing operations.
6. Notify ENGINEER prior to installing pipe into trench and allow time for ENGINEER'S inspection.
    a. Correct irregularities found during inspection.
7. Complete tie-ins within trench whenever possible to prevent overstressed connections.
8. Allow pipe sufficient time to adjust to trench temperature prior to testing, segment tie-ins or backfilling activity.
9. Install reducers adjacent to laterals and tees.
10. To reduce branch saddle stress, install saddles at slope equal to and continuous with lateral piping.
11. Pipe shall be snaked in trench to allow a minimum of 12-inches/100 feet for thermal contraction and expansion.
12. Allow extra length at future connection points to be cut to fit after backfill and prior to tie-in.

3.3 LEAKAGE TESTS

A. Refer to Section 33 05 05, Buried Piping Installation.

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SECTION 40 05 53

PROCESS VALVES, FOUR-INCH DIAMETER AND LARGER

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install process valves, four-inch diameter and larger, and appurtenances, complete and operational.
   2. Valves for digester gas and air have been specifically identified. All other valves are for liquid service.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before process valves Work.

C. Related Sections:
   1. Section 05 05 33, Anchor Systems.
   2. Section 09 91 00, Painting.
   3. Section 33 05 05, Buried Piping Installation.
   4. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Bearing Manufacturers Association (ABMA).
   2. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
   3. ANSI B16.34, Valves-Flanged, Threaded and Welding end. (ASME B16.34).
   4. API STD 594, Check Valves, Flanged Lug, Wafer and Butt-Welding.
   5. API STD 598, Valve Inspection and Testing.
   6. API STD 609, Butterfly Valves: Double Flanged, Lug-Type and Wafer-Type.
   7. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
   8. ASTM A193/A193M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
   9. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service, or Both.

10. ASTM A240/A240M, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
11. ASTM A276, Specification for Stainless Steel Bars and Shapes.
12. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
13. ASTM A351/A351M, Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts.
14. ASTM A380, Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems.
15. ASTM A536, Specification for Ductile Iron Castings.
16. ASTM A564/A564M, Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
17. ASTM A743/A743 M, Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
18. ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
19. ASTM B98/B98M, Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
20. ASTM B138/B138M, Specification for Manganese Bronze Rod, Bar and Shapes.
21. ASTM B265, Specification for Titanium and Titanium Alloy Strip, Sheet and Plate.
22. ASTM B584, Specification for Copper Alloy Sand Castings for General Applications.
23. ASTM D429, Test Methods for Rubber Property - Adhesion to Rigid Substrates.
24. AWWA C500, Metal-Seated Gate Valves for Water Supply Service.
25. AWWA C504, Rubber-Seated Butterfly Valves.
26. AWWA C508, Swing-Check Valves for Waterworks Service, 2-inch through 24-inch NPS.
27. AWWA C509, Resilient-Seated Gate Valves for Water Supply Service.
28. AWWA C550, Protective Interior Coatings for Valves and Hydrants.
29. AWWA Manual M49, Butterfly Valves: Torque, Head Loss, and Cavitation Analysis.
30. FS TT-C-494, Coating Compound, Bituminous, Solvent Type, Acid-Resistant.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have minimum of five years of experience producing substantially similar materials and equipment to that required and be able to provide evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. Obtain each type of equipment and appurtenances included in this Section, regardless of the component manufacturer, from a single manufacturer of the type of process valve. For each type of valve, do not furnish valves of more than one manufacturer.
   2. Supplier of each type of equipment specified shall review and approve or prepare all Shop Drawings and other submittals for all components associated with the type of process valve Supplier is furnishing.
   3. Components shall be suitable for use in the specified service conditions. Components shall be integrated into the overall assembly by the process valve manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Installation drawings showing orientation of valve and handwheel in both plan and elevation view. Drawings shall clearly identify valve and its appurtenances, including controls, actuators, valve stems, and other components. Show dimensions of valves and appurtenances in relation to piping and structural and architectural components, where applicable.
   2. Product Data:
      a. Product data sheets.
      b. Complete catalog information, including dimensions, weight, specifications, and identification of materials of construction of all parts.
      c. Corrosion resistance information to confirm suitability of valve materials for the application. Furnish information on chemical resistance of elastomers from elastomer manufacturer.
      d. Cv values and hydraulic headloss curves.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Certificates of compliance with referenced standards, where applicable, including those of AWWA, NSF, and others required by ENGINEER.
   2. Manufacturer Instructions:
      a. Submit manufacturer's instructions for handling, storing, and installing valves and appurtenances. Provide templates and setting drawings for valves and appurtenances that require anchor bolts or similar anchorages.
   3. Field Quality Control Submittals:
      a. Submit results of field tests required.

4. Qualifications Statements:
    a. When requested by ENGINEER, submit manufacturer's qualifications demonstrating compliance with the Specifications, including list of existing installations with contact names and telephone number(s) for each.

C. Closeout Submittals: Submit the following:
    1. Operations and Maintenance Data:
        a. Furnish operation and maintenance manuals in accordance with Section 01 78 23, Operations and Maintenance Data.
        b. Furnish in operations and maintenance manuals complete nameplate data for each valve and electric actuator.

D. Maintenance Material Submittals: Submit the following:
    1. Spare Parts, Extra Stock Materials, and Tools:
        a. Spare Parts and Extra Stock Materials: Furnish as specified for each valve type.
        b. Tools: Furnish two sets of special tools (excluding metric tools, if applicable) for each size and type of valve furnished.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
    1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.
    2. Inspect boxes, crates, and packages upon delivery to Site and notify ENGINEER in writing of loss or damage to materials and equipment. Promptly remedy loss and damage to new condition in accordance with manufacturer's instructions.
    3. Conform to Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:
    1. Keep products off ground using pallets, platforms, or other supports. Store equipment in covered storage and prevent condensation and damage by extreme temperatures. Store in accordance with manufacturer's recommendations. Protect steel, packaged materials, and electronics from corrosion and deterioration.
    2. Conform to Section 01 66 00, Product Storage and Handling Requirements.

1.6 WARRANTY

A. Valves and all components shall have a 3-year warranty from the date of authorized start-up.

PART 2 - PRODUCTS

2.1 GENERAL

A. Valves, General:
   1. Provide each valve with manufacturer's name and rated pressure cast in raised letters on valve body.
   2. Provide valves with brass or Type 316 stainless steel nameplate attached with Type 316 stainless steel screws. Nameplates shall have engraved letters displaying the following minimum information:
      a. Valve size.
      b. Pressure and temperature ratings.
      c. Application (other than water and wastewater).
      d. Date of manufacture.
      e. Manufacturer's name.
   3. Provide valves to turn clockwise to close, unless otherwise specified.
   4. Provide valves with permanent markings for direction to open.
   5. Manually operated valves, with or without extension stems, shall require not more than 40-pound pull on manual operator to open or close valve against specified criteria. Manual operators include handwheel, chainwheel, crank, lever, and T-handle wrench.

B. Valve Materials:
   1. Valve materials shall be suitable for the associated valve's service or application, as shown.
   2. Protect wetted parts from galvanic corrosion caused by contact of different metals.
   3. Wetted components and wetted surfaces of valves used with potable water or water that will be treated to become potable shall conform to ANSI/NSF 61.
   4. Clean and descale fabricated stainless steel items in accordance with ASTM A380 and the following:
      a. Passivate all stainless steel welded fabricated items after manufacture by immersing in pickling solution of six percent nitric acid and three percent hydrofluoric acid. Temperature and detention time shall be sufficient for removing oxidation and ferrous contamination without etching surface. Perform complete neutralizing operation by immersing in trisodium phosphate rinse followed by clean water wash.
      b. Scrub welds with same pickling solution or pickling paste and clean with stainless steel wire brushes or by grinding with non-metallic abrasive tools to remove weld discoloration, and then neutralize and wash clean.

C. Valve Joints:

1. Exposed Valves: Unless otherwise specified, provide with flanged ends conforming to ANSI B16.1. Pressure class of flanges shall be equal to or greater than specified pressure rating of the associated valve.
2. Buried Valves: Unless otherwise specified, provide with mechanical or push-on joints, restrained or unrestrained, as required by piping with which valve is installed.
3. For stainless steel bolting, except where nitrided nuts are required, use graphite-free anti-seize compound to prevent galling. Strength of joint shall not be affected by using anti-seize compound.

2.2 RESILIENT-SEATED GATE VALVES

A. Manufacturers: Provide products of one of the following:
   1. M&H Valve Company
   2. US Pipe and Foundry.
   3. Or equal.

B. General:
   1. Provide valves conforming to AWWA C509 and as specified in this Section.
   2. Sizes: Four-inch through 12-inch diameter, 16-inch and 20-inch diameter.
   3. Type:
      a. Provide non-rising stem (NRS) valves for buried service.
      b. For interior and exposed service, provide outside screw and yoke (OS&Y) rising-stem valves, unless otherwise specified.
      c. Provide position indicators for NRS valves used in exposed service.
   4. Minimum Rated Working Pressure:
      a. Valves 12-inch Diameter and Smaller: 200 psig.
      b. Valves 16-inch and 20-inch Diameter: 150 psig.
   5. Maximum Fluid Temperature: 150 degrees F.
   6. Provide valves with fully encapsulated resilient wedges, unless otherwise specified.

C. Materials of Construction: Shall conform to AWWA C509 and shall be as follows:
   1. Valve Body, Bonnet, and Stuffing Box: Cast-iron.
   2. Wedge: Cast-iron, symmetrically and fully encapsulated with molded rubber having minimum 1/8-inch thickness.
   3. Stem: Manganese bronze.
   4. Rubber Items: Buna-N or other synthetic rubber suitable for the application.
   5. Internal and external bolting and other hardware including pins, set screws, plug, studs, bolts, nuts, and washers shall be Type 316 stainless steel.

D. Interior Coating:

1. Valves shall be coated inside. Steel, cast-iron and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.

E. Testing:
   1. Test valves in valve manufacturer's shop in accordance with AWWA C509.

F. Gear Actuators for Manually-operated Valves:
   1. Provide valves with gear actuators conforming to AWWA C500.
   2. Size gear actuators for the following maximum differential pressures:

2.3 ECCENTRIC PLUG VALVES

A. Manufacturers: Provide products of one of the following:
   1. DeZurik.
   2. Or equal.

B. General:
   1. Provide eccentric-type plug valves each with rectangular ports.
   2. Minimum Rated Working Pressure:
      a. Valves 12-inch Diameter and Smaller: 175 psig.
      b. Valves 14-inch through 72-inch Diameter: 150 psig.
   3. Maximum Fluid Temperature: 180 degrees F.
   4. Minimum Port Area:
      a. Valves 20-inch Diameter and Smaller: 100 percent of nominal pipe area.
   5. Packing and packing gland shall be externally adjustable and accessible without disassembling valve and without removing the actuator.
   6. Valves shall provide drip-tight, bi-directional shutoff at rated pressures.
   7. Plug shall have cylindrical seating surface eccentrically offset from center of plug shaft. Interface between plug face and body seat, with plug in closed position, shall be externally adjustable in the field with valve in the line while under pressure.
   8. Plug shall be supported to top bearing by using spring that is externally adjustable.
   9. For sludge service, plug valves shall allow pigging of the piping with line-size pigs.

C. Materials of Construction:
   1. Body: Cast Iron ASTM A126 Class B, or Ductile-iron ASTM A536 Grade 65-45-12.
   2. Plug:
      a. Core: Cast Iron ASTM A126 Class B, or Ductile-iron, ASTM A536 Grade 65-45-12.
      b. Plug Facing: Neoprene.

c. For valves up to eight-inch diameter, plugs shall be fully encapsulated with rubber. For valves larger than eight-inch diameter, provide plugs with rubber facing. Minimum thickness of rubber lining shall be 1/8-inch. Rubber hardness shall be a minimum of 70 (Shore A) durometer. Rubber-to-metal bond shall withstand minimum 75-pound pull conforming to ASTM D429 Method B.

3. Seats: Minimum 1/8-inch welded overlay of minimum 90 percent pure nickel on surfaces contacting plug face. Seats shall provide contact area of at least 1/2-inch width all around.
4. Stem Bearings: Sintered, oil impregnated, permanently lubricated of Type 316 stainless steel.
5. Stem Seal: Multiple neoprene V-ring type.
6. All internal and external bolting and other hardware including pins, set screws, plug, studs, bolts, nuts and washers shall be Type 316 stainless steel.

D. Interior Coating and Lining:
1. Valves shall be coated inside. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy-coated in accordance with AWWA C550.

E. Shop Testing:
1. Operational Tests:
a. To demonstrate that complete assembly is workable, successfully operate each valve (with actuator mounted directly on valve) three times from fully closed to fully open position and reverse under no-flow condition.
2. Leakage Tests:
a. Test each valve for leaks while valve is in closed position.
b. Test valves at rated pressures. During test, valves shall be drip-tight. Test duration shall be at least five minutes for valves up to 20-inch diameter and ten minutes for valves larger than 20-inch diameter. Tests shall be repeated successfully with pressure in the unseating direction.
3. Hydrostatic Test: Test valves to an internal hydrostatic pressure equivalent to twice rated pressure of valve. During hydrostatic test, there shall be no leakage through metal, end joints, and shaft seal, nor shall any part be permanently deformed. Duration of hydrostatic test shall be sufficient to allow visual examination for leakage. Test duration shall be at least one minute for valves eight-inch diameter and smaller, three minutes for valves 10-inch through 20-inch diameter, and ten minutes for valves 24-inch diameter and larger.

F. Gear Actuators for Manually-operated Valves:

1. Provide gear actuators on buried and exposed valves, except valves four-inch diameter and smaller located less than five feet above operating floor. Gas service valves shall be provided with worm gear actuators.
2. Size gear actuators for valves eight-inch diameter and smaller for 175 psig differential pressure.
3. Provide actuators capable of holding associated valves in any intermediate position without creeping or vibrating.
4. Provide valve position indicator on each actuator. Provide stop-limiting devices for open and closed position. For buried and submerged service actuators, provide position indicators in valve box.
5. Provide adjustable stop to adjust seating pressure.
6. Make packing accessible for adjustment without requiring removal of actuator from valve, except for valves in buried and submerged service.
7. Diameter ratio of handwheel or chainwheel and gear sector shall be less than two.
8. For buried and submerged valves, gear actuator shall be grease-packed and designed to withstand submersion, and shall be drip-tight in water 20 feet deep, with self-adjusting packing.
9. Provide each actuator with gearing totally enclosed.
10. Operator shaft and gear sector shall be supported on permanently lubricated bronze or stainless steel bearings.
11. Provide metal-encased spring loaded seals in top and bottom covers of gear housing.
12. Actuators shall be provided to produce indicated torque with maximum pull of 40 pounds on handwheel or chainwheel and maximum input of 150-foot pounds on operating nuts, for both seating and unseating heads equal to maximum differential pressure rating of valve.
13. Actuator components between input and stops shall be designed to withstand, without damage, a pull of 200 pounds for handwheel or chainwheel actuators and input torque of 300-foot pound for operating nuts when operating against stops.
14. Materials of Construction:
    a. Housing: Cast-iron, ASTM A126 Class B.
    b. Gear Sector: Cast-iron ASTM A126 Class B, or ductile iron ASTM A536.
    c. Worm Shaft: Steel, AISI 1144, hardened and tempered to an average Rc 40 and within range of Rc 35-45.
    d. Bearings: Bronze oil-impregnated, or stainless steel.
    e. Hardware, including bolts, nuts, washers, set screws, and pins, shall be Type 316 stainless steel.

2.4 THERMOPLASTIC BALL VALVES

A. Manufacturers: Provide products of one of the following:
    1. Spears Manufacturing Company, True Union Ball Valves.

2. Or equal.

B. General:
   1. Provide valves conforming to ASTM D 1784 Cell Classification 12454 for PVC Type I or ASTM D1784 Cell Classification 23447 for CPVC Type IV and as specified herein.
   2. Sizes: ½-inch through 8-inch diameter.
   3. Rated Working Pressure: 150 psig at 73 degrees F.
   4. Maximum Fluid Temperature: 120 degrees F.
   5. Valve body shall have full, unobstructed, circular inlet and outlet port diameters equal to nominal diameter of valve.
   6. Valves shall provide drip-tight bi-directional shutoff at rated pressures.
   7. Valve shall include:
      a. Heavy bodied PVC or CPVC
      b. Buttress threaded double union nuts
      c. Safe-T-Blocked carrier
      d. EPDM or Viton O-ring options
      e. High impact polypropylene handle
      f. Safe-T-Shear stem
   8. Valve shall be fully repairable.

C. Materials of Construction: Materials of construction shall conform to the following:
   1. Body: PVC or CPVC.
   2. Ball: PVC or CPVC.
   3. PTFE Ball Seats.

2.5 APPURTENANCES FOR BURIED METALLIC VALVES

A. Wrench Nuts:
   1. Provide wrench nuts on buried valves of nominal two-inch size, in accordance with AWWA C500.
   2. Arrow indicating direction of opening the valve shall be cast on the nut along with the word “OPEN”.
   3. Material: Ductile iron or cast-iron.
   4. Secure nut to stem by mechanical means.

B. Extension Stems for Non-Rising Stem Gate Valves and Quarter-turn Buried Valves:
   1. Provide extension stems to bring operating nut to six inches below valve box cover.
   2. Materials of Stems and Stem Couplings: Type 316 stainless steel.
   3. Maximum Slenderness Ratio (L/R): 100
   4. Provide top nut and bottom coupling of ductile iron or cast-iron with pins and set screws of Type 316 stainless steel.

C. Valve Boxes:
   1. Valve boxes shall be as indicated and as required.
   2. Type: Heavy-duty, suitable for highway loading, two-piece telescopic, and adjustable. Lower section shall enclose valve operating nut and stuffing box and rest on valve bonnet.
   3. Material: Cast-iron or ductile iron.
   4. Coating: Two coats of asphalt varnish conforming to FS TT-C-494.
   5. Marking: As required for service.

2.6 ANCHORAGES AND MOUNTING HARDWARE

A. General:
   1. Comply with Section 05 05 33, Anchor Systems, except as modified in this Section.
   2. Obtain bolts, nuts, and washers for connection of valve and appurtenances to concrete structure or other structural members from valve Supplier.
   3. Bolts, nuts, and washers shall be of ample size and strength for purpose intended. Anchorages in concrete shall be at least 5/8-inch diameter.
   4. Provide stem guide anchorages of required strength to prevent twisting and sagging of guides under load.
   5. Materials: Provide bolts and washers of Type 316 stainless steel and nitrided nuts. Bolts shall have rolled threads. Bolts and nuts shall be electropolished to remove burrs.

2.7 TOOLS, LUBRICANTS, AND SPARE PARTS

A. Provide the following T-handle operating wrenches for buried valves.

B. Lubricants: For valves, actuators, and appurtenances requiring lubricants, provide suitable lubricants for initial operation and for first year of use following Substantial Completion. Lubricants for equipment associated with conveying potable water or water that will be treated to become potable shall be food-grade and ANSI/NSF 61-listed.

C. Tools, spare parts, and maintenance materials shall conform with Section 01 78 43, Spare Parts and Extra Materials.

2.8 PAINTING OF EXPOSED VALVES, HYDRANTS, AND APPURTENANCES

A. Exterior steel, cast-iron, and ductile iron surfaces, except machined surfaces of exposed valves and appurtenances, shall be finish painted in manufacturer's shop. Surface preparation, priming, finish painting, and field touch-up painting shall conform to Section 09 91 00, Painting.

2.9 PAINTING OF BURIED VALVES

A. Exterior steel, cast-iron, and ductile iron surfaces, except machined or bearing surfaces of buried valves, shall be painted in valve manufacturer's shop with two coats of asphalt varnish conforming to FS TT-C 494.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which materials and equipment are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
   1. Install valves and appurtenances in accordance with:
      a. Supplier's instructions and the Contract Documents.
      b. Requirements of applicable AWWA standards.
      c. Applicable requirements of Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
   2. Install valves plumb and level. Install all valves to be free from distortion and strain caused by misaligned piping, equipment, and other causes.
   3. Position swing check valves and butterfly valves so that, when valve is fully open, valve disc does not conflict with piping system elements upstream and downstream of valve.

B. Exposed Valves:
   1. Provide supports for large or heavy valves and appurtenances as shown or required to prevent strain on adjoining piping.
   2. Operators:
      a. Install valves so that operating handwheels or levers can be conveniently turned from operating floor without interfering with access to other valves, piping, structure, and equipment, and as approved by ENGINEER.
      b. Avoid placing operators at angles to floors or walls.
      c. Orient chain operators out of way of walking areas.
      d. Install valves so that indicator arrows are visible from floor level.
      e. For motor-operated valves located lower than five feet above operating floor, orient motor actuator to allow convenient access to pushbuttons and handwheel.
   3. Floor Stands and Stems:

a. Install floor stands as shown and as recommended by manufacturer.
b. Provide lateral restraints for extension bonnets and extension stems as shown and as recommended by manufacturer.
c. Provide sleeves where operating stems pass through floor. Extend sleeves two inches above floor.

C. Buried Valves:
1. Install valve boxes plumb and centered, with soil carefully tamped to a lateral distance of four feet on all sides of box, or to undisturbed trench face if less than four feet.
2. Provide flexible coupling next to each buried valve.

D. Plug Valves:
1. Install plug valves that are in horizontal liquid piping with stem horizontal and plugs on top when valve is open. Plug shall be on upstream end when valve is closed.
2. Install plug valves that are in vertical liquid piping with plug at top when closed or as recommended by valve Supplier.
3. Supplier shall tag or mark plug valves to indicate proper mounting position.

3.3 FIELD QUALITY CONTROL

A. Field Tests:
1. Adjust all parts and components as required to provide correct operation of valves.
2. Conduct functional field test on each valve in presence of ENGINEER to demonstrate that each valve operates correctly.
3. Verify satisfactory operation and controls of motor operated valves.
4. Demonstrate satisfactory opening and closing of valves at specified criteria requiring not more than 40 pounds effort on manual actuators.
5. Test ten percent of valves of each type by applying 200 pounds effort on manual operators. There shall be no damage to gear actuator or valve.

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SECTION 40 60 05

INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish, install, calibrate, test, start-up, and place in satisfactory operation a complete and operating instrumentation and control system.
   2. The specification includes instrumentation, control panels and other appurtenances information that shall be used by vendors for provision of packaged systems and CONTRACTOR provided equipment.
   3. The Work includes, but is not limited to, the following equipment to be provided by the I&C Subcontractor:
      a. Auto Dialer panel.
      b. Field mounted instruments
      c. Local Control Panels hardwired to the autodialer.
   4. The Work includes, but is not limited to, the following equipment to be provided by the Packaged WWTP Supplier:
      a. Flow Equalization Local Control Panel (FE-LCP)
      b. Anoxic Mixer Local Control Panel (AM-LCP)
      c. Recycle Pump Local Control Panel (RP-LCP)
      d. Main Air Blower Local Control Panel (MAB-LCP)
   5. The Work includes, but is not limited to, the following equipment to be provided by the Packaged LS Supplier:
      a. Duplex Lift Station #1 Local Control Panel (DLS-LCP1)
      b. Duplex Lift Station #2 Local Control Panel (DLS-LCP2)

B. Coordination:
   1. Instrumentation and Controls:
      a. Instruments and controls (I&C) Work under this Contract by I&C Subcontractor shall, as part of the Work, be interfaced with the Auto Dialer System. Programming and configuration of the autodialer along with the instrument installation and configuration is part of the Work.
      b. Some panels and equipment are furnished under other Specification Sections under this Contract. CONTRACTOR shall coordinate with Suppliers of panels and equipment to provide fully functional system complying with the Contract Documents and that interfaces with the Auto Dialer(s).

c. Auto Dialer input/output list identifies inputs and outputs required, and is part of this Section. Use input/output list for coordinating signals between equipment provided under this contract. Include Work for CONTRACTOR-furnished control options not on the input/output list and provided by the vendors at no additional cost to OWNER.

2. To centralize responsibility, materials and equipment provided under this Section shall be furnished by a single Supplier.
3. With CONTRACTOR, Supplier shall assume the responsibility for adequacy and performance of materials and equipment provided under this Section.
4. To the greatest extent possible, provide materials and equipment from a single manufacturer.
5. Supplier's Responsibilities:
   a. Preparing all instrumentation and control equipment submittals in accordance with the Contract Documents.
   b. Proper interfacing of instrumentation and control equipment with field equipment, instruments, devices, and panels, including required interfacing with packaged control systems furnished by other equipment Suppliers, and required interfacing with the Site's electrical system.
   c. Review and coordination with manufacturers, Suppliers, and other contracts of Shop Drawings and other CONTRACTOR submittals for equipment, valves, piping, and appurtenances for ensuring proper interfacing of hardware, and locations and installation requirements of inline devices and instrument taps.
   d. Direct, detailed oversight of installation of instruments, panels, consoles, cabinets, wiring and other components, and related wiring and piping connections.
   e. Calibrating, source quality control, field quality control, and start-up of the system.
   f. Responsibility for correction period obligations for instrumentation and control system.
   g. Training of operations and maintenance personnel in operation and maintenance (including calibration and troubleshooting) of the instrumentation and control system.

C. Related Sections:
   1. Section 09 91 00, Painting.
   2. Section 26 00 05, Electrical Work
   3. Section 26 32 13, Engine Generators
   4. Section 26 36 23, Automatic Transfer Switches
   5. Section 40 05 05, Exposed Piping Installation.
   6. Section 40 05 31, Thermoplastic Process Pipe.
   7. Section 46 07 53, Packaged WWTP

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI/ASQ Z1.4, Sampling Procedures and Tables For Inspection By Attributes.
   2. ASTM A269, Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
   3. ASTM A312, Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
   4. ASTM A403, Specification for Wrought Austenitic Stainless Steel Piping Fittings.
   5. ASTM B88, Specification for Seamless Copper Water Tube.
   6. IEEE 802.1 LAN/MAN Bridging & Management
   7. IEEE 802.1X, Port Based Network Access Control.
   8. IEEE 802.3, Standards Defining Physical Layer and Data Link Layer Media Access Control (MAC) Sublayer of Wired Ethernet
   9. ISA 5.1, Instrumentation Symbols and Identification.
   10. ISA 5.4, Instrument Loop Diagrams.
   11. ISA 20, Specification Forms for Process Measurement & Control Instruments, Primary Elements & Control Valves.
   12. ISO 8802-3, Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications.
   13. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   14. NFPA 70 (NEC), Article 770, Optical Fiber Cables and Raceways.
   15. NFPA 79, Electrical Standard for Industrial Machinery.
   16. UL 50, Safety Enclosures for Electrical Equipment, Non-Environmental Considerations.
   17. UL 508A, Industrial Control Panels.
   18. UL 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.
   19. UL 2062, Enclosures for Use in Hazardous (Classified) Locations.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Supplier:
      a. Shall be financially sound with at least five years continuous experience in designing, implementing, supplying, and supporting instrumentation and control systems for municipal wastewater treatment facilities comparable to the instrumentation and control systems required for the Project, relative to hardware, software, cost, and complexity.
      b. Shall have record of successful instrumentation and control system equipment installations. Upon ENGINEER's request, submit record of

experience listing for each project: project name, owner name and contact information, name and contact information for contractor, name and contact information for engineer or architect, approximate contract value of instrumentation and controls Work for which Supplier was responsible,

c. Shall have at time of Bid experienced engineering and technical staff capable of designing, supplying, implementing, and supporting the instrument and control system and complying with submittal and training requirements of the Contract Documents.

d. Shall be capable of training operations and maintenance personnel in instrumentation and control applications, and in operating, programming, and maintaining the control system and equipment.

e. Shall have UL-approved panel shop.

2. Manufacturer: Manufacturers of instrumentation and control equipment furnished under this Section shall be experienced producing similar equipment and shall have the following qualifications:

a. Shall manufacture instrumentation and control system components that are fully-developed, field-proven, and of standardized designs.

b. Shall have system of traceability of manufactured unit through production and testing in accordance with ANSI/ASQ Z1.4.

c. Shall have guaranteed availability clause (99.99 percent, minimum for one year) for microprocessor-based components and appurtenances.

d. Shall have documented product safety policy relevant to products proposed for the Work.

B. Pre-submittal Conference

1. Pre-submittal conference will be informed if required. Refer to Section 01 31 19.13, for more information on Pre-construction conference.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Field Instruments:

1) Manufacturer’s product name and complete model number of devices proposed for use, including manufacturer’s name and address.

2) Instrument tag number in accordance with the Contract Documents.

3) Data sheets and manufacturer’s catalog literature. Provide data sheets in accordance with ISA 20 and annotated for features proposed for use. For instruments not included in ISA 20, submit data sheets using a format similar to ISA 20.

4) Description of construction features.

5) Performance and operation data.

6) Installation, mounting, and calibration details; instructions and recommendations.
7) Service requirements.
8) Dimensions of instruments and details of mating flanges and locations of closed tanks, pipe sizes for insertion instruments, and upstream/downstream straight run pipe lengths required.
9) Range of each device and calibration information.
10) Descriptions of materials of construction and listing of NEMA ratings for equipment.

b. Panels, Consoles, and Cabinets:
1) Layout drawings that include:
a) Front, rear, and internal panel views to scale.
b) Tag number and functional name of components mounted in and on panel, console, or cabinet, as applicable.
c) Product information on panel components.
d) Nameplate location and legend including text, letter size and colors to be used.
e) Location of anchorage connections.
f) Location of external wiring and piping connections.
g) Mounting and installation details, coordinated with actual application.
h) Proposed layouts and sizes of operator interface graphic display panels and alarm annunciator panels.
i) Calculations for heating and cooling of panels
j) Subpanel layouts and mounting details for items located inside control panels.
2) Product information on panel components including:
a) Manufacturer's product name and complete model number of devices being provided, including manufacturer's name and address.
b) Instrument tag number in accordance with the Contract Documents.
c) Data sheets and catalog literature. Submit data sheets as shown in ISA 20 and annotated for features proposed for use. For instruments not included in ISA 20, submit data sheets with format similar to ISA 20.
d) Description of construction features.
e) Performance and operation data.
f) Installation, mounting, and calibration details; instructions and recommendations.
g) Service requirements
3) Wiring and piping diagrams, including the following:
a) Name of each panel, console, or cabinet.
b) Wire sizes and types.
c) Pipe sizes and types.
d) Terminal strip and terminal numbers.

e) Wire color coding.
f) Functional name and manufacturer's designation for components to which wiring and piping are connected.
g) Lightning and surge protection grounding.

4) Electrical control schematics in accordance with NFPA 79. Drawings shall be in accordance with convention indicated in Annex D of the NFPA 79. Typical wiring diagrams that do not accurately reflect actual wiring to be furnished are unacceptable. Tables or charts for describing wire numbers are unacceptable.
5) Stock list or bill of materials for each panel including tag number, functional name, manufacturer's name, model number and quantity for components mounted in or on the panel or enclosure.
6) Detail showing anchorage plan of wire bundles between subpanels and front panel mounted devices.

c. Field wiring and piping diagrams, include the following:
1) Wire and pipe sizes and types.
2) Terminal numbers at field devices and in panels.
3) Fiber optic termination designations in the field and in panels.
4) Color coding.
5) Conduit numbers in which wiring will be located.
6) Locations, functional names, and manufacturer's designations of items to which wiring or piping are connected.

d. Auto Dialer System:
1) Submit the following general information:
a) Detailed block diagram showing system wiring configuration showing other systems.
b) Input/Output Information:
i. Input/output (I/O) point listing with I/O module cross-reference identification.
ii. I/O module cross-reference identification based on I/O address list developed by I&C Subcontractor .
c) Suggested detailed format and configuration of alarm summaries.
2) Hardware:
a) Layout drawings showing front, rear, end and plan views to scale of equipment, I/O components, power supplies, and peripheral devices.
b) Equipment ventilation requirements.
c) Interconnection diagrams, including termination details, cable identification list, and cable length.
d) Drawings showing equipment layout.
e) Installation requirements, instructions, and recommendations.
3) Auto Dialer I/O Loop Wiring Diagrams: Prepare Shop Drawings to include the following information;

a) Location and identification of intermediate panel and field terminal blocks and terminal numbers to which I/O wiring and power supply wiring is connected. Identify power supply circuits with designation numbers and ratings.
b) Wiring types, wire numbers, and color coding.
c) Designation of conduits in which field I/O wiring will be installed.
d) Location, functional name, tag numbers and manufacturer's module numbers of panel and field devices and instruments to which I/O wiring will be connected.

e. Complete point-to-point interconnection wiring diagrams of field wiring associated with the system. Diagrams shall include the following:
1) Field wiring between each equipment item, panel, instruments, and other devices, and wiring to control stations, panelboards, and motor starters. Some of this equipment may be specified in other Divisions, CONTRACTOR is responsible for providing complete point-to-point interconnection wiring diagrams for control and monitoring of that equipment.
2) Numbered terminal block and terminal identification for each wire termination.
3) Identification of assigned wire numbers for interconnections. Assign each wire a unique number.
4) Schedule showing the wiring numbers and the conduit number in which the numbered wire is installed.
5) Junction and pull boxes through which wiring will be routed.
6) Identification of equipment in accordance with the Contract Documents.

2. Product Data:
a. Product data for field instruments in accordance with requirements for Shop Drawings in this Section.
b. Product data for panels, consoles, and cabinets in accordance with requirements for Shop Drawings in this Section.
c. Product data for field wiring and piping provided for instrumentation and control service and not included under other Sections or contracts.

3. Samples:
a. Color charts for finish paint for panels. Provide full range of paint manufacturer's standard and custom colors. Color selection will be by ENGINEER.
b. Color charts for FRP panels. Provide full range of panel manufacturer's standard and custom colors. Color selection will be by ENGINEER.

B. Informational Submittals: Submit the following:

1. Documents to be submitted prior to pre-submittal conference, in accordance with Article 1.3 of this specification.
2. Manufacturer's Instructions:
    a. Shipping, handling, storage, installation, and start-up instructions.
3. Source Quality Control Submittals:
    a. Factory test reports and results.
4. Special Procedure Submittals:
    a. Submit notification to OWNER and ENGINEER at least 14 days before readiness to begin system checkout. Schedule system checkout on dates agreed to by OWNER and ENGINEER.
    b. Submit written procedure for system checkout to ENGINEER three months prior to starting system checkout. Three months prior to starting system checkout submit written procedure for start-up to ENGINEER.
5. Field Quality Control Submittals:
    a. Submit the following prior to commencing system checkout and start-up.
        1) Completed calibration sheets for each installed instrument showing five-point calibration (0, 25, 50, 75, 100 percent of span), signed by factory-authorized serviceman.
    b. Field calibration reports
    c. Field testing reports.
6. Supplier's Reports:
    a. Installation inspection and check-out report.
    b. Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
7. Qualifications Statements:
    a. Supplier.
    b. Manufacturer, when required by ENGINEER.

C. Closeout Submittals: Submit the following:
1. Operations and Maintenance Data:
    a. Submit in accordance with Section 01 78 23, Operation and Maintenance Data.
    b. Include complete up-to-date system software documentation. Provide hardcopy and electronic copies.
    c. Include acceptable test reports, maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.
2. Record Documentation:
    a. Prepare and submit record documents in accordance with Section 01 78 39, Project Record Documents.
    b. Revise all system Shop Drawing submittals to reflect as-built conditions in accordance with the following.

1) Two copies of each revised Shop Drawings and documentation to replace out-dated drawings and documentation contained in operation and maintenance manuals. Submit half-size black line drawings for each drawing larger than 11 inches by 17 inches. Include specific instructions for out-dated drawing removal and replacement with record documents submittal.
2) Half-size black line prints of wiring diagrams applicable to each control panel shall be placed in clear plastic envelopes and stored in a suitable print pocket or container inside each control panel.
3) Submit CADD drawings of the point-to-point interconnection wiring diagrams updated to reflect final as-built equipment information and as-installed field installation information.

D. Maintenance Materials Submittals: Submit the following:
1. Spare Parts and Test Equipment
a. General
1) Furnish the spare parts and test equipment as indicated below, identical to and interchangeable with similar equipment provided under this Section.
2) Provide source quality control for spare parts as part of factory testing prior to shipment of instrumentation and control equipment.
3) For process sensors and other analog instruments, Supplier shall submit a separate quotation for recommended list of spare parts and test equipment. Separately list and price each item recommended. Spare parts quotation shall include a statement that prices quoted are valid for a period of one year from date of equipment installation and that Supplier understands that OWNER reserves the right to purchase none, any, or all parts quoted. Upon request, Supplier shall submit documentation that stock of spare parts and test equipment is obtainable within 48 hours of receipt of OWNER's order.
b. Furnish the following spare parts:
1) Five of each type of input/output relay for each quantity of forty or fraction thereof provided under the Contract.
2) One replacement power supply for each type and size provided under the Contract.
3) One-year supply of all expendable or consumable materials.
4) One per quantity of five or fraction thereof of gauges, indicators, and switches provided, complete with diaphragm seals, filled and ready to use.
5) One per quantity of ten of fraction thereof provided, per range of field instruments including insertion type instruments. No spares are required for inline instruments such as magnetic flow meters and flumes or venturis that include flow tubes through which flow is conveyed.

6) Twelve of each type and size of fuse used in instruments.
7) Twelve of each type and size of surge supressors used

c. Furnish the following test equipment:
1) Tooling required to insert, extract, and connect internal or external connectors, including edge connectors.
2) Any special calibration equipment required for system calibration.

1.5 STORAGE AND HANDLING

A. Prior to packaging, each manufacturer or Supplier shall securely attach tag number and instructions for proper field handling and installation to each instrument.

B. Comply with Section 01 65 00, Product Delivery Requirements, and Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Power Supplies:
1. Electrically powered equipment and devices shall be suitable for operation on 115-volt plus-or-minus 10 percent, single-phase, 60 Hertz plus-or-minus two Hertz, power supply. If different voltage or closer regulation is required, provide suitable regulator or transformer at no additional cost to OWNER.
2. Provide appropriate power supplies for field instruments requiring power source less than 115 volts. Power supplies shall be mounted in control panels or enclosures installed near associated instrument or in field panels.
3. Power supplies shall be capable of minimum of 130 percent of maximum simultaneous current draw.
4. Provide power on-off switch or air circuit breaker for each item provided under this Section that requires electric power.

B. Signal Requirements:
1. Control system shall use four to 20 mA DC analog signals, unless otherwise shown or indicated.
2. Provide signal converters and repeaters where required. Adequately size power supplies for signal converters and repeater loads.
3. Isolate signals from ground.
4. Signals transient DC voltage shall not exceed 300 volts over one millisecond, and shall not have a DC component over 300 volts.
5. Discrete signals shall use 120 VAC.

C. Surge Protection Requirements:

1. Provide surge protection to protect electronic instrumentation and control systems from surges propagating along signal and power supply cabling. Protection systems shall be such that the protection level shall not interfere with normal operation, but shall be lower than instrument surge withstand level, and be maintenance-free and self-restoring.
2. Provide instruments in suitable metallic cases, properly grounded. Ground wires for surge protectors shall be connected to good earth ground and, where practical, run each ground wire individually and insulated from other wires. Mount protectors within instrument enclosure or in separate junction box compatible with the area designation coupled to the enclosure.
3. The surge protection devices shall be manufactured by Phenoix Contact, MTL, or equal.

D. Miscellaneous:
   1. General:
      a. Instrumentation components shall be heavy-duty types, constructed for continuous service.
      b. System shall consist of equipment models currently in production.
      c. Materials and equipment, including cabling and interconnections, shall be in accordance with Division 16, Electrical, and manufacturer's recommendations, unless indicated otherwise in the Contract Documents.
      d. Materials and equipment shall, where applicable, be in accordance with UL standards and be so marked and labeled.
   2. Logic and control loops shall be fail-safe. Instrumentation components shall return automatically to accurate measurement within 15 seconds upon restoration of power after power failure and when transferred to standby power supply.
   3. Provide surge protection for instruments and other control system components that could be damaged by electrical surges. Provide lightning arresters on both ends of communication lines, except for fiber optic cabling, external to buildings or structures, including leased telephone lines and similar communication lines.
   4. Field-mounted instruments and system components shall be constructed for use in humid and corrosive service conditions. Field-mounted instrument enclosures, junction boxes and appurtenances shall have NEMA rating appropriate for hazardous rating requirements shown or indicated on drawings and specifications, instrument data sheets, and elsewhere in the Contract Documents.
   5. Miscellaneous hardware such as fittings, fasteners, and screws, be Type 316 stainless steel or other appropriate material to prevent galvanic reactions, and shall be suitable for service intended. Piping stands shall be provided for fastening instruments as required. Provide threaded pipe stands with flange bolted to slab. Use carbon steel piping and flanges painted in accordance with Section 09 91 00, Painting.

6. Data processing equipment and relays with interconnections to field devices shall be wired through field wiring terminal blocks in the panel. Terminals as part of relay base are unacceptable.
7. Arrange panel-mounted instruments, switches, and other devices ergonomically for functional use and ease of maintenance. Similar types of panel-mounted devices shall be by one same manufacturer and of the same model line.
8. Equipment furnished shall be of modular construction and be capable of field expansion through installation of plug-in circuit cards and additional cabinets as necessary.
9. Field- and panel-mounted instruments shall be tagged with equipment number and nomenclature indicated in the Contract Documents; if not so indicated, tag in accordance with approved Shop Drawings.
10. Coordinate ranges and scales specified in the Contract Documents with manufacturer of the equipment actually furnished for operability over the intended range. Complete the coordination prior to submitting Shop Drawings to ENGINEER.
11. Treat field-mounted devices with anti-fungus spray.
12. Protect field-mounted devices from exposure to high and freezing temperatures to provide complete operability under the environmental conditions indicated in the Contract Documents.

E. Environmental Conditions:
   1. Provide control system suitable for continuous operation under the following conditions:
      a. Indoor Instruments:
         1) Ambient Temperature: Zero degrees F to 120 degrees F.
         2) Relative Humidity: 100 percent, maximum.
      b. Outdoor Instruments
         1) Ambient Temperature: -15 degrees F to 120 degrees F.
         2) Relative Humidity: 100 percent, maximum.
   2. Protect outdoor-mounted field instruments and panels from direct sunlight by providing 3-sided, with top, sunshield for instruments and control panels with displays. Construct sunshield out of heavy gauge aluminum for outdoor mounting or stainless steel in corrosive areas. The sunshields shall be coated with power coat white. Sunshade and mounting shall withstand an ultimate design wind velocity of 130 miles per hour. Direct instrument display and mounting in northern direction if possible. The sunshield shall be provided as shown on the drawings.

2.2 PROCESS TAPS, SENSING LINES, AND ACCESSORIES

A. Pressure Tap Sensing Lines and Accessories for Pressure Gauges and Pressure Switches:
   1. For Process Sensing Taps in Ductile Iron, Steel and Stainless Steel Piping Systems:

a. Material and Fittings: Type 304 stainless steel pipe, ASTM A312; and threaded fittings and adapters, ASTM A403.
b. Sizes: 1/2-inch diameter minimum for main sensing piping and 1/4-inch diameter gauge and switch connections.
c. Pressure Rating: Equal to or greater than the applicable system test pressure as specified in the Contract Documents.
d. Accessories:
1) For applications not requiring diaphragm seals, provide separate 1/2-inch diameter Type 316 stainless steel threaded ball valve for each gauge and switch.
2) For applications requiring diaphragm seals, provide separate 1/2-inch diameter threaded Type 316 stainless steel ball valve for seal process side shutoff.

2. For Process Sensing Taps in Copper and Thermoplastic Piping Systems:
a. Pipe Material and Fittings: Use same type of pipe material and fittings as that used in the process piping system. Provide PVC and CPVC piping in accordance with Section 40 05 31, Thermoplastic Process Pipe.
b. Sizes: 1/2-inch diameter minimum for main process sensing piping and 1/4-inch diameter for gauge and switch connections.
c. Pressure Rating: Equal to or greater than the applicable system test pressure as specified in the Contract Documents.
d. Accessories:
1) For copper piping system taps with or without seals, provide separate 1/2-inch diameter minimum threaded brass or bronze ball valve for each gauge and switch.
2) For PVC and CPVC piping systems with or without diaphragm seals, provide separate 1/2-inch diameter threaded ball valve for process sensing line shutoff.

2.3 PANELS

A. General Provisions:
1. Provide electrical components and devices, support hardware, fasteners, and interconnecting wiring and piping required to provide control panels complete and operational.
2. Locate and provide hardware so that connections can be easily made and there is ample room for servicing each item.
3. Prevent movement by adequately supporting and restraining devices and components mounted on or within panel.
4. Provide panels with sub-panels for installation of all internally mounted hardware.
5. Provide numbered terminal strips for terminating field wiring and wiring from other panels, unless otherwise shown or indicated.
6. Provide copper grounding studs for hardware requiring grounding.
7. Provide the following convenience accessories inside each panel:
a. One 120 vac, 20-amp duplex, grounding type receptacle.

b. One 120 vac fluorescent service light fixture with 20-watt lamp and protective plastic shield or appropriate wattage incandescent bulb for panels two feet by two feet and smaller.
c. One 120 vac snap switch, to turn on service light, mounted in outlet box with cover and located so that switch is easily accessible from access door.
d. Service light with switch and duplex receptacle shall have a dedicated circuit breaker.

8. Control of Environment (Except NEMA 7 Panels):
   a. If required, provide 120 vac thermostatically-controlled fan-driven heater units to maintain stable temperature within enclosure to protect equipment from harmful effects of condensation, corrosion, and low temperatures inside panels.
   b. Submit supporting calculations as part of panel Shop Drawing submittal if panel equipment to comply with specified environmental requirements is proposed to be deleted as unnecessary.
9. Panels to be located in non-hazardous (non-classified) environments shall comply with UL 50 and UL 508A.
10. Panels to be located in hazardous (classified) environments shall comply with UL 698A and UL 2062.
11. Provide panels under this Section with 25% percent additional space requirements for future use. Install nothing in space reserved for future use.
12. CONTRACTOR is responsible for detailed layout and design of panels, in accordance with the Contract Documents. Base cutouts and design on instrument manufacturers' requirements.
13. Lower 12 inches of free standing panels shall be free of devices, including panduits and terminal strips, for ease of installation and maintenance.
14. For front-opening panels, install no device less than three feet above operating floor level, unless otherwise shown or indicated. For rear-opening panels, install no devices on the door.
15. Wire bundles between subpanels and front panel-mounted devices shall be anchored and protected from damage by opening and closing of panel door.
16. Do not locate front panel-mounted devices requiring manipulation by operating personnel, such as pushbuttons, hand switches, controllers, and similar devices, higher than 5.5 feet above finished floor.
17. Panduits located on either side of terminal strips shall have minimum clearance of 1.5 inches between panduit and terminal strip.
18. Provide three-inch high channel base assembly, drilled to mate panel to floor pad.
19. Provide easily-accessible pocket built into panel door to enclose "as built" panel wiring diagrams.
20. Panels shall be UL-listed.

B. Identification:
   1. Provide laminated plastic nameplate for identification of panels. Use self-tapping stainless steel screws for fastening nameplates to panels. When self-

tapping screws may degrade panel's NEMA rating, retain NEMA rating intact by using gaskets on each side of panel surface and use retaining plate on the panel back that is same size as nameplate. When gaskets and retaining plate are used, use full-penetration screws with nuts.

2. Panel identification nameplates shall have 1/2-inch high engraved letters.
3. Identify front panel-mounted devices with nameplates engraved with functional description of the device. Nameplate engraving shall be in accordance with the identification provided in the Drawing
4. Tag electric components and devices mounted within panels with high adhesive labels.
5. Identify terminal strips with nameplate engraved as "TB-XX" where "XX' is the numerical identification of terminal strip.
6. Identify terminals within each terminal strip with sequential numbers and wire numbers.
7. Internal panel wiring shall be color-coded and numerically identified with unique wire numbers affixed at each end of each wire. Color coding shall be in accordance with panel wiring color code table, below, in addition to requirements of Section 26 00 05, Electrical Identification paragraph:

Panel Wiring Color Code Table

Description	Color
110 vac panel power before fuses or breakers	Black
Controlled 110 vac power (e.g., after relay contacts, selector switch contacts, and similar equipment.)	Red
110 vac power source from devices external to panel	Yellow
110 vac neutral	White
24 vdc positive power from power supplies	Brown
24 vdc negative power from power supplies	
Controlled 24 vdc power (e.g., after PLC output contacts, relay contacts, and similar)	Blue
24 vdc positive power from devices external to panel	Orange
24 vdc negative power from devices external to panel	
24 vdc four to 20 mA DC signal cable	Grey with red positive, clear negative
Grounding wire	Green

C. Panel Construction Features:
   1. Control panels located in non-environmentally controlled areas and outdoor areas shall be rated NEMA 4X and with the following features:
      a. Construct panels of fiberglass mat-reinforced polyester resin, with minimum thickness of 3/16-inch for all surfaces, except areas requiring reinforcement.
      b. Panels shall be precision-molded to form one-pieced unit with rounded corners.
      c. Exterior surfaces shall be gel-coated to provide corrosion-resistant, maintenance-free satin finish that does not required painting or other protective coating.

d. Color pigments shall be molded into the resin.
e. Color shall be selected by ENGINEER from complete selection of standard and custom color charts furnished by manufacturer.
f. Panels shall have front access doors where rear access is not feasible.
g. Provide clear-plastic and gasketed lockable hinged door to encompass non-NEMA 4X front-of-panel devices.
h. Hardware, including hinge and means of locking shall be corrosion resistant.

2. Control panels located in non-environmentally controlled areas and outdoor areas shall be rated NEMA 4X and with the following features:
   a. Panels shall be Type 316L stainless steel construction with minimum thickness of 12-gage for all surfaces, except areas requiring reinforcing, with a smooth-brushed finish.
   b. Stainless steel screw clamp assemblies on three sides of each door.
   c. Rolled lip around three sides of door and along top of enclosure opening.
   d. Hasp and staple for padlocking.
   e. Provide clear-plastic, gasketed lockable hinged door to encompass non-NEMA 4X front-of-panel devices.
3. Control Panels Located in Hazardous Rated Areas (NEMA 7):
   a. General: Provide explosion-proof enclosures, suitable for use in NEC Class 1, Groups C and D or Class II, Groups E, F and G applications and comply with UL 2062 .
   b. Required Features:
      1) Lightweight and corrosion-resistant copper-free aluminum.
      2) Integral, cast-on mounting lugs.
      3) Left side door hinges.
      4) Viewing windows sized to suit internally-mounted components.
      5) Stainless steel cover bolts.
      6) Cadmium-plated steel mounting pans.
      7) Enclosed heat-generating devices shall not cause external surfaces to reach temperatures capable of igniting explosive gas-air mixtures in surrounding atmosphere.
      8) Mark panels with appropriate class and group(s) for which panel is qualified. Panels shall comply with features and test criteria of NEMA 250.
4. Wall-Mounted Panels:
   a. General: Wall-mounted panels shall comply with applicable features and standards specified in this Section for the associated NEMA-rated panel.
   b. Unless otherwise indicated or approved by ENGINEER, depth of wall-mounted panels shall not exceed 18 inches.
   c. Panels may be all stainless steel, fiberglass, polycarbonate, or acrylonitrile butadiene and styrene (ABS).
   c. Provide appropriate size and number of external mounting feet.

d. Drilled holes or knockouts in back of wall-mounted panels are not allowed.
e. Provide corrosion-resistant polyester quick release latches (for non-stainless steel panels) or stainless steel screw clamp assemblies (for stainless steel panels).

D. Electrical Systems:
1. Power Source and Internal Power Distribution:
a. Provide in the panel, near where incoming power is terminated, nameplate with panel power supply source, type, voltage, and circuit number.
b. Protect incoming 480 and 208 vac power feeds to power the panels by providing surge protective devices, properly connected to grounds. Surge Protection Device shall be as specified in Section 26 00 05, Electrical Work.
c. Provide panels with internal 480 vac and 120 vac power distribution system with properly-sized and -rated circuit breakers to distribute power. Power not more than six devices from a single 120 vac breaker. When power supplies are included in the panel, not more than two power supplies shall be powered from a single breaker. Convenience receptacles and interior panel lights shall have their own breakers. When one or more field instruments require 120 vac power from the panel for instrument power, power not more than three instruments from a given breaker.
d. Provide space for a minimum of two spare breakers in each panel.
2. Electrical Systems:
a. Internal wiring shall be Type MTW and THW stranded copper wire with thermoplastic insulation rated for 600 volts at 85 degrees C for single conductors, color-coded and labeled with wire identification.
b. For DC signal wiring, use shielded cable with 18-gage conductors. DC field signal wiring terminal strips shall be capable of handling wires up and including No. 12 size.
c. For AC power wiring, use No. 12 minimum AWG. For AC signal and control wiring, use No. 16 minimum AWG. For wiring carrying more than 15 amps, use sizes required by the NEC (NFPA 70) .
d. Inside of panels, route DC signal wiring separately from power wiring with minimum separation distance of six inches.
e. Use covered panduits to route internal panel cables and wiring. Panduits in each section of panel shall be appropriately sized to accommodate the quantity of wires to be routed with a spare capacity of 40 percent.
f. Install wire troughs inside panels along horizontal or vertical routes to present a neat appearance. Angled runs are unacceptable.
g. Wiring that is routed without panduits shall be adequately supported and restrained to prevent sagging or other movement. Use of adhesive anchors to support or restrain wiring is unacceptable.

h. Terminate internal panel wiring using forked, insulated, crimp-on connectors; soldered connectors are unacceptable. Provide panels with 600-volt rated barrier type terminal strips mounted on Din rails. Identify terminal strips as indicated in this Section. Identification devices shall be self-stick, plastic tape strips with permanent, machine-printed numbers. .
i. Wiring in panels shall be installed such that, if wires are removed from any one device, power will not be disrupted to other devices.
j. Provide spare terminals equal in number to 20 percent of terminals used for each type of wiring (e.g., DC signal and AC power).
k. Provide ground terminals to terminate the shield wire of shielded cables. Termination of more than two shielded wires on a single ground terminal is unacceptable.
l. Provide a single copper bus bar with 5/16-inch diameter copper grounding stud to connect the panel to external ground. Panel's internal grounds shall be terminated to the bus bar.
m. Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation.
n. When DC power or low voltage AC power is required, furnish and install in the panel required power supplies and transformers.
o. Provide complete wiring diagram of "as-built" circuitry enclosed in transparent plastic.

2.4 DATA SHEETS – PANEL INSTRUMENTS AND PRIMARY SENSORS AND FIELD INSTRUMENTS

A. General:
1. Panel-mounted devices and instruments and primary sensors and field instruments shall be in accordance with the "data sheets" included in Part 3 of this specification.
2. Do not fabricate, ship, or assemble instruments and devices in panels until required Shop Drawings and other submittals required for fabrication are approved or accepted as required.

2.5 IDENTIFICATION

A. Instrument Tagging
1. Headings on the instrument index in the Contract Documents have the following meaning:
a. "TAG" is divided into two sections. The first seven to nine alphanumeric characters represent the OWNER's equipment number and the remaining characters comply with ISA Standard S5.1.
b. "DESCRIPTION/LOCATION" is an explanation of instrument function and location.

c. “RANGE/SET POINT” is the limit for the specified units of the instrument and set point is the precise value within the instrument’s range.
d. “SPEC REF” is the paragraph reference in the Specifications where the instrument’s requirements are specified.
e. “DRAWING NO.” indicates the Drawing where the device is shown or indicated.
f. “REMARKS” contains specific notes relative to the instrument.

B. Auto Dialer Input/Output List Identification
1. I/O point list contains information required to configure I/O interface hardware, and to indicate location of the signal origination.
2. “POINT NUMBER” is an alphanumeric character string. For example, for the point “FI-806” the following apply:
a. The first two character is the functional identifier and conforms with ANSI/ISA S5.1. In the example, “F” represents flow.
b. The first three-digit number (806) identifies the P&ID number.
c. Suffix, where required, is used for distinguishing between similar variables.
3. “DESCRIPTION” is an alphanumeric character string up to 40 characters in length. Points described as “SPARE” indicate pre-wired I/O.
4. “SIGNAL TYPE” is one of the following:
a. AI indicates analog input.
b. DI indicates discrete input.
c. PI indicates pulse input.
d. AO indicates analog output.
e. DO indicates momentary, maintained or latched discrete output.

C. ISA Identification
1. A = Analytical.
2. B = Burner, Combustion.
3. C = Cooling (Cooling Condenser).
4. D = Dissolved.
5. E = Voltage.
6. F = Flow.
7. G = Intrusion.
8. H = Hand.
9. I = Current.
10. J = Power.
11. K = Time.
12. L = Level.
13. M = Manual.
14. N = UNDEFINED.
15. O = Overload.
16. P = Pressure.
17. Q = Communication.

18. R = Reverse.
19. S = Speed, Frequency.
20. T = Temperature.
21. U = Universal (Common).
22. V = Vibration.
23. W = Torque (Weight or Force).
24. X = Critical (Emergency).
25. Y = Event, State or Presence.
26. Z = Position, Dimension.

D. Function Identifier:
1. A = Alarm
2. B = UNDEFINED.
3. C = Control.
4. D = Differential.
5. E = Element.
6. F = Failure.
7. G = UNDEFINED.
8. H = High.
9. I = Indication.
10. J = UNDEFINED.
11. K = Factor.
12. L = Low.
13. M = Mode.
14. N = Normal.
15. O = Oxygen.
16. P = UNDEFINED.
17. Q = Quantity.
18. R = Rotation.
19. S = Switch.
20. T = Timer
21. U = UNDEFINED.
22. V = Slow (output)
23. W = Slow (input)
24. X = Selector Switch (input)

2.6 SOURCE QUALITY CONTROL

A. General:
1. Factory Test for equipment provided by Vendors and I&C subcontractor:
   a. Neither OWNER or ENGINEER will witness factory test at the testing facility during operational test of equipment. Registered professional engineer retained by CONTRACTOR or Supplier shall witness factory test to verify that approved test procedures are followed. When factory tests have been successfully completed, submit to ENGINEER factory test report signed and sealed by professional engineer.

2. Factory test results will be acceptable when all components within tested control panel or system being tested successfully operate and meet its intended function, and are so certified by the testing entity.
3. Do not ship the equipment until obtaining ENGINEER's acceptance of factory test results.

B. Factory Inspection:
   1. Inspect each panel, console, device, and cabinet before testing and before shipping. Inspection shall include, but not be limited to the following:
      a. Verify all "Approved as Corrected" comments on Shop Drawings were implemented.
      b. Verify presence of and accuracy of nameplates and tags.
      c. Verify that wire sizes and color-coding comply with the Contract Documents.
      d. Verify presence of terminal blocks, terminal block numbers, and required quantity of spares.
      e. Verfiy annunciator window engravings and quantity of spare windows comply with the Contract Documents.
      f. Verify proper wiring practices and grounding.
      g. Verify enclosure flatness, finish, and color.
      h. Verify anchoring of wire bundles between subpanels and front panel-mounted devices.
      i. Verify presence of applicable items specified in this Section.

C. Auto Dialer Operational Testing:
   1. Test all input/output components to verify that internal panel wiring is properly terminated at correct locations. Verify initial ranges and settings.
   2. Test all system hardware and software to verify proper operation as stand-alone units. Test shall include, but not be limited to, the following:
      a. Power distribution and breaker ratings to match approved Shop Drawings.
      b. Power fail/restart tests.
      c. Diagnostics checks.
      d. Demonstrate that all specified equipment functional capabilities are working properly.
   3. Test components and devices requiring data transmission to verify that communication between such components is working properly. Verify communication by using the same media required for the completed system at the Site as indicated in the Contract Documents.
   4. Perform integrated system test with all system equipment and simulated inputs/outputs connected to verify that equipment is performing properly as an integrated system.
   5. Simulation devices shall be of suitable quality to not mask control panel defects.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Environmental Requirements:
   1. Do not install instruments in areas where construction may cause instrument to be damaged, without providing adequate protection for said instrument.

B. Installation of Instrumentation:
   1. Secure field-mounted instruments to stands or brackets in accordance with manufacturer's recommendations, approved or accepted (as applicable) submittals, and the Contract Documents.
   2. Locate sensors where shown on the Drawings. Confirm exact locations in the field with ENGINEER.
   3. Install all devices so that devices are readily accessible for service and do not cause potential hazards.

C. Services and Operator Instructions:
   1. Provide repairs or replacement of defective materials, equipment or workmanship, including with respect to equipment, the services of factory-trained servicemen.
   2. In addition to the calibration required for check-out, provide two additional calibrations on all instruments. The first re-calibration shall be approximately six months after acceptance of the system, and the second shall be approximately eleven months after acceptance. As part of each calibration, provide two copies of the calibration sheets, a detailed list of deficiencies (should any be found), and a statement that the entire system is in proper operation and condition (except for the deficiencies noted) and shall be turned over to the OWNER.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections: Field-verify calibration and performance of each instrument prior to start-up of the associated equipment, and document on a separate sheet for each.
   1. For each calibration certification sheet, include the following information:
      a. Project name.
      b. Tag number and description.
      c. Manufacturer.

d. Model and serial number.
e. Date, time and person who performed calibration.
f. Calibration data to include.
    1) Input, output, and error at 0, 25, 75, and 100 percent of span for analog instruments.
    2) Switch setting, contact action and deadband, if applicable, for discrete elements.
g. Space for comments.
h. Signature and date.

2. System Check-Out and Start-Up Responsibilities for packaged systems and I&C subcontractor systems:
    a. CONTRACTOR shall retain the services of the System Supplier to supervise and/or perform check-out and start-up of all system components. As part of these services, the System Supplier shall include for those equipment items not manufactured by him the services of an authorized manufacturer's representative to check the equipment installation and place the equipment in operation. The manufacturer's representative shall be thoroughly knowledgeable about the installation, operation and maintenance of the equipment.
    b. Check and approve the installation of all instrumentation and control system components and all cable and wiring connections between the various system components prior to placing the various processes and equipment into operation.
    c. Conduct a complete system checkout and adjustment, including calibration of all instruments, tuning of control loops, checking operation functions, and testing of final control actions. When there are future operational functions included in the Work, they should be included in the system checkout. All problems encountered shall be promptly corrected to prevent any delays in start-up of the various unit processes.
    d. CONTRACTOR shall provide all test equipment necessary to perform the testing during system checkout and start-up.
    e. CONTRACTOR and System Supplier shall be responsible for initial operation of monitoring and control system and shall make any required changes, adjustments or replacements for operation, monitoring and control of the various processes and equipment necessary to perform the functions intended at no additional cost to the OWNER. These changes or adjustments shall be documented by the CONTRACTOR and submitted to the ENGINEER as part of the Installation Inspection Report described in Paragraph g. below.
    f. CONTRACTOR shall furnish to the ENGINEER certified calibration reports for field instruments and panel mounted devices specified in this Section as soon as calibration is completed.
    g. CONTRACTOR shall furnish ENGINEER an Installation Inspection Report certifying that all equipment has been installed correctly and is

operating properly. The report shall be signed by authorized representatives of both CONTRACTOR and the System Supplier.

h. Instrumentation and Control System Field Test:
   1) Following the instrumentation and control system checkout and initial operation, CONTRACTOR, under the supervision of the System Supplier, shall perform a complete system test to verify that all equipment and programmed software is operating properly as a fully integrated system, and that the intended instrumentation and control functions are fully implemented and operational. Any defects or problems found during the test shall be corrected by CONTRACTOR and then retested to demonstrate proper operation.
   2) Following demonstration of all system functions, the instrumentation and control system, including field sensors/transducers and instruments, and telemetry system shall be running and fully operational for a continuous 48 hour period.

3.4 MANUFACTURER'S SERVICES

A. General:
   1. CONTRACTOR shall retain the services of the System Supplier to provide operation and maintenance training for all instrumentation and control system equipment as specified herein.
   2. For equipment items not manufactured by the System Supplier, he shall provide for on-Site training by an authorized representative of the equipment manufacturer as part of his services. The manufacturer's representative shall be fully knowledgeable in the operation and maintenance of the equipment.
   3. CONTRACTOR shall be responsible for all costs associated with training and shall provide all required materials, texts and required supplies.
   4. Training shall conform to the requirements of Section 01 79 23, Instruction of Operations and Maintenance Personnel.

B. On-Site Training:
   1. General:
      a. Provide on-Site operation and maintenance training by System Supplier and the equipment manufacturer representatives prior to placing the equipment in continuous operation.
      b. Training courses shall include time for students to develop and demonstrate understanding of training concepts. Testing shall include hands on training with equipment.
      c. At the conclusion of each course students shall be tested on course material. Testing shall include exercises where students must demonstrate proper response to normal operational needs, emergencies and maintenance tasks. Every student shall be tested individually.
      d. Training shall accomplish the following:
         1) Provide instruction covering use and operation of the equipment to perform the intended functions.

2) Provide instruction covering procedures for routine, preventive and troubleshooting maintenance, including equipment calibration.
3) Explain procedures for placing the equipment in and out of operation and explain necessary actions and precautions to be taken regarding the overall plant monitoring and control system.
4) Provide classes and field training as to how to change process control and alarm set points in all microprocessor based controllers and transmitters. Maintenance personnel shall be trained to enter passwords, programming or configuration data, etc.

2. Primary Sensors/Transducers and Field Instruments:
   a. The services of equipment manufacturer's representatives shall be provided for a minimum of 1 hour for each type of instrument.
   b. Training shall include:
      1) Basic repair and maintenance capabilities of installed equipment.
      2) Procedures for placing the equipment in and out of operation.
      3) Use of any special repair equipment or software packages that are used for repair or maintenance.
      4) Procedures for testing any repair before placing equipment back in service.
3. Auto Dialer Equipment:
   a. The supplier shall allow minimum 1 hour for training.
   b. The supplier shall provide training that covers Auto Dialer system as follows:
      1) Provide an overview of hardware and software (if any).
      2) It shall train people in configuration and operation of the system.
      3) The emphasis shall be placed on how to perform minor configuration changes, range changes, diagnostics and upkeep of documentation.
      4) Instruction for hardware maintenance, troubleshooting and maintenance planning.

3.5 SUPPLEMENTS

A. The supplements listed below, following the “End of Section” designation, are part of this Specification section.

B. Data Sheets – Panel Instruments and Devices

Parag.	Description	Page
3.5.B.2	Automatic Telephone Dialer	27
3.5.B.17	Power Supply – Single Unit	28
3.5.B.21	Relay - Control	29
3.5.B.23	Relay - Time Delay	30
3.5.B.24	Selector Switches, Pushbuttons and Indicating Lights	31
3.5.B.25	Timer - Cycle Type	32

3.5.B.26 Timer - Elapsed Time Meter (Hour Meter) 33

C. Data Sheets – Primary Sensors and Field Instruments

Parag.	Description	Page

Article	Description	Page
3.5.C.34	Flow Meter (Ultrasonic) - Transit Time Open Channel	35
3.5.C.59	Level Switch - Float Type (Single Point)	36
3.5.C.73	Pressure Gauge - Bourdon Type	40
-	References	41

D. Instrument Index 42

E. Auto Dialer Input/Output List 43

+ + END OF SECTION + +

DATA SHEETS - PANEL INSTRUMENTS AND DEVICES

PRODUCT	Automatic Telephone Dialer	SHEET 1	OF 1
PROJECT	COLUMBIA COUNTY - ELLISVILLE WWTP	SPEC. NO. 40 60 05 - 3.5.B.2	ADDENDUM./C.O.

DIALER		
Type:	1	Solid-State, Message Recording, Automatic Telephone Dialer.
Input:	2	4 Digital Inputs (up to 32 optional) with surge protection.
Power Supply:	3	120 VAC, 60 Hz; 20-hour automatically rechargeable battery back-up (Battery operation shall be automatic upon power failure).
Operating Temp.:	4	20 to 130 degrees F.
Operating Humidity:	5	0 to 95% non-condensing.
Relay:	6	SPST dry contact for fault detection transmission.
Alarm:	7	Power failure alarm.
Capacity:	8	Stores up to 16 telephone numbers; Data entry via keyboard and audio input.
Message:	9	Variable message length of each fault.
Indication/Display:	10	Status only indication.
Enclosure/Housing:	11	NEMA 4X.
Mounting:	12	Panel or Wall Mount, as required.
Additional Features:	13	4-Digit Security Code; Internal Clock.
NOTES		
Functions:	14	Dialer shall: - Respond to any change in a monitored condition by automatically executing a series of telephone calls and repeating a pre-programmed human voice message. - Use standard telephone lines, detect a busy signal and automatically proceed to the next telephone number programmed for the fault. - Detect a fault via normally open/closed contacts.
Installation:	15	Refer to Contract Drawings and manufacturer's recommendations for installation details.
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MANUFACTURE		Provide products of one of the following, Or Equal:
Manufacturer:	31	RACO - Verbatim

DATA SHEETS - PANEL INSTRUMENTS AND DEVICES

PRODUCT	Power Supply - Single Unit	SHEET 1 OF 1	
PROJECT	COLUMBIA COUNTY - ELLISVILLE WWTP	SPEC. NO. 40 60 05 - 3.5.B.17	ADDENDUM./C.O.

SINGLE UNIT		
Type:	1	Single Unit Power Supply with Solid-State Circuitry.
Input:	2	120 VAC ±10%, 60 Hz.
Output:	3	24VDC ± 1%
Line / Load:	4	±0.005% line to load regulation.
Ripple:	5	0.25 mV RMS.
Polarity:	6	Floating output.
Ambient Temp.:	7	15 to 150 degrees F.
Response Time:	8	Less than 20 micro-seconds.
Protection:	9	Transient surge protection Varistor
Connections:	10	Twist-lock AC power connector plug; DC power terminal strip screw terminals for connecting a minimum of two No.14 AWG wires.
Mounting:	11	Surface mount; Provide mounting brackets.
Additional Features:	12	Provide fuses as required.
NOTES		
Location:	13	Power Supplies shall be located in control room panels, remote terminal units, and field panels as required.
Installation:	14	Refer to Contract Drawings and manufacturer's recommendations for installation details.
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MANUFACTURE		Provide products of one of the following, Or Equal:
Manufacturer:	32	Acopian Corporation

DATA SHEETS - PANEL INSTRUMENTS AND DEVICES

PRODUCT	Relay - Control	SHEET 1 OF 1	
PROJECT	COLUMBIA COUNTY - ELLISVILLE WWTP	SPEC. NO. 40 60 05 - 3.5.B.21	ADDENDUM./C.O.

RELAY		
Type:	1	General Purpose, Plug-in Control Relay.
Coil Voltage:	2	24 VDC OR 120 VAC, as required.
Rating:	3	Continuous Duty.
Contacts:	4	Silver cadmium oxide rated not less than 5A resistive at 120 VAC or 24 VDC; For switching low energy circuits (less than 200mA) use: fine silver, gold flashed contacts rated not less than 3A resistive at 120 VAC or 24 VDC.
Indication/Display:	5	Pilot light to show energized coil.
Enclosure/Housing:	6	Clear plastic dust cover.
Mounting:	7	DIN rail or surface mounted
Additional Features:	8	
NOTES		
Location:	9	Control Relays located in local control panels as required.
Installation:	10	Refer to Contract Drawings and manufacturer's recommendations for installation details.
Approvals:	11	Relays shall be UL recognized.
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MANUFACTURE		Provide products of one of the following, Or Equal:
Manufacturer:	32	Square D Company / IDEC

DATA SHEETS - PANEL INSTRUMENTS AND DEVICES

PRODUCT	Relay - Time Delay	SHEET 1 OF 1	
PROJECT	COLUMBIA COUNTY - ELLISVILLE WWTP	SPEC. NO. 40 60 05 - 3.5.B.23	ADDENDUM./C.O.

PERFORMANCE		
Accuracy:	1	10%.
Operating Temp.:	2	32 to 130 degrees F.
RELAY		
Type:	3	Plug-in Type Time Delay Relay.
Power Supply:	4	120 VAC or 24 VDC, as required.
Contacts:	5	DPDT.
Rating:	6	5A at 120 VAC, 5A at 24 VDC.
Indication/Display:	7	Timing status LED.
Range:	8	Switch selectable ranges as follows: 1 seconds, 10 seconds, 1 minute, 10 minutes, 1 hour, 10 hours.
Enclosure/Housing:	9	Dust and moisture resistant molded plastic case.
Mounting:	10	DIN rail or surface mounted
Additional Features:	11	MOS digital circuit with transformer coupled power.
NOTES		
Function:	12	Dial adjustable, plug-in type time delay relay providing delay-on-make, delay-on-break or interval operation.
Installation:	13	Refer to Contract Drawings and manufacturer's recommendations for installation details.
Approvals:	14	Relay shall be UL recognized.
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MANUFACTURE		Provide products of one of the following, Or Equal:
Manufacturer:	33	Automatic Timing and Controls Company / IDEC

DATA SHEETS - PANEL INSTRUMENTS AND DEVICES

PRODUCT	Selector Switches, Pushbuttons and Indicating Lights	SHEET 1 OF 1	
PROJECT	COLUMBIA COUNTY - ELLISVILLE WWTP	SPEC. NO. 40 60 05 - 3.5.B.24	ADDENDUM./C.O.

SWITCH			
Type:	1	**Selector Switch**	**Rotary Cam Switch**
Position / Pole:	2	Amount as required to perform intended functions as specified and shown.	Amount as required to perform required signal switching function as specified and shown.
Contacts:	3	Double break, silver contacts with movable contact blade providing scrubbing action; No. and arrangement as required to perform intended functions specified, but not less than one single pole, double throw contact.	Gold-flashed contacts housed in mechanical blocks. No. and arrangement of contacts as required to perform intended function.
Rating:	4	AC or DC compatible - 10A resistive at 120 VAC or DC continuous minimum.	AC or DC compatible - 20A resistive at 600 VAC or 250 VDC continuous minimum.
Operator:	5	Standard black knob.	Standard black knob.
PUSHBUTTON			
Type:	6	Maintained or Momentary, Standard or Illuminated, Single or Dual Type Pushbuttons.	
Contacts:	7	Double break, silver contacts with movable contact blade providing scrubbing action; No. and arrangement of contacts as required to perform intended functions specified, but not less than one single pole, double throw contact.	
Operator:	8	Standard black button unless otherwise noted (See Notes for Color Chart). Provide mushroom head pushbuttons for all emergency stop functions.	
LIGHT			
Type:	9	Indicating Lights, Compact, Integral Transformer Type.	
Lamps:	10	LED; 6 Volts, Long Life (20,000 hours minimum); Lens Color (See Notes for Color Chart).	
Additional Features:	11	Common push to test circuitry shall be provided for each panel to simultaneously test all indicating lights on the panel using a single pushbutton.	
UNIT			
Type:	12	Operator-Indicator Unit.	
Enclosure/Housing:	13	Oil-tight, heavy duty; Black bezel and knob.	
Indication:	14	Maximum 4 quadrant displays with individual lamp; 6 Volt Lamps.	
Components:	15		

Component	Type	Use	Color Coding and Legends		
			Quadrant	Color	Legend
Indicator Light Module	LED	Equipment Status (e.g., "ON/OFF", "OPEN/CLOSED")	A	Red	Off; Closed; No
			B	Green	On; Open; Flow
			C & D	White	(Equipment Name)
Alarm Acknowledge Pushbutton*	Momentary Pushbutton Action	To silence audible device associated with annunciator	A & B	Amber	Alarm
			C & D	Amber	Acknowledge
Annunciator Test Pushbutton*	Momentary Pushbutton Action	To functionally test annunciator lights and audible device	A & B	Amber	Alarm
			C & D	Amber	Test
Two Position Selector Switch	2-Position Maintained Contact	To select equipment mode (e.g., winter / summer; pumps 1/2)	A	Blue**	(Mode)
			B	Green**	(Mode)
			C & D	White**	(Function)
Three Position Selector Switch	3-Position Maintained Contact	For manual or automatic operation of equipment (e.g., pumps, gates)	A	Green**	Hand; Open
			B	Red**	Off; Closed
			C	Green**	Auto
			D	White**	(Equipment Name)

* Pushbuttons shall not have lights.

** Red, Blue, or Green quadrant lights shall be energized depending on selected position of the switch. White quadrant light shall be energized continuously.

NOTES		
Location:	16	Located on local control panels as required.
Attributes:	17	Switches, pushbuttons, and lights shall be:
	18	- Supplied by one manufacturer and be of the same series or model type.
	19	- Heavy duty, oil tight, full size, and with modular contacts.
	20	- NEMA rated to match panel in which mounted.
Mounting:	21	Flush mount switches, pushbuttons and indicating lights on control panel front, unless otherwise noted.
Installation:	22	Refer to Contract Drawings and manufacturer's recommendations for installation details.
Color Chart:	23	

Color	Legend
Green	Open; On; Running
Red	Closed; Off (Ready); Stopped
Amber	Equipment Malfunction; Process Trouble; Alarms (e.g., "HIGH LEVEL")
Blue	Electrical Control Power ON

Legend Plate:	24	Provide legend plate for indication of switch, pushbutton, or light function (e.g. "OPEN-CLOSED", "HAND-OFF-AUTO").		
MANUFACTURE		Provide products of one of the following, Or Equal:		
Manufacturer:	25	Cutler-Hammer	Allen Bradley	Micro Switch

DATA SHEETS - PANEL INSTRUMENTS AND DEVICES

PRODUCT	**Timer - Cycle Type**		SHEET 1 OF 1	
PROJECT	COLUMBIA COUNTY - ELLISVILLE WWTP		SPEC. NO. 40 60 05 - 3.5.B.25	ADDENDUM./C.O.
TAG NO.		### - ###		
Ref. Dwg. No.:	1	[NTS: See Note in Unprintable Area]		
LOCATION				
Location/Panel:	2	[NTS: See Note in Unprintable Area]		
PERFORMANCE				
Accuracy:	3	Timer: ±10 ms on all ranges; Counter: 100% on all ranges.		
Operating Temp.:	4	32 to 140 degrees F.		
TIMER				
Type:	5	Adjustable, Microprocessor-based Multipurpose Timer/Counter.		
Power Supply:	6	120 VAC.		
Relay:	7	1 early and 1 delayed DPDT Load Relays.		
Rating:	8	7A at 120 VAC.		
Display/Indication:	9	3-Digit Display; Switch Selectable Ranges (See Notes, Line 17).		
Enclosure/Housing:	10	[--NTS--]; Fully gasketed, dust and watertight.		
Mounting:	11	Panel Mounted.		
Area Classification:	12	[NTS: See Note in Unprintable Area]		
Additional Features:	13	Screw terminals accessible at rear.		
NOTES				
Installation:	14	Refer to Contract Drawings and manufacturer's recommendations for installation details.		
Time/Count Periods:	15	3-programmable presets of pulse, early, and main. Programmable to run up and down from the setpoint and to stop or continue up from zero after time-out/ count-out.		
Memory:	16	Non-volatile memory that will retain entire program and present time/count periods at loss of power. Programmable for both rest and non-reset power fail operation.		
Selectable Ranges:	17	Cycle Timer shall have the following ranges available for selection: - 0 to 0.99 seconds - 0 to 99.9 seconds - 0 to 999 seconds - 0 to 9.99 minutes - 0 to 99.9 minutes - 0 to 999 minutes - 0 to 99.9 hours - 0 to 999 hours		
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MANUFACTURE		Provide products of one of the following, Or Equal:		
Manufacturer:	29	Automatic Time and Controls Company		

DATA SHEETS - PANEL INSTRUMENTS AND DEVICES

PRODUCT	Timer - Elapsed Time Meter (Hour Meter)	SHEET 1 OF 1	
PROJECT	COLUMBIA COUNTY - ELLISVILLE WWTP	SPEC. NO. 40 60 05 - 3.5.B.26	ADDENDUM./C.O.

PERFORMANCE		
Accuracy:	1	1%
Operating Temp.:	2	-40 to 150 degrees F
METER		
Type:	3	Elapsed Time Indicator.
Input:	4	Contact Closure OR Open Collector, as required.
Output:	5	4 to 20 mADC.
Power Supply:	6	120 VAC.
Runtime Capacity:	7	Up to 99,9999.9 hours; Automatic recycle to zero; One-tenth hour resolution.
Indication/Display:	8	LCD for continuous time readouts; 6 Digits minimum; Easy to read analog figures; Engineering Units; Non-resetable time indicator.
Enclosure/Housing:	9	Sealed against dirt and moisture; Tamperproof; Shock Resistant.
Mounting:	10	Front Panel Mount.
Additional Features:	11	Nameplate mounted below display engraved with "TOTAL HOURS".
NOTES		
Location:	12	Elapsed Time Meter shall be located in control room panels, remote terminal units, and field panels as required.
Installation:	13	Refer to Contract Drawings and manufacturer's recommendations for installation details.
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MANUFACTURE		Provide products of one of the following, Or Equal:
Manufacturer:	33	Veeder-Root / Cutler-Hammer

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DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT		Flow Meter (Ultrasonic) - Transit Time Open Channel		SHEET 1 OF 1
PROJECT		COLUMBIA COUNTY - ELLISVILLE WWTP		SPEC. NO. 40 60 05 - 3.5.C.34 / ADDENDUM/C.O.
TAG NO.		**FIQR - 300**		
Ref. Dwg. No.:	1	I-03		
PROCESS				
Location:	2	Refer to Electrical Drawings		
Service:	3	WWTP Discharge		
Vessel / Line No.:	4	Chlorine Contact Chamber		
Fluid:	5	Chlorinated Water		
Temp. Min/Max:	6	14 degrees F to 120 degrees F.		
Velocity Min/Max:	7	0 - 10gpm		
Up/Down Stream	8	Approx. 8 in/ Approx. 6 ft		
PERFORMANCE				
Range:	9	1-26 ft.		
Accuracy:	10	±1% of Range.		
Temperature:	11	-4 degrees F to 149 degrees F.		
Deadband:	12	16 inch.		
SENSOR				
Type:	13	Radar Velocity Sensor and Ultrasonic Level Sensor		
Element:	14	Piezoelectric Transducer.		
Channel Size:	15	1 ft H X 2 ft W X 7 ft L		
Enclosure/Housing:	16	PVDF body and CSM face		
Mounting:	17	1" NPT or BSP conduit connection		
Commun. Cable:	18	PVC Jacketed, Interconnecting Cable to Transmitter; Length as Required.		
Area Classification:	19	Not Applicable		
Additional Features:	20	Temperature Compensation; Surcharge Velocity Sensor.		
TRANSMITTER				
Type:	21	Transmitter.		
Output:	22	4-20 mADC isolated.		
Power Supply:	23	120 VAC, 60 Hz.		
Relays:	24	As Required.		
Indication / Display:	25	Integral LCD; Engineering Units; Display flow rate, flow, totals, average velocity, and level.		
Enclosure/Housing:	26	NEMA 4X; Polycarbonate.		
Mounting:	27	Wall Mount Unit		
Area Classification:	28	Corrosive		
Additional Features:	29			
NOTES				
Function:	30	Unit shall consist of a radar velocity sensor, an ultrasonic level sensor, and a transmitter, and shall provide measurement of the process fluid surface velocity within the specified accuracy. The radar sensor shall transmit a microwave beam at a defined angle to the flow surface, receive the reflected signals, and determine process fluid surface velocity which is proportional to the frequency. The ultrasonic sensor shall transmit an ultrasonic pulse perpendicular to the flow surface, receive the reflected signals, and determine the surface level to dynamically modify the surface velocity measurement.		
Installation:	31	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.		
Calibration:	32	Provide ISO Factory Calibration Certificate.		
	33			
	34			
	35			
	36			
MANUFACTURE		Provide products of one of the following, Or Equal:		
Manufacturer:	37	Siemens	Marsh-McBirney	

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT	Level Switch - Float Type (Single Point)		SHEET 1 OF 4
PROJECT	COLUMBIA COUNTY - ELLISVILLE WWTP		SPEC. NO. 40 60 05 - 3.5.C.59 / ADDENDUM/C.O.

		TAG NO.	LS - 101	LS - 102	LS - 103
	1	Ref. Dwg. No.:	I-02	I-02	I-02
PROCESS					
	2	Location:	Duplex Lift Station #1	Duplex Lift Station #1	Duplex Lift Station #1
	3	Service:	Lift Station Pumps	Lift Station Pumps	Lift Station Pumps
	4	Vessel / Line No.:	Duplex Lift Station	Duplex Lift Station	Duplex Lift Station
	5	Fluid:	Wastewater	Wastewater	Wastewater
	6	Temp. Min/Max:	32/140 degrees F.	32/140 degrees F.	32/140 degrees F.
	7	Level Min/Max:	0/15 ft.	0/15 ft.	0/15 ft.
	8	Density Min/Max:	0.65g/cm^3/0.8g/cm^3	0.65g/cm^3/0.8g/cm^3	0.65g/cm^3/0.8g/cm^3
PERFORMANCE					
	9	Operating Temp.:	-40 to 140 degrees F.	-40 to 140 degrees F.	-40 to 140 degrees F.
SWITCH					
	10	Type:	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.
	11	Relays:	SPDT rated 10A resistive at 250 VAC and 5A resistive at 30 VDC.	SPDT rated 10A resistive at 250 VAC and 5A resistive at 30 VDC.	SPDT rated 10A resistive at 250 VAC and 5A resistive at 30 VDC.
	12	Switch Action:	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.
	13	Setpoints:	EL. 52.50 ft.	EL. 55.25 ft.	EL. 55.70 ft.
	14	Enclosure/Housing:	Hollow hermetically sealed, rigidly molded polypropylene float body; Contains switch and weight.	Hollow hermetically sealed, rigidly molded polypropylene float body; Contains switch and weight.	Hollow hermetically sealed, rigidly molded polypropylene float body; Contains switch and weight.
	15	Mounting:	Pole Mount; 316 S.S. Hardware.	Pole Mount; 316 S.S. Hardware.	Pole Mount; 316 S.S. Hardware.
	16	Electrical Cable:	Heavy duty, 3-conductor, flexible, submersible cable sheathed in PVC with watertight seal; Length as required.	Heavy duty, 3-conductor, flexible, submersible cable sheathed in PVC with watertight seal; Length as required.	Heavy duty, 3-conductor, flexible, submersible cable sheathed in PVC with watertight seal; Length as required.
	17	Area Classification:	Class 1, Division II, Group D	Class 1, Division II, Group D	Class 1, Division II, Group D
	18	Additional Features:	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).
NOTES					
	19	General:	Direct acting, pear shaped, eccentric weighted, displacement type liquid level sensor.		
	20	Installation:	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.		
	21	Weight:	Provide eccentric metal weight to cause sensor to hang straight down from cable when not immersed and only allow float to pivot when immersed in liquid.		
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MANUFACTURE			Provide products of one of the following, Or Equal:		
	34	Manufacturer:	FLYGT - Division of ITT Industries	STI	SJE-Rhombus

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT	Level Switch - Float Type (Single Point)		SHEET 2 OF 4
PROJECT	COLUMBIA COUNTY - ELLISVILLE WWTP		SPEC. NO. 40 60 05 - 3.5.C.59 / ADDENDUM/C.O.

		TAG NO.	LS - 104	LS - 201	LS - 202
	1	Ref. Dwg. No.:	I-02	I-02	I-02
PROCESS					
	2	Location:	Duplex Lift Station #1	Duplex Lift Station #2	Duplex Lift Station #2
	3	Service:	Lift Station Pumps	Lift Station Pumps	Lift Station Pumps
	4	Vessel / Line No.:	Duplex Lift Station	Duplex Lift Station	Duplex Lift Station
	5	Fluid:	Wastewater	Wastewater	Wastewater
	6	Temp. Min/Max:	32/140 degrees F.	32/140 degrees F.	32/140 degrees F.
	7	Level Min/Max:	0/15 ft.	0/15 ft.	0/15 ft.
	8	Density Min/Max:	0.65g/cm^3/0.8g/cm^3	0.65g/cm^3/0.8g/cm^3	0.65g/cm^3/0.8g/cm^3
PERFORMANCE					
	9	Operating Temp.:	-40 to 140 degrees F.	-40 to 140 degrees F.	-40 to 140 degrees F.
SWITCH					
	10	Type:	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.
	11	Relays:	SPDT rated 10A resistive at 250 VAC and 5A resistive at 30 VDC.	SPDT rated 10A resistive at 250 VAC and 5A resistive at 30 VDC.	SPDT rated 10A resistive at 250 VAC and 5A resistive at 30 VDC.
	12	Switch Action:	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.
	13	Setpoints:	EL. 57.70 ft.	EL. 61.90 ft.	EL. 64.65 ft.
	14	Enclosure/Housing:	Hollow hermetically sealed, rigidly molded polypropylene float body; Contains switch and weight.	Hollow hermetically sealed, rigidly molded polypropylene float body; Contains switch and weight.	Hollow hermetically sealed, rigidly molded polypropylene float body; Contains switch and weight.
	15	Mounting:	Pole Mount; 316 S.S. Hardware.	Pole Mount; 316 S.S. Hardware.	Pole Mount; 316 S.S. Hardware.
	16	Electrical Cable:	Heavy duty, 3-conductor, flexible, submersible cable sheathed in PVC with watertight seal; Length as required.	Heavy duty, 3-conductor, flexible, submersible cable sheathed in PVC with watertight seal; Length as required.	Heavy duty, 3-conductor, flexible, submersible cable sheathed in PVC with watertight seal; Length as required.
	17	Area Classification:	Class 1, Division II, Group D	Class 1, Division II, Group D	Class 1, Division II, Group D
	18	Additional Features:	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).
NOTES					
	19	General:	Direct acting, pear shaped, eccentric weighted, displacement type liquid level sensor.		
	20	Installation:	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.		
	21	Weight:	Provide eccentric metal weight to cause sensor to hang straight down from cable when not immersed and only allow float to pivot when immersed in liquid.		
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	33				
MANUFACTURE			Provide products of one of the following, Or Equal:		
	34	Manufacturer:	FLYGT - Division of ITT Industries	STI	SJE-Rhombus

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT		Level Switch - Float Type (Single Point)		SHEET 3 OF 4
PROJECT		COLUMBIA COUNTY - ELLISVILLE WWTP		SPEC. NO. 40 60 05 - 3.5.C.59 / ADDENDUM/C.O.
TAG NO.		**LS - 203**	**LS - 204**	**LS - 301**
Ref. Dwg. No.:	1	I-03	I-03	I-03
PROCESS				
Location:	2	Duplex Lift Station #2	Duplex Lift Station #2	Flow Equalization Basin
Service:	3	Lift Station Pumps	Lift Station Pumps	Flow Equalization Pumps and Blowers
Vessel / Line No.:	4	Duplex Lift Station	Duplex Lift Station	Flow Equalization Basin
Fluid:	5	Wastewater	Wastewater	Wastewater
Temp. Min/Max:	6	32/140 degrees F.	32/140 degrees F.	32/140 degrees F.
Level Min/Max:	7	0/15 ft.	0/15 ft.	0/15 ft.
Density Min/Max:	8	0.65g/cm^3/0.8g/cm^3	0.65g/cm^3/0.8g/cm^3	0.65g/cm^3/0.8g/cm^3
PERFORMANCE				
Operating Temp.:	9	-40 to 140 degrees F.	-40 to 140 degrees F.	-40 to 140 degrees F.
SWITCH				
Type:	10	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.
Relays:	11	SPDT rated 10A resistive at 250 VAC and 5A resistive at 30 VDC.	SPDT rated 10A resistive at 250 VAC and 5A resistive at 30 VDC.	SPDT rated 10A resistive at 250 VAC and 5A resistive at 30 VDC.
Switch Action:	12	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.
Setpoints:	13	EL. 65.10 ft.	EL. 67.10 ft.	XX ft.
Enclosure/Housing:	14	Hollow hermetically sealed, rigidly molded polypropylene float body; Contains switch and weight.	Hollow hermetically sealed, rigidly molded polypropylene float body; Contains switch and weight.	Hollow hermetically sealed, rigidly molded polypropylene float body; Contains switch and weight.
Mounting:	15	Pole Mount; 316 S.S. Hardware.	Pole Mount; 316 S.S. Hardware.	Pole Mount; 316 S.S. Hardware.
Electrical Cable:	16	Heavy duty, 3-conductor, flexible, submersible cable sheathed in PVC with watertight seal; Length as required.	Heavy duty, 3-conductor, flexible, submersible cable sheathed in PVC with watertight seal; Length as required.	Heavy duty, 3-conductor, flexible, submersible cable sheathed in PVC with watertight seal; Length as required.
Area Classification:	17	Class 1, Division II, Group D	Class 1, Division II, Group D	Class 1, Division II, Group D
Additional Features:	18	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).
NOTES				
General:	19	Direct acting, pear shaped, eccentric weighted, displacement type liquid level sensor.		
Installation:	20	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.		
Weight:	21	Provide eccentric metal weight to cause sensor to hang straight down from cable when not immersed and only allow float to pivot when immersed in liquid.		
	22			
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	33			
MANUFACTURE		Provide products of one of the following, Or Equal:		
Manufacturer:	34	FLYGT - Division of ITT Industries	STI	SJE-Rhombus

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT		Level Switch - Float Type (Single Point)		SHEET 4 OF 4
PROJECT		COLUMBIA COUNTY - ELLISVILLE WWTP		SPEC. NO. 40 60 05 - 3.5.C.59 / ADDENDUM/C.O.
TAG NO.		**LS - 302**	**LS - 303**	**LS - 304**
Ref. Dwg. No.:	1	I-03	I-03	I-03
PROCESS				
Location:	2	Flow Equalization Basin	Flow Equalization Basin	Flow Equalization Basin
Service:	3	Flow Equalization Pumps and Blowers	Flow Equalization Pumps and Blowers	Flow Equalization Pumps and Blowers
Vessel / Line No.:	4	Flow Equalization Basin	Flow Equalization Basin	Flow Equalization Basin
Fluid:	5	Wastewater	Wastewater	Wastewater
Temp. Min/Max:	6	32/140 degrees F.	32/140 degrees F.	32/140 degrees F.
Level Min/Max:	7	0/15 ft.	0/15 ft.	0/15 ft.
Density Min/Max:	8	0.65g/cm^3/0.8g/cm^3	0.65g/cm^3/0.8g/cm^3	0.65g/cm^3/0.8g/cm^3
PERFORMANCE				
Operating Temp.:	9	-40 to 140 degrees F.	-40 to 140 degrees F.	-40 to 140 degrees F.
SWITCH				
Type:	10	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.
Relays:	11	SPDT rated 10A resistive at 250 VAC and 5A resistive at 30 VDC.	SPDT rated 10A resistive at 250 VAC and 5A resistive at 30 VDC.	SPDT rated 10A resistive at 250 VAC and 5A resistive at 30 VDC.
Switch Action:	12	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.
Setpoints:	13	XX ft.	XX ft.	XX ft.
Enclosure/Housing:	14	Hollow hermetically sealed, rigidly molded polypropylene float body; Contains switch and weight.	Hollow hermetically sealed, rigidly molded polypropylene float body; Contains switch and weight.	Hollow hermetically sealed, rigidly molded polypropylene float body; Contains switch and weight.
Mounting:	15	Pole Mount; 316 S.S. Hardware.	Pole Mount; 316 S.S. Hardware.	Pole Mount; 316 S.S. Hardware.
Electrical Cable:	16	Heavy duty, 3-conductor, flexible, submersible cable sheathed in PVC with watertight seal; Length as required.	Heavy duty, 3-conductor, flexible, submersible cable sheathed in PVC with watertight seal; Length as required.	Heavy duty, 3-conductor, flexible, submersible cable sheathed in PVC with watertight seal; Length as required.
Area Classification:	17	Class 1, Division II, Group D	Class 1, Division II, Group D	Class 1, Division II, Group D
Additional Features:	18	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).
NOTES				
General:	19	Direct acting, pear shaped, eccentric weighted, displacement type liquid level sensor.		
Installation:	20	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.		
Weight:	21	Provide eccentric metal weight to cause sensor to hang straight down from cable when not immersed and only allow float to pivot when immersed in liquid.		
	22			
	23			
	24			
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	27			
	28			
	29			
	30			
	31			
	32			
	33			
MANUFACTURE		Provide products of one of the following, Or Equal:		
Manufacturer:	34	FLYGT - Division of ITT Industries	STI	SJE-Rhombus

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT	Pressure Gauge - Bourdon Type	SHEET 1 OF 1	
PROJECT	COLUMBIA COUNTY - ELLISVILLE WWTP	SPEC. NO. 40 60 05 - 3.5.C.73	ADDENDUM/C.O.

GAUGE		
Type:	1	Liquid Filled Gauge for pressure ranges >15 psi and vacuum ranges <30 inches-Hg.
Element:	2	316 S.S. Bourdon Tube and Socket; Heliarc Welded, unless otherwise specified.
Accuracy:	3	±0.5% of span.
Diaphragm Seal:	4	A diaphragm seal is required for all mediums except air or potable water. Diaphragm material shall be compatible with the process fluid. Refer to Diaphragm Seal Data Sheet for requirements.
Pressure Snubber:	5	Provide sintered stainless steel or brass (for copper pipe) pressure snubber threaded into gauge socket or in external steel housing with 1/4 inch NPT male and female connections.
Indication / Display:	6	Glass window; White and Black markings on Dial; 300 series S.S. movement; Built-In overload/underload stops; Rotary geared with Teflon S coating, or cam and roller type.
Enclosure/Housing:	7	4-1/2 inch Black Case; Solid front design constructed of glass filled polyester; Full blowout back for overpressure protection.
Mounting:	8	Stem Mounting; 1/4 inch male NPT connection on bottom.
Additional Features:	9	Threaded, glass filled polyester ring.
NOTES		
General:	10	All wetted parts shall be compatible with the process fluid. Refer to Materials Compatibility Chart.
Installation:	11	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.
Calibration:	12	Adjustable pointer and externally accessible zero adjustment; Provide ISO Factory Calibration Certificate.
Process Isolation:	13	Provide all valves for process isolation in accordance with specifications in this Section.
Fill Fluid:	14	Use silicone except for process fluids containing chlorine. When the process fluid contains chlorine, the filling liquid shall be Halocarbon 63 or Fluorolube 63.
	15	
	16	
	17	

MANUFACTURE		Provide products of one of the following, Or Equal:		
Manufacturer:	18	Ashcroft	Helicoid	WIKA Instrument Corporation

INSTRUMENT

Requirements specified above shall apply to all instrument tag numbers listed below.

	Tag No.	Process Fluid	Area Classification / Process Press. Min/Max (PSI)	Performance Range	Location / Service / Reference Drawing No.
1	PI - 301	Air	Not Applicable / 0-100 psi	0-TBD psig	X" Flow Equalization Air Supply / I-03
2	PI - 302	Air	Not Applicable / 0-100 psi	0-TBD psig	X" Main Air Supply / I-03
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

REFERENCES: Materials Compatibility and Area Classification Charts

MATERIALS COMPATIBILITY CHART

Process Fluid	Diaphragm	O-Ring	Gasket			
Wastewater / Sludge	316 SS	Buna-N	Buna-N			
Potassium	Carpenter 20	Viton	Viton			
Sodium Hypochlorite	Teflon	Teflon	Teflon			
Polymer	316 SS	Buna-N	Buna-N			
Phosphoric Acid	316 SS	Buna-N	Buna-N			
Alum	316 SS	Teflon	Teflon			
Chlorine Gas	Teflon	Teflon	Teflon			
Chlorine Solution	Teflon	Teflon	Teflon			
Sodium Chloride	Teflon	Teflon	Teflon			
Ammonia	316 SS	Teflon	Teflon			
Methanol	316 SS	Teflon	Teflon			
Carbon	316 SS	Buna-N	Buna-N			
Lime	316 SS	Teflon	Teflon			
Ferric Chloride	Teflon	Teflon	Teflon			
Caustic Soda	Teflon	Teflon	Teflon			
Sodium Bisulfite	Teflon	Teflon	Teflon			
Sodium Hydroxide	Teflon	Teflon	Teflon			
Scrubber Solution	Teflon	Teflon	Teflon			
Fluoride	Hastelloy C	Viton	Viton			
Phosphate	316 SS	Teflon	Teflon			

AREA CLASSIFICATION CHART

Location	Description
Class 1	Class I locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.
Class 1, Division 1	A location (1) In which ignitable concentrations of flammable gases or vapors can exist under normal operating conditions; or (2) In which ignitable concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or (3) In which breakdown or faulty operation of equipment or processes might release ignitable concentrations of flammable gases or vapors and might also cause simultaneous failure of electrical equipment in such a way as to directly cause the electrical equipment to become a source of ignition.
Class 1, Division 2	A location (1) In which volatile flammable liquids or flammable gases are handled, processed, or used, but in which the liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; or (2) In which ignitable concentrations of gases or vapors are normally prevented by positive mechanical ventilation and might become hazardous through failure or abnormal operation of the ventilating equipment; or (3) That is adjacent to a Class I, Division 1 location, and to which ignitable concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided.
Class 2	Class II locations are those that are hazardous because of the presence of combustible dust.
Class 2, Division 1	A location (1) In which combustible dust is in the air under normal operating conditions in quantities sufficient to produce explosive or ignitable mixtures; or (2) Where mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitable mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electric equipment, through operation of protection devices, or from other causes; or (3) In which Group E combustible dusts may be present in quantities sufficient to be hazardous.
Class 2, Division 2	A location (1) In which combustible dusts due to abnormal operations may be present in the air in quantities sufficient to produce explosive or ignitable mixtures; or (2) Where combustible dust accumulations are present but are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus, but could as a result of infrequent malfunctioning of handling or processing equipment become suspended in the air; or (3) In which combustible dust accumulations on , in, or in the vicinity of the electrical equipment could be sufficient to interfere with the safe dissipation of heat from electrical equipment, or could be ignitable by abnormal operation or failure of electrical equipment.
Class 3	Class III locations are those that are hazardous because of the presence of easily ignitable fibers or filings, but in which such fibers or filings are not likely to be in suspension in the air in quantities sufficient to produce ignitable mixtures.
Class 3, Division 1	A location in which easily ignitable fibers or materials producing filings are handled, manufactured or used.
Class 3, Division 2	A location in which easily ignitable fibers are stored or handled (except in the process of manufacture).

* Source: NEC 2005 Edition - Article 500

3.5.D.INSTRUMENT INDEX
Columbia County - Ellisville WWTP

Tag	Description	Range/Setpoint	Drawing	Section	Article	Remarks
Duplex Lift Station #1 Instruments						
LSLL-101	Lift Station Level Switch Low Low	EL. 52.50	I-02	40 60 05	3.5.C.59	Field Adjustable
LSL-102	Lift Station Level Switch Low	EL. 55.25	I-02	40 60 05	3.5.C.59	Field Adjustable
LSH-103	Lift Station Level Switch High	EL. 55.70	I-02	40 60 05	3.5.C.59	Field Adjustable
LSHH-104	Lift Station Level Switch High High	EL. 57.70	I-02	40 60 05	3.5.C.59	Field Adjustable
Duplex Lift Station #2 Instruments						
LSLL-201	Lift Station Level Switch Low Low	EL. 61.90	I-02	40 60 05	3.5.C.59	Field Adjustable
LSL-202	Lift Station Level Switch Low	EL. 64.65	I-02	40 60 05	3.5.C.59	Field Adjustable
LSH-203	Lift Station Level Switch High	EL. 65.10	I-02	40 60 05	3.5.C.59	Field Adjustable
LSHH-204	Lift Station Level Switch High High	EL. 67.10	I-02	40 60 05	3.5.C.59	Field Adjustable
Flow Equalization Tank Instruments						
LSLL-301	Flow Equalization Tank Level Switch Low Low	TBD	I-03	40 60 05	3.5.C.59	Field Adjustable
LSL-302	Flow Equalization Tank Level Switch Low	TBD	I-03	40 60 05	3.5.C.59	Field Adjustable
LSH-303	Flow Equalization Tank Level Switch High	TBD	I-03	40 60 05	3.5.C.59	Field Adjustable
LSHH-304	Flow Equalization Tank Level Switch High High	TBD	I-03	40 60 05	3.5.C.59	Field Adjustable
Chlorine Contact Chamber Instruments						
FE-300	Chlorine Contact Chamber Effluent Flow Meter	0-10 gpm	I-03	40 60 05	3.5.C.34	
Blower Discharge Manifold Instruments						
PI-301	Flow Equalization Supply Pressure Gauge	0-100 psi	I-03	40 60 05	3.5.C.73	
PI-302	Main Air Supply Pressure Gauge	0-100 psi	I-03	40 60 05	3.5.C.73	

- END OF SECTION -

3.5.E. Auto Dialer Input/Ouput list
Columbia County - Ellisville WWTP

Sl.no	Description	Type	Output	Input	Drawing	Remarks
Lift Station No. 1						
1	Lift Station Pump No. 1 Fail	Discrete	DLS-LCP1	Auto Dialer (ADP1)	I-02	
2	Lift Station Pump No. 2 Fail	Discrete	DLS-LCP1	Auto Dialer (ADP1)	I-02	
3	Lift Station Wet Well Level High	Discrete	DLS-LCP1	Auto Dialer (ADP1)	I-02	
4	DLS-LCP1 Power Fail	Discrete	DLS-LCP1	Auto Dialer (ADP1)		
5	ATS Normal Source Connected	Discrete	Existing ATS	Auto Dialer (ADP1)		
6	ATS Emergency Source Connected	Discrete	Existing ATS	Auto Dialer (ADP1)		
7	Generator Run Status	Discrete	Existing Generator	Auto Dialer (ADP1)		
8	Generator Fail	Discrete	Existing Generator	Auto Dialer (ADP1)		
Lift Station No. 2						
9	Lift Station Pump No. 1 Fail	Discrete	DLS-LCP2	Auto Dialer (ADP2)	I-02	
10	Lift Station Pump No. 2 Fail	Discrete	DLS-LCP2	Auto Dialer (ADP2)	I-02	
11	Lift Station Wet Well Level High	Discrete	DLS-LCP2	Auto Dialer (ADP2)	I-02	
12	DLS-LCP2 Power Fail	Discrete	DLS-LCP2	Auto Dialer (ADP2)		
WasteWater Treatment Facility						
13	Flow Equalization Pump No. 1 Fail	Discrete	FE-LCP	Auto Dialer (ADP)	I-03	
14	Flow Equalization Pump No. 2 Fail	Discrete	FE-LCP	Auto Dialer (ADP)	I-03	
15	Flow Equalization Blower No. 1 Fail	Discrete	FE-LCP	Auto Dialer (ADP)	I-03	
16	Flow Equalization Blower No. 2 Fail	Discrete	FE-LCP	Auto Dialer (ADP)	I-03	
17	Flow Equalization Tank Level High	Discrete	FE-LCP	Auto Dialer (ADP)	I-03	
18	Anoxic Mixer No. 1 Fail	Discrete	AM-LCP	Auto Dialer (ADP)	I-03	
19	Anoxic Mixer No. 2 Fail	Discrete	AM-LCP	Auto Dialer (ADP)	I-03	
20	Recycle Pump No. 1 Fail	Discrete	RP-LCP	Auto Dialer (ADP)	I-03	
21	Recycle Pump No. 2 Fail	Discrete	RP-LCP	Auto Dialer (ADP)	I-03	
22	Main Air Blower No. 1 Fail	Discrete	MAB-LCP	Auto Dialer (ADP)	I-03	
23	Main Air Blower No. 2 Fail	Discrete	MAB-LCP	Auto Dialer (ADP)	I-03	
24	ATS Normal Source Connected	Discrete	ATS	Auto Dialer (ADP)		
25	ATS Emergency Source Connected	Discrete	ATS	Auto Dialer (ADP)		
26	Generator Run Status	Discrete	Generator	Auto Dialer (ADP)		
27	Generator Fail	Discrete	Generator	Auto Dialer (ADP)		

3.5.E. Auto Dialer Input/Ouput list
Columbia County - Ellisville WWTP

Sl.no	Description	Type	Output	Input	Drawing	Remarks
28						
29						
30						

SECTION 46 07 53

PACKAGED WASTEWATER TREATMENT PLANT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, equipment, materials, and incidentals as required to furnish, install, check, calibrate, start-up, test, document, and place in satisfactory operation, the 0.025 MGD average daily flow packaged activated sludge wastewater treatment plant (Packaged WWTP) complete with all appurtenances for proper operation as shown and as specified.
   2. Packaged WWTP shall be of the Modified Ludzak-Ettinger (MLE) configuration.
   3. Items furnished under this Section shall include, but not be limited to the following:
      a. Steel packaged treatment plant.
      b. Air distribution system including blowers, coarse bubble diffusers, air piping and valves, and other ancillary components.
      c. Aerated flow equalization basin including influent manual bar screen, flow equalization, valves, level floats, and other ancillary equipment.
      d. Anoxic chamber(s) with mechanical mixing equipment.
      e. Aeration basin(s) with mixed liquor recycle pumps.
      f. Two hydraulically separated clarifier with RAS/WAS airlift pumps, inlet baffle, effluent baffle, air driven skimmer system, effluent weir and other ancillary components.
      g. Chlorine contact chamber including chlorine tablet feed system, baffles, and other ancillary components.
      h. Aerated sludge holding chamber including air driven supernatant return system.
      i. Access stairway and walkway grating.
      j. Flanged influent and effluent piping connections and internal piping and valves.
      k. Control panels.
      l. Electrical and instrumentation components specified herein.
      m. Anchorage devices and holddown lugs.
      n. Painting.
      o. Spare parts as specified.
   4. The Packaged WWTP shall be provided by a SINGLE manufacturer with sole responsibility for the satisfactory manufacture, delivery, start-up, performance testing, and training for the complete furnished Packaged WWTP.

5. Unless stated otherwise, the term Manufacturer stated herein shall refer to the manufacturer responsible for the supply of the Packaged WWTP.

B. General:
   1. Naming of a manufacturer does not indicate approval nor shall standard product offerings by any manufacturers be accepted in lieu of component features as specified herein. All manufacturers are required to comply fully with these specifications.
   2. Descriptions contained hereinafter are for guidance and to show the functions desired. They do not describe or specify all components to interface equipment. All parts and equipment necessary to meet functional and performance requirements shall be provided and fit within the dimensions and configuration shown.
   3. The site, mechanical, structural, instrumentation, and electrical design has been based on a Packaged WWTP manufactured by RWL Water USA, Golden Valley, MN. The cost of any changes or modifications to site, mechanical, structural, instrumentation, or electrical facilities necessary to adapt alternate equipment to the layout and design shown shall be borne by CONTRACTOR. Any such proposed changes or modifications are subject to review and acceptance by the ENGINEER in accordance with the special instructions in Instructions to Bidders. Clearances shown shall be maintained.
   4. CONTRACTOR shall be completely responsible for the proper operation and function of the Packaged WWTP herein specified. CONTRACTOR shall be responsible for coordination of all mechanical, structural, instrumentation, or electrical facilities to achieve the required Packaged WWTP operation and treatment performance.
   5. Some equipment may require modifications from the Manufacturer's standard to conform to the Contract Documents.
   6. All fasteners (nuts, bolts and washers) used for Packaged WWTP shall be Type 316 stainless steel.
   7. Blowers, mixers, and specified control panels shall be supplied as part of the Packaged WWTP.
   8. Control panels for the Packaged WWTP equipment shall be provided by the Manufacturer as specified in Section 40 60 05, Instrumentation and Control for Process Systems.
   9. Wiring, motor starters, and other electrical equipment and materials are specified in Section 26 00 05, Electrical Work.
   10. All components of the Packaged WWTP shall be factory coated, unless otherwise specified. Provisions for field touch up shall be made.

C. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the Packaged WWTP Work.

D. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 05 05 33, Anchor Systems.
   3. Section 09 91 00, Painting.
   4. Section 26 00 05, Electrical Work.
   5. Section 33 05 05, Buried Piping Installation.
   6. Section 40 05 05, Exposed Piping Installation.
   7. Section 40 05 31, Thermoplastic Process Pipe.
   8. Section 40 60 05, Instrumentation and Control for Process Systems.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. Anti-Friction Bearing Manufacturers' Association, (AFBMA).
   2. American National Standards Institute, (ANSI).
   3. American Society for Testing and Materials, (ASTM).
   4. Hydraulic Institute Standards, (HI).
   5. National Electrical Code, (NEC).
   6. National Electrical Manufacturer's Association, (NEMA).
   7. The Society for Protective Coatings, (SSPC).
   8. Underwriter's Laboratories, Inc., (UL).
   9. Florida Building Code, 2010 Edition with 2012 Amendments, (FBC).

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:
      a. Minimum of five years of experience producing substantially similar equipment and able to show evidence of at least five installations in satisfactory operation for at least five years, Florida references are preferred. Provide at least five references: name, address, phone, and email.
   2. Professional Engineer:
      a. Engage a registered professional engineer legally qualified to practice in the State of Florida and experienced in providing engineering services of the kind indicated.
      b. Submit qualifications data.
      c. Responsibilities include but are not necessarily limited to:
         1) Carefully reviewing performance and design criteria stated in the Contract Documents.
         2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to ENGINEER by CONTRACTOR.

3) Preparing or supervising the preparation of design calculations and related drawings, Shop Drawings, operations manuals, and a comprehensive engineering analysis verifying compliance of the with the requirements of the Contract Documents.
4) Signing and sealing all calculations and design drawings, and Shop Drawings.
5) Certifying that:
   a) It has confirmed the design of the plant in accordance with the performance and design criteria stated in the Contract Documents, and
   b) The said design conforms to all applicable local, state and federal codes, rules and regulations, and to the prevailing standards of practice.

B. Requirements of Regulatory Agencies: Comply with the applicable provisions of the Florida Department of Environmental Protection and the current edition of the Florida Building Code.

C. Products used in the Work of this Section shall be produced by manufacturers regularly engaged in the production of such items and have a successful history of product acceptability, as interpreted by ENGINEER.

D. Responsibilities:
1. In order to centralize responsibility, it is required that all equipment provided as part of the Packaged WWTP be obtained from a single supplier or manufacturer who shall assume full responsibility for the completeness of the system. The supplier or manufacturer shall be the source of information on all equipment furnished regardless of the manufacturing source of that equipment.
2. The sole responsibility for proper operation of the Packaged WWTP shall rest with CONTRACTOR.

E. CONTRACTOR shall provide certifications that all stainless steel accessories, including hangers and supports, are Type 316 stainless steel.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
   a. CONTRACTOR shall submit for review to ENGINEER, sufficient literature, detailed specifications, and drawings to show dimensions, fabricator or manufacturer, speed, model, size, type, horsepower, service factors, efficiency, materials used, design features, internal construction, weights, and any other information required by ENGINEER for review of all Packaged WWTP equipment. No

Packaged WWTP equipment will be accepted, and installation will not be allowed until such review has been completed.

b. Shop Drawings shall include, as a minimum, the following:
   1) Dimensions of Packaged WWTP, including compartments, internal and external equipment, pipe, fittings, connection points, access systems, electrical and instrumentation components, and other appurtenances.
   2) Materials of construction of all system components.
   3) Service Conditions: Chemical environment and temperature.
   4) Statement that fabrication shall be in accordance with these Specifications.
   5) Total shipping weight and operating weight of Packaged WWTP.
   6) Description of fabrication.
   7) Complete, detailed instructions on the installation of the Packaged WWTP, equipment, and piping.
   8) Diffuser system and piping layout including supports.
   9) Description of surface preparation and shop primer and shop finish coating as specified in this Section.
   10) Detailed information on instrumentation components including manufacturer model, materials of construction, and location.
   11) Dimensions and locations of access stairway and walkway grating.
   12) Full drain outlet details.
   13) Submit a list of five similar installations, with contacts, currently operating a similar Packaged WWTP.
   14) Wiring diagrams for all equipment as required.
   15) Control panel submittal as defined in Section 40 60 05, Instrumentation and Control for Process Systems
   16) Detailed process calculations that are signed and sealed by a Professional Engineer, including but not limited to:
      a) Hydraulic Retention Time.
      b) Basin Volumes.
      c) Standard oxygen transfer efficiency (SOTE) of the aeration system.
      d) List of parameters used in basin sizing.
      e) Expected treatment efficiencies.

c. Submittal for disinfection system shall include as a minimum the following:
   1) Manufacturer's capacity data.
   2) Shop Drawings providing details of construction, dimensions, and connection locations.
   3) Descriptive literature, bulletins, and catalogs of the equipment.
   4) A complete bill of materials.
   5) A list of the manufacturer's recommended spare parts.

d. Submittal for the flow equalization and mixed liquor recycle pumps shall include as a minimum the following:
    1) Manufacturers rating data and pump curves.
    2) Shop Drawings providing details of construction, dimensions, and connection locations.
    3) Descriptive literature, bulletins, and catalogs of equipment.
    4) A complete bill of materials.
    5) A list of manufacturer's recommended spare parts; including gaskets, packing, etc.
    6) Complete data on motors, motor starters, nameplate data, controls, and motor control schematic wiring diagrams.
e. Detailed structural calculations that are signed and sealed by a Structural Engineer, registered in the State of Florida, including but not limited to:
    1) Stairs
    2) Walkway
    3) Railing
    4) Anchor System
f. Submittal for the blowers shall include as a minimum the following:
    1) Manufacturer's rating data.
    2) Shop Drawings providing materials and details of construction, dimensions, and anchor bolt locations.
    3) Descriptive literature, performance curves, bulletins, and catalogs of the equipment.
    4) The total weight of the equipment.
    5) A complete bill of materials.
    6) A list of the manufacturer's recommended spare parts.
    7) Complete data on motors, motor starters, nameplate data, controls, and motor control schematic wiring diagrams.
    8) Data on noise in accordance with AMCA 300.
    9) Description of surface preparation and shop primer and shop finish coating as specified in this Section.
    10) Results of factory dynamic balance of blower and field check of dynamic balance of blower.
g. Submittal for the mixers shall include as a minimum the following:
    1) Manufacturer's rating data.
    2) Shop Drawings providing materials and details of construction, dimensions, and connection locations.
    3) Descriptive literature, bulletins, and catalogs of the equipment.
    4) The total weight of the equipment.
    5) A complete bill of materials.
    6) A list of the manufacturer's recommended spare parts.
    7) Complete data on motors, motor starters, nameplate data, controls, and motor control schematic wiring diagrams.

8) Description of surface preparation and shop primer and shop finish coating as specified in this Section.

h. Expansion joints and flexible connectors for blowers, pumps, and piping.

i. Flow meters and level floats.

j. Material list.

2. Performance Testing Plans and Procedures:

a. Submit written test procedures for the required Packaged WWTP start-up and performance testing.

b. At a minimum the performance tests must demonstrate the system's ability to meet the design criteria set forth in this Section.

B. Informational Submittals: Submit the following:

1. Test and Evaluation Reports:

a. UL Label.

2. Site Quality Control Submittals:

a. Test Results: Submit a written report providing the results of the required start up and performance tests.

3. Supplier Reports:

a. Submit a written report of the results of each visit by a Manufacturer's serviceman, including purpose and time of visit, tasks performed and results obtained.

C. Closeout Submittals: Submit the following:

1. Operation and Maintenance Manuals:

a. Submit complete installation, operation and maintenance manuals, test reports, maintenance data and schedules, description of operation, and spare parts information.

b. Packaged WWTP Manufacturer shall provide detailed plant and equipment operating and maintenance instructions. Each O&M manual shall be prepared specifically for the type of equipment delivered, and all instructions shall refer only to that particular equipment.

c. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operation and Maintenance Data.

d. There shall be a minimum of two volumes of Operations and Maintenance Manuals.

e. Volume I shall detail the care and operation of the treatment plant. It shall provide instructions on normal, hot and cold weather, emergency, and troubleshooting operations for each unit. It shall provide the operator with "best practices" for various operating conditions. It shall also include guidelines on health and safety. This information shall be discussed in detail during training. Volume II shall consist of a compilation of the various equipment Operations and Maintenance Manuals. It shall include an Index and Summary section with an overview of all equipment and a unified list of all scheduled

maintenance activities in one section. Training shall include an overview of the required maintenance of various equipment.

D. Maintenance Materials Submittals: Submit the following:
   1. Spare Parts:
      a. Furnish all required spare parts as specified in Part 2 of this specification.
   2. Tools:
      a. Furnish all required special tools as specified in Part 2 of this specification.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Product Delivery, Storage and Handling:
   1. CONTRACTOR shall be responsible for safe transportation, including all freight costs for delivery to the Site, procuring any required permits, handling, and open air storage of the Packaged WWTP and other materials purchased as specified in this Section.
   2. All equipment shall be properly protected such that no damage will occur from the time of shipment until the time of installation.
   3. Manufacturer shall protect all flange faces and the more fragile appurtenances of the sub-assemblies, with padding between pieces in order to prevent one piece from impacting with another, and by crating or other means for shipment.
   4. CONTRACTOR shall be responsible for offloading all shipped equipment and shall inspect all equipment upon arrival. CONTRACTOR shall notify the Manufacturer within 24 hours of any damage to equipment or surface finish due to shipping.
   5. Packaged WWTP and ancillary equipment shall be unloaded with care at their final destination where they will be free from damage. Manufacturer shall supply detailed storage instructions at the time of shipment.
   6. Large sub-assemblies shall be supported during unloading to prevent excessive deflection and overstressing.
   7. Pumps shall come completely assembled and protected against entry of foreign objects. Suction and discharge ports shall be protected against entry of foreign objects.
   8. Store equipment and materials so as to keep free from moisture, damage, deterioration, and theft.
   9. Structure and equipment shall be protected, by padding or bracing, from banding or ropes used in shipment. No chains are to be used to secure any tanks or equipment in transportation.
   10. Product delivery, storage, and handling shall comply with the requirements of Sections 01 65 00, Product Delivery Requirements and 01 66 00, Product Storage and Handling Requirements.

1.6 EQUIPMENT INSPECTIONS

A. Prior to final inspection, all surfaces shall be made clean by brushing, wiping, or with a compressed-air blast to remove all loose foreign materials.

B. A thorough inspection of each piece of equipment will be conducted upon arrival at the Site to inspect for damage incurred in transit. Any damage shall be immediately repaired by respective equipment fabricator's personnel, not a sales representative.

1.7 GENERAL REQUIREMENTS

A. The Drawings show general arrangement and extent of the Work to be completed, but the exact location and arrangement of all parts shall be determined as the Work progresses, to conform in the best possible manner with the actual Packaged WWTP supplied, and with the surroundings. The exact location of all parts of the Work must be governed by actual equipment supplied and Site conditions. Piping, equipment, ducts, etc. found to interfere with the construction of the equipment pad, plumbing apparatus and piping, panel, electrical wiring or other obstructions, etc. shall be located to clear such obstructions. Connections shown to the various units are intended as an indication only. The actual connections shall be made and to best suit each particular case, provide for expansion, clearances, vibration, and minimize the amount of space required. Field adjustments are expected and shall not result in a request for change order by the CONTRACTOR.

B. Drawings do not show all offsets, fittings, accessories and details, which may be required. CONTRACTOR shall examine all the Contract Documents for conditions, which may affect the installation of the Work, and shall arrange the Work accordingly. Provide all required items to complete the systems to the extent required by the Contract Documents.

C. If piping can be run to better advantage, CONTRACTOR, before proceeding with the Work, shall prepare and submit complete Shop Drawings showing all details of the proposed rearrangement for written approval by the ENGINEER.

1.8 EQUIPMENT DEFECTS

A. Equipment that has mechanical defects and does not meet Manufacturer's requirements will be rejected and shall be replaced at CONTRACTOR'S full expense for furnishing, installing, removal, and replacement.

B. Mechanical defects shall include excessive vibration, improper balancing of rotating parts, improper tolerances, binding, excessive bearing heating, defective materials, improper fitting of parts, and any other defect which will in time damage the equipment or impair its operation.

C. Requirements shall be met concerning minimum and maximum dimensions and the specifications for materials. If it is found upon delivery that materials do not agree with the requirements of these Specifications as to size, type, quality, or metallurgy, they will be rejected as unfit for use in the Work.

1.9 WARRANTY

A. The Packaged WWTP Manufacturer shall warrant that the equipment supplied as part of the Packaged WWTP meets the requirements of the Contract Documents and that it is new and unused, free from defects in materials and/or workmanship. This warranty shall be for **18 months** from equipment delivery to the job site or **12 months** from system start-up, whichever comes first. In the event that it is determined that a defect exists, the manufacturer shall repair or replace the defective components, provided that any such defect was not the result of misuse of the component by the OWNER.

B. Warranties and guarantees by the suppliers of various components in lieu of a single source responsibility by the equipment manufacturer shall not be accepted. The CONTRACTOR, through agreements with the Packaged WWTP Manufacturer, shall be solely responsible for the warranty of the equipment and all related components.

C. This warranty shall be valid only if the product is properly serviced and operated under normal conditions and in accordance with the Manufacturer's instructions.

PART 2 – PRODUCTS

2.1 GENERAL

A. When two or more units of equipment for the same purpose are required they shall be the product of one manufacturer.

B. Packaged WWTP Manufacturer: Provide a complete system furnished by one of the following:
   1. RWL Water USA.
   2. Or approved equal.

2.2 DESIGN REQUIREMENTS

Packaged WWTP Design Criteria:

A. All components supplied shall conform to the size requirements as set forth in the plans, to the requirements included in other sections of this specification, and to the following broad design parameters.

B. Requirements per unit:

Number of Packaged WWTPs	1
Flow:	
Average daily design flow (gpd)	25,000
Peak day design flow (gpd)	62,500
Influent Characteristics:	
Influent CBOD5 (mg/L)	200
Influent TSS (mg/L)	200
Influent TKN (mg N/L)	40
Influent Ammonia (as N, mg N/L)	27
Influent Total Phosphorus (mg P/L)	8
Maximum Effluent Requirements:	
Effluent CBOD5 (mg/L)	30
Effluent TSS (mg/L)	30
Effluent Nitrate (as N, mg N/L)	12

C. Process Volume Criteria:
1. Each process shall have 1.5 feet of free board.

	25,000 gpd ADF
Process	**Volume (gallons)**
Flow Equalization Chamber	6,400
Anoxic Chamber	6,704
Aeration Chamber	25,070
Clarifiers	6,250
Sludge Holding Chamber	4,190
Chlorine Contact Chamber	655

2. All volumes are minimums; minor variations may be allowed upon approval by the ENGINEER as long as system performance can be maintained.

2.3 EQUIPMENT

A. General:
1. Provisions shall be made for draining each compartment of the Packaged WWTP independently. All drains shall include a plug valve/SS ball valve, Cam-lock fittings, and water-tight cover. Cam-lock fittings and cover tube shall be 316 stainless steel.

B. Packaged WWTP Influent Connection:
   1. Provide an influent connection to the Packaged WWTP consisting of one 4-inch flanged inlet entering the flow equalization chamber. The influent flow shall be discharged into a bar screen box with integral overflow weir.

C. Flow Equalization Chamber:
   1. To control the peak hourly flow rates a flow equalization system shall be provided at the influent end of the Packaged WWTP. The influent peak flow rates shall enter into the flow equalization chamber where it is to be held and mixed until the secondary treatment system is ready to process it.
   2. Influent flow shall enter the flow equalization chamber by passing through a manual bar screen flow-proportioning box. An adjustable side weir shall limit the maximum flow into the packaged WWTP.
   3. The flow equalization chamber shall be covered with removable solid aluminum panels.
   4. Manufacturer shall provide the following equipment:
      a. Two (2) flow equalization blower units. Refer to Air Distribution System in this Section for blower requirements.
      b. One (1) lot of coarse air diffusers with drop assemblies for mixing. Refer to Air Distribution System in this Section for requirements. The diffusers shall be capable of providing complete mixing of the chamber if it is half full or greater.
      c. Two (2) flow equalization pumps with a maximum capacity of 60 gpm. Pump shall be capable to flow raw water from the flow equalization chamber to the flow proportioning box. Pump shall be of the Gould submersible type, or approved equal, rated for ½ HP, 460 volt, 3 phase, 60 Hz. The pumps shall operate in an alternated duty/stand-by configuration and shall be located in the flow equalization chamber, as shown. The motors shall be rated for continuous duty under full nameplate load while at full submergence. Each pump shall include a seal fail sensor. Pump guide rails shall be constructed of Type 316 stainless steel, and discharge piping shall be constructed of Schedule 80 PVC.
      d. One (1) 316 stainless steel manual bar screen to remove large solids from the influent flow. The bar screen shall be fabricated from 1/2-inch diameter bars spaced 1/2-inch apart. The bars shall be sloped to permit easy removal of accumulated debris. A large screenings drying area with grating shall be provided, which allows excess water to drain to the equalization chamber.
      e. One (1) flow proportioning box shall be provided, constructed of aluminum. The flow rate through the flow-proportioning box shall be controlled by an adjustable v-notch and flat overflow weir system.
      f. Liquid level control sensors: level switch, float type as specified in Section 40 60 05, Instrumentation and Control for Process Systems.
      g. Flow Equalization Local Control Panel (FE-LCP). See P&IDs for required switches, indicator lights, controllers, etc. Provisions shall be made to FE-

LCP for connection with two remote HOA switches (provided by others) as shown in the drawings. The panel shall be shipped loose for installation in the field. Refer to the Electrical and Controls section, below and Section 40 60 05, Instrumentation and Control for Process Systems.

h. An emergency overflow weir shall allow the transfer of peak flows from the equalization chamber to the anoxic chambers to prevent overflows.

D. Anoxic Chamber(s):

1. The anoxic chamber(s) shall be designed to meet the requirements set forth in the Design Requirements paragraph of this Section. An anoxic chamber shall be provided to reduce nitrate to nitrogen gas to meet the nitrate effluent requirement. The total chamber volume can be provided with one or two chambers. The anoxic chamber(s) shall be covered with removable solid aluminum panels.
2. The anoxic chamber(s) shall be equipped with two fixed-mount, open tank, slow mixers, Lightnin Model Mi5Q1 or equal. Each mixer shall be rated for 1/2 hp, 460 volt, 3 phase, 60 Hz service, and shall be provided with TEFC motors designed for continuous operation. The mixers shall continuously mix the contents of the anoxic chamber(s) so as to prevent settling. The Packaged WWTP Manufacturer shall provide motors, housings, propellers, control panel as described below, anchorage systems, and all appurtenances required. The mixer shaft and blade shall be constructed of 316 stainless steel. Supports and anchor systems shall be constructed of 316 stainless steel. Both mixers shall provide complete mixing of chamber(s) and maintain mixed liquor and perform bottom scour.
3. The system shall be provided with an Anoxic Mixer Local Control Panel (AM-LCP). See P&IDs for required switches, indicator lights, controllers, etc. Provisions shall be made to AM-LCP for connection with two remote HOA switches (provided by others) and two remote E-stops (provided by others) as shown in the drawings. The panel shall be shipped loose for installation in the field. Refer to the Electrical and Controls section, below and Section 40 60 05, Instrumentation and Control for Process Systems.
4. Units shall be capable of keeping solids in suspension and mixing municipal wastewater. Each mixer shall be capable of continuous operation with the mixer blade both partially or completely submerged and capable of continuous operation for a minimum of two hours unsubmerged. Mixer shall be able to be raised and lowered and shall be easily removed for inspection or service without the need for personnel to enter the tank.
5. Flow from the anoxic chamber(s) shall flow by gravity to the aeration chamber.

E. Aeration Chamber:

1. The aeration chamber shall be designed to meet the requirements set forth in the Design Requirements paragraph of this Section.
2. The aeration chamber and flow control baffles shall be designed in a manner which ensures maximum retention time and eliminates short circuiting,

facilitates the rotation of the chamber contents, prevents sludge accumulation, and prevents scum and froth accumulation.

3. The chamber width to depth proportion shall not exceed 1.33 to 1 in the direction of rotation. The velocity of rotation shall be sufficient to scour the bottom and prevent sludge filleting.
4. The aeration chamber shall be provided with air diffusers, placed longitudinally along one side of the chamber.
5. Two mixed liquor recycle (MLR) pumps shall be supplied with a capacity of 200% of the daily average flow. Recycle pumps shall be located in the aeration chamber, as shown on the drawings.
6. The MLR pumps shall be of the Gould submersible type, or approved equal, rated for 3/4 HP 460 volt, 3 phase, 60 Hz service with maximum capacity of 90 gpm. The motors shall be rated for continuous duty under full nameplate load while at full submergence. The pumps shall be located in the aeration chamber, as shown. Each pump shall include a seal fail sensor. Pump guide rails shall be constructed of Type 316 stainless steel and discharge piping shall be constructed of Schedule 80 PVC.
7. Walkways shall be provided as needed for safe access to all valves, pumps and diffusers. Walkways shall be constructed of removable aluminum grating.
8. The system shall be provided with a Recycle Pump Local Control Panel (RP-LCP). See P&IDs for required switches, indicator lights, controllers, etc. Provisions shall be made to RP-LCP for connection with two remote HOA switches (provided by others) as shown in the drawings. The panel shall be shipped loose for installation in the field. Refer to the Electrical and Controls section, below and Section 40 60 05, Instrumentation and Control for Process Systems.

F. Air Distribution System:
   1. The air distribution system shall consist of a peripheral air header, diffuser drop pipes, diffuser assembly, and two sets of two blowers (for a total of four blowers). There shall be two separate air distribution systems:
      a. Flow equalization chamber: Air Supplied by two (2) blowers, each providing a minimum of 40 scfm at 5 psi as needed for complete mixing at half full or above.
      b. Aeration basin: Air Supplied by two (2) blowers, each providing 150 scfm at 5 psi. Also supply air to sludge holding tank, sludge return pumps and scum skimmer pumps. Air supply must include valving to adjust and balance air delivery system.
   2. Diffusers shall be located in the Flow Equalization Chamber, Aeration Chamber, and Sludge Holding Chamber. Diffusers shall be RWL Cyclone coarse bubble, Type 316 stainless steel, non-clog diffusers, or approved equal. An air distribution manifold shall be installed longitudinally along one side of the tank with diffuser drop assemblies connected thereto. The air manifold shall be Type 316 stainless steel. The body of the diffusers shall be constructed of Type 316

stainless steel. Provide a cast end cap with an integral 3/4" NPT male pipe connection.

a. A bottom deflector shall be incorporated into the diffuser to prevent foreign material from entering and clogging the air ports. The deflector shall deflect liquid across the outer walls of the diffuser and help to shear bubbles as they rise.
b. The diffuser ends shall be partially open to allow air to escape in the event of plugging of the diffuser openings.
c. A balancing orifice shall be provided as required within the 3/4" NPT male pipe connection to assure proper head loss and uniform distribution of the air throughout the system.

3. Each diffuser drop assembly shall be equipped with a Type 316 stainless steel air regulating and/or shutoff ball valve, a disconnecting union, and a diffuser bar with non-clog air diffuser nozzles mounted on the tee bar. Each aeration zone drop pipe assembly shall include a flange to allow for ease of removal, a stainless steel ball valve accessible from the peripheral walkway for the purpose of air shut-off and regulation of the air supply, as well as all required pipe and fittings. All pipe and fittings for the Air Distribution System shall be constructed of Type 316 stainless steel.
4. Diffuser assemblies shall be designed with external check valve capability to prevent entry of mixed liquor into diffuser or air piping on air shutdown or interruption of air supply.
5. Air Supply for the Flow Equalization Chamber shall be provided by two (2) Roots Universal RAI Blowers, Model 22-URAI (3 hp, 460V, 3 phase, 60 Hz), or approved equal, installed as shown. Blower motors shall be rated for continuous duty. Blower operation shall be controlled in conjunction with the flow equalization pump floats.
    a. Each blower shall have the capability of providing 100% of the air requirements of the flow equalization system.
    b. Each blower shall be capable of delivering 40 scfm at an operating pressure of 5 psi.
    c. Each blower shall provide the air required to keep solids in suspension.
    d. Blowers shall be completely factory built and tested before shipping.
    e. Blower discharge piping shall include, pressure relief valve, pressure gauge, one 1-inch blower discharge pipe with a 1-inch marine rubber hose and two (2) stainless steel clamps, and rubber connection. These items shall be pre-mounted and piped within the blower enclosure.
    f. The blower motor unit shall be factory pre-mounted on a steel skid. The enclosure shall have ivory finish. The blower motor enclosure unit shall be mounted on four (4) vibration pad dampers to reduce blower vibration and noise transmission.
    g. The system starters, indicator lights, controllers, etc. shall be provided in the FE-LCP as specified in Section 2.3.B above.

6. The air header for the Aeration Chamber shall be designed to supply air to the aeration basin, as well as the diffusers in the sludge holding chamber, the airlift pumps in the clarifiers, and the scum skimmer in the clarifiers.
7. The Aeration Chamber air system shall be constructed of Type 316 Stainless Steel and designed to provide a minimum of 45 pounds of oxygen per day at average design flow and 100 pounds of oxygen per day at peak design flow. Oxygen transfer efficiency shall be guaranteed and substantiated by submission of test data compiled by a nationally recognized independent testing laboratory.
8. The air system in the Sludge Holding Chamber shall provide complete mixing and maintain 1.0 to 2.0 mg/L of dissolved oxygen in the mixed liquor at all times.
9. Air supply for the Aeration Chamber shall be provided by two (2) Roots, Universal RAI Blowers, Model 24-URAI (7.5 hp, 460 V, 3 phase, 60 Hz), or approved equal installed as shown. Blower motors shall be rated for continuous duty.
    a. Each blower shall be capable of providing 100% of the oxygen requirements of the Aeration Chamber as described, as well as the air requirements of the Sludge Holding Chamber (mixing and airlift supernatant decant system), and the Clarifiers (return sludge airlift pumps and airlift scum skimmer system).
    b. Each blower shall be capable of delivering, at minimum, 150 scfm at an operating pressure of 5 psi.
    c. Blowers shall be completely factory built and tested before shipping.
    d. Blower discharge piping shall include, pressure relief valve, pressure gauge, one 1-inch blower discharge pipe with a 2-inch marine rubber hose and two (2) stainless steel clamps, and rubber connection. These items shall be pre-mounted and piped within the blower enclosure
    e. The system shall be provided with a Main Air Blower Local Control Panel (MAB-LCP). The panel shall be shipped loose for installation in the field. See P&IDs for required switches, indicator lights, controllers, etc. Refer to the Electrical and Controls section, below and Section 40 60 05, Instrumentation and Control for Process Systems.
10. Each pair of blowers for the Flow Equalization Chamber and the Aeration chamber shall be installed within a single FRP enclosure, Tipton Environmental International Inc. model TEII-FE-2.5 or equal. The blower enclosure shall be complete with:
    a. Gel coated FRP hood.
    b. Inlet filter.
    c. Silencer.
    d. Hinged base with Type 316 stainless steel hardware.
    e. Lifting handle.
    f. Hood opening support system.
    g. Locking clasp.
    h. Aluminum air vent louver.

G. Clarifiers:
   1. Provide one gravity, hopper-bottomed clarifier, designed to meet the requirements set forth in the Design Requirements section, above.
   2. The clarifier shall consist of a clarifier influent assembly, sludge collector mechanism, effluent launderer and scum baffle, stilling well, scum removal system, and exterior splash baffles for the aerated zones. The slope of the hopper walls will not be less than 1.7 vertical to 1.0 horizontal. Settled sludge shall be returned from each sludge well to the anoxic chamber(s) by a positive displacement sludge return system. Settled sludge shall also have the capability of being wasted to the sludge holding chamber.
   3. Clarifier Influent Assembly:
      a. The clarifier influent assembly shall be constructed of ¼-inch minimum thickness carbon steel.
      b. The influent assembly shall be designed to prevent settling of solids, as well as to prevent the backup of liquid in the aeration chamber during peak flows.
      c. The inlet of the clarifier chamber shall be provided with an influent baffle to slow the velocity of the flow from the aeration chamber to aid the settling process. It shall prevent floatables and scum from entering the clarifier settling area.
   4. Sludge shall be collected in the clarifier center sump and removed from the sump by means of an airlift pump.
   5. A clarifier effluent launderer shall be provided around the inside periphery of the clarifier to collect the supernatant. The launderer shall be designed to handle peak flows without becoming submerged.
   6. A notched aluminum weir plate shall be attached to each side of the launderer and shall be vertically adjustable for leveling.
      a. The weir plate shall be fabricated from 1/8-inch thick aluminum with 1¼-inch deep V-notches on 2½-inch centers.
      b. Gasketing material, 3/8-inch thick x 1½ inches wide, shall be attached to the back of the weirs to prevent leaks.
      c. An FRP scum baffle shall be provided to prevent floating scum from being carried over the weir. The scum baffle shall project a minimum of 18 inches below and 6 inches above the clarifier water surface and shall be attached to the launderer support brackets.
      d. The clarifier effluent shall pass over the edge of the baffled adjustable effluent weir plate into the effluent trough, one trough for both clarifiers.
   7. The sludge return piping from each sludge well shall be configured such that each hopper bottom can be isolated from the other with valving, as shown.

H. Scum Removal System:
   1. Each clarifier shall be equipped with two 2-inch diameter positive airlift pump-type skimming systems for removal of the scum from the collection trough and the clarifier inlet baffle. Skimmer piping and valves shall be Schedule 80 PVC,

except for the air distribution piping, which shall be constructed of Type 316 stainless steel.

2. Air shall be supplied by the aeration basin blower. The airline supplying air to the skimming device shall be equipped with a needle valve to regulate the rate of return.
3. The scum intake shall be equipped with an adjustable assembly, enabling operator to control the position of the skimmer at water level without contacting the wastewater. The discharge port shall be sloped for manual determination of flow rate.
4. All valves shall be accessible to the operator without the need to remove floor panels.

I. Return Sludge System:
   1. A return sludge system shall be provided to transport settled sludge in the clarifier to the anoxic chamber(s).
   2. The return sludge system shall consist of a positive sludge re-circulation pumping system utilizing airlift pumps, one in each clarifier.
      a. All sludge return piping and valves shall be painted Schedule 80 PVC. All valves shall be Schedule 80 PVC True Union ball valves.
      b. Each clarifier hopper-bottom shall be equipped with one 4-inch diameter airlift sludge return assembly, consisting of the following:
         1) An airlift pump system with a re-circulation capacity ranging from 0% to 150% of the daily average flow.
         2) Airline supplying air to the pump, equipped with an air control valve to vary the capacity of the pumping rate.
      c. Air for the airlift pumps shall be supplied by the aeration basin blower.
      d. The airlift pumps shall be firmly supported and shall be equipped with a clean-out plug to allow for easy cleaning and maintenance.

J. Sludge Holding Chamber:
   1. A sludge holding chamber shall be provided with capacity to store waste sludge for a minimum of 14 days based on the daily average flow rate.
   2. Waste sludge shall be manually directed to the sludge holding chamber, transported by the return sludge piping system.
   3. The sludge holding chamber shall be equipped with a supernatant decant airlift system to transfer supernatant back to the secondary treatment system for processing and to concentrate sludge solids.
   4. The chamber shall be aerated. Diffused air shall be supplied by the aeration basin blower. The diffusers and diffuser piping shall be as specified for the aeration chamber.
   5. Emergency overflow weirs shall be installed in the wall between the aeration basin.

K. Disinfection System:

1. Provide a chlorine contact chamber with a minimum volume to provide a 15 minute detention time based on the peak daily flow rate and a minimum chlorine residual of 0.5 mg/L.
2. Provide a 3-inch tablet chlorine disinfection system, Sanuril 1000 Tablet Chlorinator, or approved equal, located as shown.
3. Provide a V-notch weir for flow measurement at the effluent of the chlorine contact chamber. The V-notch weir shall be constructed of Type 316 Stainless Steel including mounting hardware.
    a. Manufacturer shall provide a stainless steel mounting bracket over upstream of V-notch weir to mount an ultra-sonic level sensor. See Sheet I-04 for reference.
    b. Manufacturer shall provide aluminum staff gauge with graduations marked in feet, tenths, and hundredths zeroed to V-notch weir.

L. Effluent Flow Measurement:
1. The effluent flow meter shall be installed upstream of the V-notch weir of the chlorine contact chamber. The flow meter shall be an ultrasonic, open channel type as specified in Section 40 60 05, Instrumentation and Control for Process Systems. The effluent flow meter shall be furnished and installed by the instrumentation and control integrator.

M. Portable Hoist and Winch Assembly:
1. A portable hoist and winch assembly shall be provided for lifting the pumps and mixers from each basin.
2. The hoist shall be constructed of Type 316 Stainless Steel tubing, with a 500 pound loading capacity.
3. Stainless steel wall mounted sockets shall be bolted to the hand rail and angle iron support to allow easy placement of the portable hoist and winch assembly.
4. A hand crank shall automatically locate at any position upon release.
5. A heavy duty safety hook and 30 feet of ¼-inch thick stainless steel cable shall also be provided.

N. Packaged Plant Effluent Connection:
1. The effluent connection of the Packaged WWTP shall consist of one (1) 6" diameter standard flanged Schedule 80 PVC pipe, as shown

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2.4 TANK FABRICATION

A. All vertical steel bulkheads that will contain process water shall be designed to withstand the full hydrostatic forces from either side of the bulkhead or wall.
1. The design of the walls shall be such that any isolated compartment may be individually dewatered.
2. The minimum wall thickness shall be ¼ inch. All tank vessels, walls, tank dividers shall be fabricated of ¼ inch thick structural grade A-36 steel plate; joined by arc welding with fillets of adequate section for the joint involved.

3. All walls shall be continuous, watertight and shall be supported by structural reinforcing members where required.
4. All other areas such as the tank floor, tank end walls, and internal bulkheads shall be adequately reinforced to prevent bowing when fully loaded.

B. All shop welds shall have burrs, spatter, etc. removed prior to blasting. All chain or skip welds on surfaces above water level or on an outer surface shall be caulked prior to painting.

C. All reinforcing on the bulkheads shall be gussetted to develop the full strength of the reinforcing.

D. The method used to initially fill the plant with liquid may be selected by the Engineer to test the hydrostatic design. Any failure or excessive deflection shall be remedied and all costs shall be borne by the manufacturer.

E. All fasteners, hardware, and hangers shall be constructed of Type 316 Stainless Steel.

F. Each plant component shall be prefabricated in the factory of the component manufacturer and shall be shipped in assemblies complete and operable as shown and specified.

G. The Packaged WWTP shall be pre-assembled and pre-tested, and transported to the project site in one major section. Each component assembly shall be installed in the field in accordance with the Manufacturer's installation drawings.

2.5 WALKWAYS, GRATING, AND STAIRS

A. Walkways:
1. Service walkways shall be provided for access to, and maintenance of, all plant equipment, valves, clarifier weir, and all air diffuser drop pipes and regulating valves.
2. All grating panels shall be constructed of skid-resistant aluminum with maximum yield strength of 37,000 psi.
3. All walkways shall be a minimum of 24 inches wide and have a deck made of 1-inch aluminum "I-Bar" grating adequately supported to withstand a live load of 100 lbs. per square foot, minimum.

B. Handrails:
1. Shall be provided around the perimeter of the service walkway and access stair
2. The handrail system shall consist of two-rail, 1½-inch-diameter Schedule 40, anodized aluminum pipe, and 4-inch by ¼-inch aluminum toeplate.
3. Railing shall be designed in accordance with OSHA Standard 1910.23.

4. Limit deflection in each single span of railing and handrail to 1.5-inch maximum, and to 1/4-inch maximum on railing posts. Applied loads shall not produce permanent deflection in the completed Work when loads are removed.

C. Aluminum Access Stair:
   1. Shall be provided as shown on Drawings.
   2. Railing shall be provided as described above.
   3. Access stair shall be designed in accordance with OSHA Standard 1910.24.
   4. Access stair shall be a minimum of 30 inches wide and have grating treads made of 1-inch aluminum "I-Bar" grating adequately supported to withstand a live load of 100 lbs. per square foot, minimum.

2.6 ELECTRICAL AND CONTROLS

A. General:
   1. All provided panels shall comply with UL 50 and UL 508A, and be provided in powder coated white, NEMA 4X enclosures with sunshields.
   2. The motor and auxiliary branch circuits shall be protected by circuit breakers as specified in Section 26 00 05, Electrical Work.
   3. The control voltage shall be 120 volts AC. This voltage shall be supplied from a single phase transformer.
   4. Switches, indicator lights, alternators, timers, etc. shall be furnished and installed per the drawings and as specified in Section 26 00 05, Electrical Work.
   5. All control panels shall be completely factory assembled and tested prior to shipment.
   6. The following local control panels shall be provided for each system:
      i. FE-LCP - Flow Equalization Local Control Panel
      ii. AM-LCP - Anoxic Mixer Local Control Panel
      iii. RP-LCP - Recycle Pump Local Control Panel
      iv. MAB-LCP - Main Air Blower Local Control Panel

B. Flow Equalization Local Control Panel (FE-LCP)
   1. The incoming service to the panel shall be 480 volts, 3 phase, 60 Hz.
   2. A step down transformer shall be supplied by the Manufacturer to step the electrical power down from 480 volt to 120-volt power for control voltages for the secondary power.
   3. The FE-LCP shall control the operation of the following equipment:
      a. Flow Equalization Blower Motor Unit BM-1, 3 HP, 460 volts, 3 phase, 60 Hz.
      b. Flow Equalization Blower Motor Unit BM-2, 3 HP, 460 volts, 3 phase, 60 Hz.
      c. Flow Equalization Pump No. 1: P-1, 1/2 HP, 460/3/60.
      d. Flow Equalization Pump No. 2: P-2, 1/2 HP, 460/3/60.
      e. Liquid level sensors -4 float switches.

f. Time Clock Control.
g. Seal fail sensor for each pump.

4. Motor starters and overcurrent protection shall be provided as specified in Section 26 00 05, Electrical Work.
5. Control panels, panel mounted instruments, and appurtenances shall be provided as specified in Section 40 60 05, Instrumentation and Control for Process Systems.
6. Flow Equalization Blowers - The flow equalization blowers shall be controlled either manually by the HOA switches located at the FE-LCP, or automatically by a duplex controller/alternator which changes the duty/standby blower designation based on two (2) of the four (4) float switches as described in 2.6.B.7 below.
7. Flow Equalization Pumps - The flow equalization pump operation shall be controlled either manually by the HOA switches located near the pumps, manually by the Start/Stop push buttons at the FE-LCP, or automatically by four (4) float switches, each individually adjustable for the following:
   a. All Pumps & Blowers off
   b. Lead Pump and Duty Blower on
   c. Lag Pump on
   d. High Level Alarm.

   A duplex pump alternator shall change the lead/lag pump designation after all pumps are turned off. If the liquid level reaches the high water level, the alarm will be activated.
8. All wiring, terminal blocks, supports and accessories required for the operations of the control panel shall be provided in compliance with the National Electric Code.

C. Main Air Blower Local Control Panel (MAB-LCP)
1. The incoming service to the panel shall be 480 volts, 3 phase, 60 Hz.
2. A step down transformer shall be supplied by the Manufacturer to step the electrical power down from 480 volt to 120-volt power for control voltages for the secondary power.
3. The MAB-LCP shall control the operation of the following equipment:
   a. Main Air Blower Motor Unit BM-3, 7.5 HP. 460/3/60
   b. Main Air Blower Motor Unit BM-4, 7.5 HP. 460/3/60
   c. Time Clock Control.
4. Motor starters and overcurrent protection shall be provided as specified in Section 26 00 05, Electrical Work.
5. Control panels, panel mounted instruments, and appurtenances shall be provided as specified in Section 40 60 05, Instrumentation and Control for Process Systems.
6. Main Air Blowers - The main air blowers shall be controlled either manually by the HOA switches located at the MAB-LCP, or automatically by a duplex controller/alternator which changes the duty/standby blower designation based on a time clock (adjustable).

7. All wiring, terminal blocks, supports and accessories required for the operations of the control panel shall be provided in compliance with the National Electric Code.

D. Recycle Pump Local Control Panel (RP-LCP)
   1. The incoming service to the panel shall be 480 volts, 3 phase, 60 Hz.
   2. A step down transformer shall be supplied by the Manufacturer to step the electrical power down from 480 volt to 120-volt power for control voltages for the secondary power.
   3. The FE-LCP shall control the operation of the following equipment:
      a. Recycle Pump No. 1: P-3, 3/4 HP, 460/3/60.
      b. Recycle Pump No. 2: P-4, 3/4 HP, 460/3/60.
      c. Seal fail sensor for each pump.
   4. Motor starters and overcurrent protection shall be provided as specified in Section 26 00 05, Electrical Work.
   5. Control panels, panel mounted instruments, and appurtenances shall be provided as specified in Section 40 60 05, Instrumentation and Control for Process Systems.
   6. Recycle Pumps - The recycle pump operation shall be controlled either manually by the HOA switches located near the pumps, manually by the Start/Stop push buttons at the RP-LCP, or automatically by a duplex controller/alternator which changes the duty/standby pump designation based on a time clock (adjustable).
   7. All wiring, terminal blocks, supports and accessories required for the operations of the control panel shall be provided in compliance with the National Electric Code.

E. Anoxic Mixer Local Control Panel (AM-LCP)
   1. The incoming service to the panel shall be 480 volts, 3 phase, 60 Hz.
   2. A step down transformer shall be supplied by the Manufacturer to step the electrical power down from 480 volt to 120-volt power for control voltages for the secondary power.
   3. The AM-LCP shall control the operation of the following equipment:
      a. Anoxic Mixer AM-1, 1/2 HP. 460/3/60 Main Secondary
      b. Anoxic Mixer AM-2, 1/2 HP. 460/3/60 Main Secondary
   4. Motor starters and overcurrent protection shall be provided as specified in Section 26 00 05, Electrical Work.
   5. Control panels, panel mounted instruments, and appurtenances shall be provided as specified in Section 40 60 05, Instrumentation and Control for Process Systems.
   6. Anoxic Mixers - The anoxic mixers shall be controlled either manually by the HOA switches located at the mixers, or manually by the Start/Stop push buttons at the AM-LCP.

7. All wiring, terminal blocks, supports and accessories required for the operations of the control panel shall be provided in compliance with the National Electric Code.

2.7 TOOLS AND SPARE PARTS

A. General: Furnish all special tools that are required to assemble, disassemble, repair, and maintain any item of mechanical equipment. Special tools shall include any type of tool that has been specifically made for use on an item of equipment for assembly, disassembly, repair, and maintenance. When special tools are provided they shall be marked or tagged, and a list of such tools shall be included with maintenance and operation instructions describing use of each marked tool.

B. Provide:
   1. Two sets of spare belts for each blower.
   2. Two sets of inlet filters for each blower.
   3. Two coarse bubble diffusers.
   4. One gallon of both interior and exterior paint. (Not to be sued by CONTRACTOR for touch-up).

C. Spare parts shall be packed in sturdy containers with clear indelible identification markings, referencing the equipment that they are intended for, and shall be stored in a dry, warm location until transferred to the OWNER at the conclusion of the Project. Provide complete ordering information including manufacturer, part number, part name and equipment for each part to be used.

2.8 SURFACE PREPARATION AND PROTECTIVE COATINGS

A. Packaged WWTP, motors, drives, frames, steel plates, appurtenances, etc., shall receive shop primer and shop finish coating conforming to the requirements of Section 09 91 00, Painting. If any damage to the paint system occurs, the equipment shall be repainted as directed by the ENGINEER.

B. Surface preparation and painting shall conform to the requirements of Section 09 91 00, Painting.

C. All steel surfaces shall receive a near white blast to remove rust, mill scale and weld slag. All weld splatter and surface roughness shall be removed by chipping and grinding smooth. Blasting shall be accomplished indoors using steel shot to produce a mil profile for optimum adhesion of the primer.

D. All prepared surfaces shall be thoroughly dry and free from preparation dust and foreign matter prior to the application of any coating. All materials shall be evenly applied and shall be free from obvious defects.

E. Protective coatings shall not be applied to improperly prepared surfaces or during conditions considered to be not conducive to sound painting practices or in fog, rain, snow, mist or when the surface temperature is less than 40°F. or the humidity exceeds 85 percent.

F. Immediately after surface preparation, a rust inhibitive epoxy primer coat shall be applied. No discoloration of the cleaned areas shall occur prior to the application of the prime coat. All steel surfaces shall receive a 3 mil dry film thickness of Sherwin-Williams B62Y110 Copoxy primer, or equal.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 UNLOADING AND SETTING

A. Packaged WWTP manufacturer shall inform the contractor, prior to system shipment, of the calculated weight of the treatment plant.

B. Crane to off-load and set the Packaged WWTP onto the concrete slab shall be provided by the CONTRACTOR.

C. Setting of the Packaged WWTP and connection to influent and effluent piping and power, anchoring of the Packaged WWTP, and thrust blocking of the influent and effluent piping that is connected to the Packaged WWTP shall be the responsibility of the CONTRACTOR.

3.3 INSTALLATION

A. CONTRACTOR shall provide all materials, equipment, and labor necessary to install and connect the Packaged WWTP system.

B. Installation of the Packaged WWTP shall be completed by the CONTRACTOR as specified and in accordance with the Manufacturer's written instructions. The Manufacturer’s technical representative shall be available for consultation prior to and during installation. The final installation must be certified by the Manufacturer as correct prior to start-up. The Manufacturer's technical representative performing this service shall be a direct employee of the equipment Manufacturer, normally engaged in this type of service work.

C. Examine pads and supports to receive Packaged WWTP for:
   1. Proper anchor bolt locations.
   2. Unevenness, irregularities, and incorrect dimensions.

D. Packaged WWTP shall be installed on a concrete pad and secured with anchor bolts in accordance with the manufacturer's recommendations and as shown. Concrete work and grout shall be in accordance with Section 03 00 05, Concrete. The Packaged WWTP base shall be accurately shimmed to grade and the spaces between filled with an approved non-shrink grout. After the grout has reached its initial set, exposed edges shall be cut back 1/2-inch and the edges neatly finished with 1 to 2 cement mortar. Where channel skid bases are used, the void inside the channel shall be filled with non-shrink grout and the open ends plastered with 1 to 2 cement mortar.

E. Installation shall encompass the total treatment plant assembly, as required for a complete and operable WWTP. Installation shall also include leveling and adjusting weir plates, scraper assemblies, air regulation valves, skimmings trough, and other ancillary equipment. CONTRACTOR shall include furnishing and applying an initial supply of lubrication, as recommended by the Manufacturer.

F. Perform the following inspection of equipment with the equipment manufacturer's representative.
   1. Verify proper equipment mounting and setting.
   2. Verify that control, interlock and power wiring is complete and operational.
   3. Verify alignment of each motor and drive.
   4. Verify proper piping connections and accessories.
   5. Verify that lubrication has been completed.
   6. Verify direction of rotation.
   7. Verify setting of safety controls.
   8. Monitor heat build-up in bearings.
   9. Check motor loads against nameplate data.
   10. Verify function of safety and operating controls.
   11. Verify proper operation of equipment.
   12. Remove debris and waste materials resulting from installation.

3.4 SURFACE PREPARATION AND CORROSION PROTECTION (FIELD)

A. Surface preparation and painting shall conform to the requirements of Section 09 91 00, Painting.

B. All field welds and marred areas shall be near white blasted to remove weld slag and surface impurities.

C. The color shall be as selected by the ENGINEER/OWNER.

D. Dry film thickness of all coats shall be verified by employing standard calibrated dry film thickness gauges.

3.5 PACKAGED WWTP START-UP

A. CONTRACTOR shall check and approve the installation of all anchoring, piping, control system components, and all cable and wiring connections between the various system components prior to placing the various processes and equipment into operation.

B. CONTRACTOR shall perform a hydrostatic test on the Packaged WWTP compartments, initially filling the plant with water to test the hydrostatic design. Any leaks, failures, or excessive deflection shall be remedied and all costs shall be borne by the manufacturer.

C. CONTRACTOR shall conduct a complete system checkout and adjustment, including all equipment, calibration of all instruments, tuning of control loops, checking operation functions, and testing of final control actions. When there are future operational functions included in this work, they should be included in the system checkout. All problems encountered shall be promptly corrected to prevent any delays in startup of the various unit processes.

D. Additionally, Manufacturer's representative shall check and approve the installation before operation. The Manufacturer's representative shall test the system in the presence of the ENGINEER, verify that the system conforms to the specified requirements, and instruct plant personnel on care and maintenance of the equipment. Provide the Manufacturer's representative to revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

E. Once the installation of the Packaged WWTP has been certified by the Manufacturer, the CONTRACTOR, with assistance from the Manufacturer’s qualified technical representative shall provide field engineering to start-up, stabilize, and test at proper operating conditions.

F. The start-up, or acclimation period, for the Packaged WWTP shall take no longer the four weeks. At any point during this startup period, at the discretion and direction of the Manufacturer, the CONTRACTOR shall switch the system over to normal operation. CONTRACTOR shall haul at least one 5,000 to 10, 000 gallon load of mixed liquor from existing WWTP to seed plant. The ENGINEER shall make arrangements for pickup.

G. After satisfactory startup and the corresponding switch over to normal operation, the CONTRACTOR shall, in the presence of the ENGINEER, conduct the performance test as detailed in Paragraph 3.5 below.

3.6 PACKAGED WWTP PERFORMANCE TESTING

A. Performance testing of the Packaged WWTP shall not commence until after CONTRACTOR and ENGINEER have mutually agreed that the Packaged WWTP has been satisfactorily started-up. CONTRACTOR and a qualified field service representative of the Manufacturer shall conduct an operating test of the Packaged WWTP equipment and controls in the presence of ENGINEER to demonstrate that the equipment and its controls will function correctly.

B. General: CONTRACTOR and Manufacturer at their sole cost shall conduct Packaged Wastewater WWTP performance tests following completion of process start-up. The field acceptance tests shall be initiated within 45 days of process start-up. Field acceptance tests shall be coordinated and scheduled with OWNER. The time of the performance test and detailed test procedure shall be submitted for approval by the ENGINEER at least 30 working days prior to testing. Performance testing shall be conducted by the CONTRACTOR on the Packaged WWTP for at least 30 consecutive days. During performance testing, the plant must be operated or 10 consecutive days within 90% of the average hydraulic loading rate. The ENGINEER may make periodic site visits during the performance test and the results will be furnished to the ENGINEER in writing within 14 days of completion of the performance test.
   1. CONTRACTOR shall provide all equipment required for conducting the performance testing.
   2. During testing, significant changes in Packaged WWTP operating conditions shall not be permitted without the consent of the ENGINEER. All fine-tuning of operating conditions shall be performed prior to testing.

C. Test Procedure:
   1. During the field acceptance tests, daily grab samples shall be obtained. CONTRACTOR shall take the samples and have them analyzed by an OWNER approved laboratory. If requested by OWNER, CONTRACTOR will provide split samples after such request for analysis by another certified laboratory at OWNER's expense. The test results shall be used to calculate weekly and monthly averages. The performance tests will have been met if after 30 days of operation, the weekly averages are equal to or better than the values specified in the Design Requirements, Paragraph 2.2 of this Section. Testing shall be completed in accordance with Standard Methods for the Examination of Water and Wastewater, latest edition and EPA 40CFR136.
   2. The following recordings and samples shall be taken, analyzed and weekly and monthly averages calculated:
      a. Plant Influent:
         1) TSS (mg/L).
         2) CBOD5 (mg/L).
         3) TKN (mg/L).

4) Ammonia-N (mg/L)
5) Total P (mg/L).

b. Plant Effluent:
1) Flow (gal/day).
2) TSS (mg/L).
3) CBOD5 (mg/L).
4) Ammonia-N (mg/L)
5) Nitrate-N (mg/L).
6) Total P (mg/L)

D. In the event that the Packaged WWTP does not meet the Design Requirements during the field acceptance tests, the Packaged WWTP Manufacturer and CONTRACTOR will be permitted to make changes to the equipment and methods of operation at the Manufacturer's and CONTRACTOR'S sole expense. The re-adjustments shall be made as soon as practicable within a period not to exceed 30 days. Following the re-adjustments, the CONTRACTOR and Manufacturer at their sole expense (including all sample collection, delivery, and laboratory costs) shall make a second test run similar to the first. Additional testing of any equipment that has been repaired, modified or replaced shall be conducted in accordance with the procedure for the initial acceptance test described above. Conformance with the Design Requirements for a period of 30 consecutive days must be achieved before the Packaged WWTP will be deemed acceptable. A maximum of two retests shall be allowed to show conformance with the Design Requirements. However, after initial start-up, OWNER shall have the right to use the equipment as needed to treat wastewater until an accepted, or if rejected, until acceptable replacement system or modified system is available for use.

E. Satisfactory completion of the performance tests does not release CONTRACTOR from other guarantees required by the Contract Documents or provided by law.

F. A report describing the performance tests and results shall be submitted to OWNER and ENGINEER. This report shall summarize pertinent details regarding the tests as well as test results to demonstrate that the tested equipment complies with the specified Design Requirements.

3.7 MANUFACTURER'S SERVICES

A. Factory trained representative(s) shall be provided for installation supervision, start-up services, performance testing services, and operation and maintenance personnel training services. The representative shall visit the Site a minimum of three days, minimum eight hours on-site for each day at the Site. The first visit shall be for checking the completed installation and start-up of the system. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the Packaged WWTP conforms to the requirements. The second visit shall be to assist performance tests and initial operation. The third visit shall be as

described under Section 01 79 23, Instruction of Operations and Maintenance Personnel. Manufacturer's representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory at no additional cost to OWNER.

B. All costs, including travel, lodging, meals and incidentals shall be considered as included in CONTRACTOR'S bid price.

C. Reports: The manufacturer's supervising Engineer shall submit a report of each visit to the Site. Reports shall provide complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction and all other pertinent information.

++ END OF SECTION ++

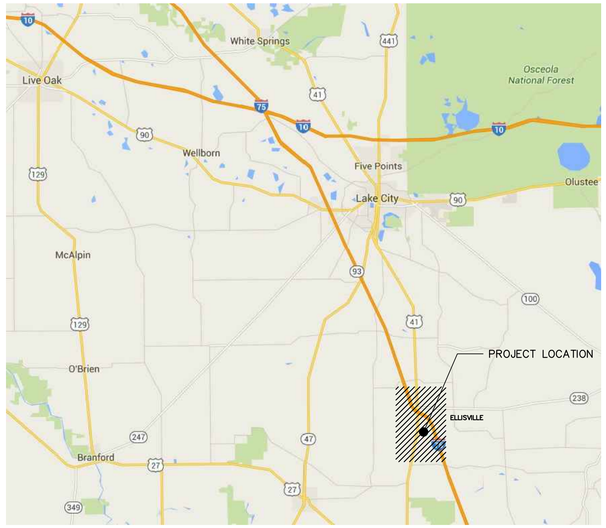
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BY: NEGRON-VIEIRA, VANESSA

ELLISVILLE WASTEWATER TREATMENT PLANT

BID SET

DATE ISSUED / DATE REVISED

OCTOBER 2016



LOCATION MAP



COLUMBIA COUNTY, FLORIDA

PREPARED BY:

ARCADIS

CERTIFICATION OF AUTHORIZATION NO. 7917
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350, TAMPA, FL 33607

ORIGINAL SIGNED AND SEALED SHEET ON FILE

SEAN K. CHAPARRO, P.E.
FLORIDA P.E. # 75865

DATE

KEY CONTACTS:

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COLUMBIA COUNTY UTILITIES
P.O. BOX 1529
LAKE CITY, FLORIDA 32056

TELEPHONE: 386-758-1019
CONTACT: CHAD WILLIAMS, P.E.

ENGINEER:
ARCADIS U.S. INC.
3109 W. MARTIN LUTHER KING JR. BLVD.,
SUITE 350
TAMPA, FLORIDA 33607
TELEPHONE: 813.903.3100
ENGINEER OF RECORD:
SEAN K. CHAPARRO, P.E.

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GENERAL NOTES

1. ALL CONSTRUCTION AND MATERIALS SHALL BE IN CONFORMANCE WITH THE "COLUMBIA COUNTY WATER AND WASTEWATER SYSTEMS HANDBOOK" (LATEST EDITION), UNLESS OTHERWISE SHOWN IN THESE PLANS.

2. CONTRACTOR SHALL CONTACT SUNSHINE STATE ONE CALL OF FLORIDA (SSOCOF) BY CALLING 811 OR 1-800-432-4770 AT LEAST 48 HOURS PRIOR TO EXCAVATION. ALL PROPOSED CONSTRUCTION SHALL BE WHITE-LINE PAINTED PRIOR TO CONTACTING SSOCOF.

3. ALL CONTRACTORS ARE DIRECTED, PRIOR TO BIDDING, TO CONDUCT WHATEVER NON-DESTRUCTIVE INVESTIGATIONS THEY MAY DEEM NECESSARY TO ARRIVE AT THEIR OWN CONCLUSIONS REGARDING THE ACTUAL CONDITIONS THAT WILL BE ENCOUNTERED.

4. DETERMINING THE ACTUAL LOCATION OF ANY EXISTING UTILITY IS THE CONTRACTORS RESPONSIBILITY. BEFORE COMMENCING WORK, IT IS THE CONTRACTOR'S RESPONSIBILITY TO CONTACT THE VARIOUS UTILITY COMPANIES WHICH MAY HAVE BURIED OR AERIAL UTILITIES WITHIN OR NEAR THE CONSTRUCTION AREA. (PROVIDE 72 HOURS MINIMUM NOTICE TO ALL UTILITY COMPANIES PRIOR TO BEGINNING CONSTRUCTION). THE CONTRACTOR IS FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT OCCUR DUE TO THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES. THE OWNER AND ENGINEER ASSUME NO LIABILITY FOR ANY DAMAGES SUSTAINED OR COSTS INCURRED BECAUSE OF THE CONTRACTOR'S OPERATIONS IN THE VICINITY OF EXISTING UTILITIES OR STRUCTURES, NOR FOR TEMPORARY BRACING AND SHORING OF SAME. SCHEDULE AND EXECUTE ALL WORK INVOLVING EXISTING UTILITIES TO MINIMIZE INTERRUPTION OF SERVICES. WHENEVER SUCH INTERRUPTION IS NECESSARY FOR COMPLETION OF THE WORK, NOTIFY THE ENGINEER AND THE OWNER AT LEAST 72 HOURS IN ADVANCE. ALL WORK TO REPAIR/RESTORE UTILITY SERVICE SHALL BE PERFORMED AS REQUIRED BY THE APPROPRIATE UTILITY. IF IT IS NECESSARY TO SHORE, BRACE, OR SWING A UTILITY, CONTACT THE UTILITY COMPANY OR DEPARTMENT AFFECTED AND OBTAIN THEIR PERMISSION REGARDING THE METHOD TO USE FOR SUCH WORK. ALL COSTS RELATED TO SERVICE, MAINTENANCE, INTERRUPTION, REPAIR, RELOCATION AND RESTORATION ARE TO BE INCLUDED IN THE CONTRACTOR'S BID. ANY DELAY OR INCONVENIENCE CAUSED TO THE CONTRACTOR BY THE VARIOUS UTILITIES SHALL BE INCIDENTAL TO THE CONTRACT, AND NO EXTRA COMPENSATION SHALL BE PAID.

5. FIELD CONDITIONS MAY NECESSITATE SLIGHT ALIGNMENT AND/OR GRADE DEVIATIONS FROM THOSE WHICH ARE INDICATED ON THE PLANS. ANY DEVIATIONS OR ADJUSTMENTS SHALL FIRST BE APPROVED BY THE ENGINEER BEFORE BEING PERFORMED.

6. THE CONTRACTOR IS RESPONSIBLE FOR ALL CONSTRUCTION STAKING, INCLUDING HORIZONTAL AND VERTICAL CONTROL FOR ALIGNMENT OF WORK. ALL SURVEY WORK TO ESTABLISH THE HORIZONTAL AND VERTICAL CONTROL SHALL BE UNDER THE GUIDANCE AND DIRECT SUPERVISION OF A FLORIDA REGISTERED PROFESSIONAL SURVEYOR AND MAPPER, PER FLORIDA ADMINISTRATIVE CODE, CHAPTER 61G17-6, "MINIMUM TECHNICAL STANDARDS."

7. THE CONTRACTOR SHALL PRESERVE ALL CONTROL STAKES, BENCH MARKS, REFERENCE POINTS AND PROPERTY CORNERS. THE OWNER WILL GRANT NO CLAIM FOR DAMAGES OR LOSS OF TIME BY THE CONTRACTOR DUE TO LOSS OR DISTURBANCE OF SURVEY CONTROL POINTS. CONTROL STAKES, BENCH MARKS, REFERENCE POINTS AND PROPERTY CORNERS DISTURBED BY THE CONTRACTOR'S WORK SHALL BE REPLACED BY A FLORIDA REGISTERED PROFESSIONAL SURVEYOR AND MAPPER WHO WILL BE SELECTED BY AND PAID BY THE CONTRACTOR. THE OWNER WILL NOT MAKE FINAL PAYMENT TO THE CONTRACTOR UNTIL ALL DISTURBED OR DESTROYED PROPERTY CORNERS AND PERMANENT BENCH MARKS HAVE BEEN REPLACED BY THE FLORIDA REGISTERED SURVEYOR AND MAPPER. THE SURVEYOR SHALL CERTIFY THAT SUCH MARKERS HAVE BEEN REPLACED IN ACCORDANCE WITH THE STATE OF FLORIDA ADMINISTRATIVE CODE, CHAPTER 61G17-6, "MINIMUM TECHNICAL STANDARDS".

8. ALL TREES, SHRUBS, ETC., ALONG THE LINES OF CONSTRUCTION SHALL BE PROTECTED UNLESS SHOWN TO BE REMOVED. ANY DISTURBANCE TO THESE ITEMS SHALL REQUIRE APPROVAL OF THE ENGINEER.

9. RESTORE ALL PRIVATE AND PUBLIC PROPERTY AFFECTED BY THIS WORK TO A CONDITION EQUAL TO OR BETTER THAN EXISTED BEFORE COMMENCING CONSTRUCTION WORK, UNLESS SPECIFICALLY EXEMPTED BY THE DRAWINGS. THE CONTRACTOR SHALL RECONSTRUCT ALL FACILITIES TO PRE-CONSTRUCTION GRADES AND DIMENSIONS. THE ACQUISITION OF SUCH ADDITIONAL INFORMATION SHALL BE THE CONTRACTOR'S RESPONSIBILITY AND AT HIS EXPENSE. WATER, FERTILIZE AND SUPPLY ALL ITEMS AND CARE NECESSARY TO MAINTAIN THE HEALTH OF ALL NEW VEGETATION AND VEGETATION REPLACED AT NO EXPENSE TO THE OWNER, IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.

10. THE CONTRACTOR IS RESPONSIBLE FOR TRAFFIC MAINTENANCE IN ACCORDANCE WITH THE SPECIFICATIONS, U.S. DEPARTMENT OF TRANSPORTATION'S "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES," FLORIDA DEPARTMENT OF TRANSPORTATION (FDOT) SPECIFICATIONS AND OTHER GOVERNING AGENCY'S SPECIFICATIONS. IN THE EVENT OF A CONFLICT, THE MORE STRINGENT SPECIFICATION OR REQUIREMENT SHALL GOVERN. PROVIDE ALL NECESSARY BARRICADES, WARNING SIGNS, DELINEATORS, FLAGMEN, PILOT CARS, ETC., REQUIRED FOR TRAFFIC CONTROL AND/OR MAINTENANCE.

11. PROVIDE ANY TEMPORARY CONTROLS AND/OR STRUCTURES REQUIRED TO MAINTAIN SUITABLE AND SAFE WORKING CONDITIONS AT ALL TIMES. SUCH ITEMS SHALL BE REMOVED ONCE THAT PORTION OF WORK HAS BEEN COMPLETED.

12. UPON COMPLETION OF THE PROJECT, PROVIDE AN AS-BUILT SURVEY OF ALL IMPROVEMENTS IN AUTOCAD 2011 FORMAT. THE AS-BUILT SURVEY MUST BE PREPARED BY A FLORIDA REGISTERED SURVEYOR AND MAPPER IN ACCORDANCE WITH THE STATE OF FLORIDA ADMINISTRATIVE CODE, CHAPTER 61G17-6, "MINIMUM TECHNICAL STANDARDS". AS A MINIMUM, AS-BUILT DRAWINGS FOR PLANT AND PIPELINE CONSTRUCTION SHALL SHOW CONSTRUCTED HORIZONTAL AND VERTICAL LOCATIONS OF ALL BENDS, FITTINGS, VALVES AND STRUCTURES, AND ELEVATIONS AT ALL LOCATIONS WHERE PROPOSED DESIGN ELEVATIONS ARE SHOWN ON THE DRAWINGS. THE AS-BUILT SURVEY SHALL BE TIED INTO THE STATE PLANE COORDINATE SYSTEM.

13. SPECIAL EMPHASIS ON EXCAVATION SAFETY AND TRENCH CONSTRUCTION:
   A. OSHA'S EXCAVATION SAFETY STANDARDS 29, CFR PART 1926.650-652 SUBPART P, AS WELL AS FLORIDA'S TRENCH SAFETY ACT (FLORIDA STATUTE 90-96) ARE CONSIDERED AS COMPLIMENTARY TO THESE CONTRACT DOCUMENTS. IF THERE IS ANY DUPLICATION, REDUNDANCY OR CONFLICT BETWEEN THE STIPULATIONS OF THESE CONTRACT DOCUMENTS AND THOSE STANDARDS, THE MOST STRINGENT REQUIREMENT SHALL GOVERN.
   B. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE THAT EXCAVATIONS DO NOT ENDANGER WORKMEN, EXISTING STRUCTURES, UTILITIES, OR OTHER FACILITIES. IF SUCH CONDITIONS OCCUR WHICH MAY ENDANGER WORKMEN, EXISTING STRUCTURES, UTILITIES, OR OTHER FACILITIES, IMMEDIATELY INSTALL AND MAINTAIN ADEQUATE SHEETING AND BRACING PER OSHA SPECIFICATIONS. CEASE ALL WORK UNTIL THE SHEETING AND BRACING HAS BEEN PROPERLY AND COMPLETELY INSTALLED. INSTALL THE SHEETING AND BRACING IN A MANNER THAT WILL ALLOW REMOVAL WITHOUT INJURING OR ENDANGERING WORKMEN, THE WORK, ADJACENT STRUCTURES, AND THE LIKE. PROMPTLY AND COMPLETELY FILL ALL VOIDS CAUSED BY THE WITHDRAWAL OF SHEETING WITH SAND AND COMPACT TO A DEGREE EQUAL TO THE SURROUNDING SOIL. REMOVE THE SHEETING AS THE WORK PROGRESSES OR, AT THE DISCRETION OF THE ENGINEER, CUT THE SHEETING OFF BELOW FINISHED GRADE AND LEAVE IN PLACE.

14. THE CONTRACTOR SHALL MAINTAIN ACCESS TO PRIVATE PROPERTY AT ALL TIMES.

15. ALL AFFECTED GRASSED AREAS SHALL BE RESTORED WITH THE APPLICATION OF ARGENTINE BAHIA SOD, HYDROMULCH SEEDING OR APPROVED EQUAL. ALL SLOPED AREAS TO BE SODDED. ANY SOD LAID ON A INCLINE SHALL BE PROPERLY PINNED. ALL SOD SHALL BE WATERED BY CONTRACTOR AS NEEDED UNTIL ESTABLISHED TO THE SATISFACTION OF THE ENGINEER. ALL DEAD AREAS SHALL BE REPLANTED IMMEDIATELY AT NO ADDITIONAL COST TO THE OWNER.

16. CONTRACTOR SHALL REPAIR ALL DISTURBED COUNTY ROADWAYS TO 95% OF MAXIMUM DENSITY PER AASHTO T-180. (MODIFIED PROCTOR DENSITY).

17. SECURITY OF CONSTRUCTION EQUIPMENT AND MATERIALS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. ALL STORAGE AREAS SHALL BE FENCED.

18. ALL AREAS DISTURBED BY THE CONTRACTOR SHALL BE RESTORED TO THEIR ORIGINAL CONDITION OR AS INDICATED ON THE CONTRACT DRAWINGS.

19. CONTRACTOR SHALL MAINTAIN 36" MINIMUM COVER OVER PROPOSED FORCE MAIN.

20. UNDER NO CIRCUMSTANCES SHALL PIPE BE LAID IN A WET TRENCH OR STRUCTURES BE CONSTRUCTED IN A WET EXCAVATION. DEWATERING SHALL BE INCLUDED IN THE CONTRACTOR'S BID PRICE.

21. IF NECESSARY, USE TEMPORARY SHEETING OR TRENCH BOXES TO MINIMIZE THE SIZE OF THE EXCAVATIONS AND TO PROTECT ADJACENT EXISTING ROADWAYS, UTILITIES AND OTHER FACILITIES. THERE SHALL BE NO ADDITIONAL COST TO THE OWNER UNLESS THE CONTRACTOR IS DIRECTED TO LEAVE THE SHEETING IN PLACE.

22. BACKFILL ALL TRENCHES WITHIN PUBLIC RIGHT-OF-WAY AT THE END OF EACH DAYS WORK. NO TRENCH SHALL BE LEFT OPEN OVERNIGHT. THE ENDS OF ALL PIPE SHALL BE PLUGGED AT THE CLOSE OF EACH DAYS WORK.

23. PERFORM SURFACE RESTORATION IMMEDIATELY FOLLOWING SUCCESSFUL PRESSURE TESTING, INCLUDING ROADWAY, DRIVEWAY, LANDSCAPING, GRASSING OR OTHER. RESHAPE DITCHES TO EXISTING CONTOURS. SOD SHALL BE INSTALLED IN ALL AREAS DAMAGED BY CONSTRUCTION.

EROSION CONTROL NOTES

1. NO UNAUTHORIZED DISTURBANCE OF ANY WETLANDS WILL BE PERMITTED. TEMPORARILY INSTALL SILT FENCES, BARRIERS OR SYNTHETIC BALES IMMEDIATELY ADJACENT TO AND UPLAND FROM ALL EXISTING WETLANDS PRIOR TO CONSTRUCTION ACTIVITIES WHICH MIGHT IMPACT THE WETLANDS. REMOVE ALL WETLAND PROTECTION MEASURES AFTER THE PROJECT HAS BEEN ACCEPTED BY THE OWNER.

2. ALL CONSTRUCTION ACTIVITIES SHALL INCORPORATE BEST MANAGEMENT PRACTICES TO CONTROL EROSION, SEDIMENTATION, AND THE POTENTIAL FOR DOWNSTREAM WATER QUALITY DEGRADATION. CONSTRUCTION PRACTICES INCLUDE:
   A. CONSTRUCT TEMPORARY SEDIMENTATION BASINS OR EARTHEN BERMS AT DOWN-GRADIENT ENDS OF NEWLY GRADED AREAS TO PROVIDE FOR SEDIMENT AND TURBIDITY REMOVAL.
   B. TURBIDITY BARRIERS, SYNTHETIC BALES AND OTHER EROSION CONTROL MEASURES SHALL REMAIN IN PLACE UNTIL CONSTRUCTION ACTIVITIES ARE COMPLETE AND THE POTENTIAL FOR EROSION IS ELIMINATED.

3. DO NOT EMPLOY SILT FENCES IN A MANNER TO CAUSE THEM TO ACT AS A DAM ACROSS PERMANENTLY FLOWING WATERCOURSES. USE SILT FENCES AT UPLAND LOCATIONS, AND TURBIDITY BARRIERS IN PERMANENT WATER BODIES, REGARDLESS OF WATER DEPTH.

SEQUENCE OF CONSTRUCTION

1. INSTALL AND MAINTAIN EROSION CONTROL STRUCTURES THROUGHOUT THE PROJECT DURATION. ALL EROSION CONTROL MEASURES MUST BE APPROVED BY THE ENGINEER BEFORE STARTING CONSTRUCTION. THE INSTALLATION MAY BE PHASED TO MATCH CONSTRUCTION.

2. LAYOUT WASTEWATER TREATMENT PLANT SITE. REMOVE VEGETATION AS NEEDED. REMOVE AND STOCKPILE TOPSOIL IN ALL DISTURBED AREAS. COVER BERMS WITH 4 TO 6 INCHES OF TOPSOIL FOLLOWING CONSTRUCTION.

3. LAYOUT FORCE MAIN PATH AND IDENTIFY ALL UTILITY CROSSINGS AND TREES TO BE REMOVED ALONG PATH.

4. EXCAVATE RAPID INFILTRATION BASINS (RIBS), INSTALL DISTRIBUTION PIPING, CONSTRUCT BERMS, ADD TOPSOIL AND SOD TO BERMS AND WATER TO ESTABLISH GROWTH. EXCAVATED MATERIAL TO BE STOCKPILED AND USED TO FILL EXISTING RIBS FOLLOWING PLANT DECOMMISSIONING.

5. INSTALL WASTEWATER TREATMENT PLANT, SITE FENCING, YARD PIPING, NEW ELECTRICAL SERVICES AND COMPLETE CIVIL SITE WORK. FILL WITH WATER AND HYDRAULICALLY TEST WASTEWATER TREATMENT PLANT PRIOR TO THE INTRODUCTION OF WASTEWATER.

6. INSTALL NEW LIFT STATION NO.1. TEST LIFT STATION AND FORCE MAIN WITH WATER PRIOR TO THE INTRODUCTION OF WASTEWATER.

7. TRANSFER MULTIPLE LOADS OF RAS/WAS FROM EXISTING WASTEWATER TREATMENT PLANT TO NEW PLANT UNTIL MIXED LIQUOR CONCENTRATION IS 2500 TO 3000 MG/L. FEED PLANT MOLASSES AT CONTROLLED RATES FOR APPROXIMATELY 30 DAYS OR UNTIL MIXED LIQUOR CONCENTRATIONS IS STABILIZED TO THE SATISFACTION OF THE ENGINEER. TRANSFER LIQUIDS VIA NEW LIFT STATION. ONCE NEW WWTP IS ONLINE, REMAINING EXISTING PLANT LIQUID TO BE FLUSHED AND DRAINED TO NEW WWTP. ALL GRIT AND SOLIDS SHALL BE REMOVED BY CONTRACTOR AND DISPOSED OF IN APPROPRIATE MANNER, AS APPROVED BY OWNER.

8. SCHEDULE FINAL CONNECTION FROM OLD LIFT STATION TO NEW LIFT STATION. SEAL, COAT AND ADD MANHOLE LID TO OLD LIFT STATION.

9. DRAIN EXISTING PLANT AT A MAXIMUM RATE OF 5000 GALLONS PER DAY OR AS DIRECTED BY OWNER. USE TRASH PUMP TO REMOVE LIQUID FROM TOP DOWN EVENLY ACROSS BASINS TO PREVENT LOADING BULK HEADS. SAND AND GRIT MAY EXIST AT BOTTOM OF TANK. DO NOT ALLOW THIS MATERIAL TO TRANSFER. KEEP PUMP SUCTION AT LEAST 12 INCHES OFF BOTTOM OF TANK AND DIGESTER. REMAINING GRIT MIXED LIQUOR TO BE DISPOSED OF BY CONTRACTOR AT HIS COST.

10. REMOVE AND SCRAP STEEL TANKS. PUNCH HOLES IN BOTTOM OF DIGESTER TO ALLOW DRAINAGE. CRUSH CONCRETE ROOF AND SIDES INTO DIGESTER TO BELOW GRADE. OTHER SITE DEBRIS MAY BE CRUSHED AND DISPOSED OF IN A SIMILAR MANNER. BACKFILL WITH SAND OR STOCK PILED MATERIAL. ADD WATER OR ALLOW RAIN TO SETTLE SAND IN HOLE AND ADD MORE UNTIL SETTLING STOPS.

11. LEVEL BERMS AND BACKFILL ALL EXISTING RIBS WITH STOCKPILED MATERIAL. IF ADDITIONAL MATERIAL IS REQUIRED, THIS SHALL BE ADDED AT CONTRACTORS EXPENSE. ADD TOP SOIL AND COVER AREA WITH SOD. ABANDON ALL VALVES BELOW GRADE. PLUG ALL ABANDONED YARD PIPING AND CONDUITS. REMOVE WIRE FORM ALL CONDUITS BEFORE ABANDONING.

12. GRADE SITE TO GENTLY SLOPE TOWARD DRAINAGE DITCH.

13. UPON ESTABLISHMENT OF VEGETATION TO THE SATISFACTION OF THE ENGINEER, REMOVE ALL EROSION CONTROL MEASURES.

14. INSTALL NEW LIFT STATION NO. 2 AND FORCE MAIN WITH WATER PRIOR TO INTRODUCTION OF WASTEWATER.

15. COMPLETE RE-ROUTE AND FINAL CONNECTION OF EXISTING SEWER LINES TO LIFT STATION NO. 2.

16. COMPLETE DEMOLITION OF EXISTING DREAM INN WWTF AS SHOWN AND SPECIFIED. BACKFILL EXISTING PONDS AND TANKS SHOWN AND SPECIFIED.

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CADD\ACAD\PROJ\67104 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\01-GENERAL\G-02.dwg LAYOUT: G-02 SAVED: 10/6/2016 3:46 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:13 AM BY: NEGRON-VIEIRA, VANESSA

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

THIS DRAWING IS THE PROPERTY OF THE ARCADIS ENTITY IDENTIFIED IN THE TITLE BLOCK AND MAY NOT BE REPRODUCED OR ALTERED IN WHOLE OR IN PART WITHOUT THE EXPRESS WRITTEN PERMISSION OF SAME.

Professional Engineer's Name: SEAN K. CHAPARRO, P.E.
Professional Engineer's No.: 75865

State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
SLJ	KAK	DAO

SEAN K. CHAPARRO
P.E. NO. 75865

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

GENERAL NOTES

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

G-02

FLUID ABBREVIATIONS

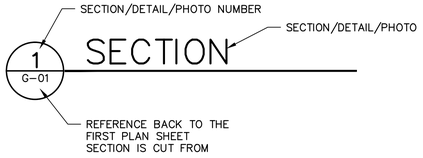
A	AERATION
FE	FINAL EFFLUENT
ML	MIXED LIQUOR
MLR	MIXED LIQUOR RETURN
EOF	EMERGENCY OVERFLOW
PW	POTABLE WATER
RAS	RETURN ACTIVATED SLUDGE
RW	RAW WATER
RWOF	RAW WATER OVERFLOW
S	SCUM
WAS	WASTE ACTIVATED SLUDGE

GENERAL, CIVIL, AND MECHANICAL ABBREVIATIONS

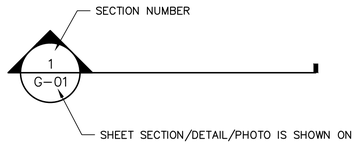
AB	ANCHOR BOLT
ABAN.	ABANDONED
ADD'L.	ADDITIONAL
ADJ.	ADJUSTABLE
AH	ACCESS HATCH
ALUM.	ALUMINUM
ALT.	ALTERNATE
APPROX.	APPROXIMATELY
BC	BOTTOM OF CURB
BF	BLIND FLANGE
BITUM.	BITUMINOUS
BL	BASELINE
BLDG.	BUILDING
BM	BENCH MARK
BM.	BEAM
BOP	BOTTOM OF PIPE
BOT.	BOTTOM
BRG	BEARING
BRP	BUILDING REFERENCE POINT
℄	CENTERLINE
C/C	CENTER TO CENTER
CAP	CAPACITY
CB	CATCH BASIN
CHH	COMMUNICATION HANDHOLE
CJ	CONSTRUCTION JOINT
CL.	CLEAR
CMH	COMMUNICATION MANHOLE
CO	CLEANOUT
COL.	COLUMN
CONC.	CONCRETE
CONT.	CONTINUED
CPLG.	COUPLING
CR	CURVE RADIUS
CW	CITY WATER
CY	CUBIC YARD(S)
DET.	DETAIL
DI	DUCTILE IRON
DIA.	DIAMETER
DISCH.	DISCHARGE
DMH	DROP MANHOLE
DN.	DOWN
DO	DIESEL OIL
DR	DRAIN
DWG.	DRAWING
DWL.	DOWELS
EA.	EACH
ECC	ECCENTRIC
EF	EACH FACE
EFF.	EFFLUENT
EJ	EXPANSION JOINT
EL.	ELEVATION
ELEC.	ELECTRIC
EMH	ELECTRICAL MANHOLE
EQ.	EQUAL
EW	EACH WAY
EX.	EXISTING
FD	FLOOR DRAIN
FD CON	FIRE DEPARTMENT CONNECTION
FDN.	FOUNDATION
FDND	FOUNDATION DRAIN
FF	FAR FACE
FIN.	FINISHED
FLEX.	FLEXIBLE
FLG.	FLANGE
FLR.	FLOOR
FM	FORCE MAIN
FMH	FUTURE MANHOLE
FSD	FLAT SIDE DOWN
FSU	FLAT SIDE UP
FTG.	FOOTING
FT., '	FEET
FYH	FUTURE YARD HYDRANT
G	GAS
GA.	GAGE OR GAUGE
GALV.	GALVANIZED
GE	GROOVED END JOINT
GRD.	GROUND
GRAT.	GRATING
HB	HOSE BIB
HDPE	HIGH DENSITY POLYETHYLENE
HORIZ.	HORIZONTAL
HP	HIGH POINT
HWL	HIGH WATER LEVEL
ID	INSIDE DIAMETER
IF	INSIDE FACE
IN	INLET
IN., "	INCHES
INF.	INFLUENT
INV.	INVERT
JST.	JOIST
JT.	JOINT
K	KIP (1000 POUNDS)
KSF	KIPS PER SQUARE FOOT
LFT	LINEAR FEET
LG.	LONG
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
L.P.	LOW POINT
LR	LONG RADIUS
LSH	LEVEL SWITCH HIGH
LSLL	LEVEL SWITCH LOW LOW
MAS	MASONRY
MAX.	MAXIMUM
MCC	MOTOR CONTROL CENTER
MFR.	MANUFACTURER
MGD	MILLION GALLONS PER DAY
MH	MANHOLE
MIN.	MINIMUM
MJ	MECHANICAL JOINT
MO	MASONRY OPENING
NC	NORMALLY CLOSED
NF	NEAR FACE
NO	NORMALLY OPEN
NO., #	NUMBER
O	OVERFLOW
OC	ON CENTER
OD	OUTSIDE DIAMETER
OF	OUTSIDE FACE
OPNG.	OPENING
OPP.	OPPOSITE
P/A	PLUG AND ABANDON
PC	POINT OF CURVATURE
PCC	POINT OF COMPOUND CURVATURE
PE	PLAIN END
PI	POINT OF INTERSECTION
℗	PLATE OR PROPERTY LINE
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PS	PUMP STATION
PT	POINT OF TANGENCY
R	RADIUS
RCP	REINFORCED CONCRETE PIPE
RED.	REDUCER
REINF.	REINFORCEMENT OR REINFORCE
REQ'D.	REQUIRED
RIB	RAPID INFILTRATION BASIN
RJ	RESTRAINED JOINT
RM.	ROOM
R.O.W	RIGHT OF WAY
SAN	SANITARY
SCH	SCHEDULE
SD	STORM DRAIN
SHT.	SHEET
SLP	SLOPE
SPA.	SPACING
SPEC.	SPECIFICATION
SR	SHORT RADIUS
SS	STAINLESS STEEL
ST.	STREET
STA	STATION
STD.	STANDARD
STL.	STEEL
STRUC.	STRUCTURAL
SWK	SIDEWALK
T/C	TOP OF CONCRETE
TC	TOP OF CURB
TF	TOP OF FRAME
T&B	TOP AND BOTTOM
THK.	THICKNESS
TYP.	TYPICAL
UON	UNLESS OTHERWISE NOTED
USG	UNITED STATES STANDARD GAGE
V	VALVE
VERT.	VERTICAL
W	WATER
W/	WITH
WP	WORK POINT
WPCF	WATER POLLUTION CONTROL FACILITY
WS	WATER STOP
WV	WATER VALVE
WWF	WELDED WIRE FABRIC
WWTP	WASTEWATER TREATMENT PLANT
YH	YARD HYDRANT
E	EAST
W	WEST
N	NORTH
S	SOUTH
NE	NORTHEAST
NW	NORTHWEST
SE	SOUTHEAST
SW	SOUTHWEST

SEE STRUCTURAL, ELECTRICAL AND INSTRUMENTATION SHEETS FOR LIST OF MORE ABBREVIATIONS

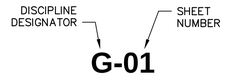
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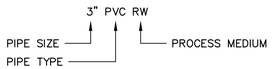
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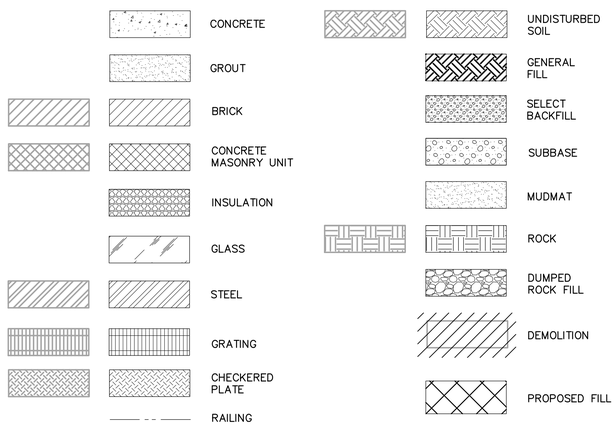
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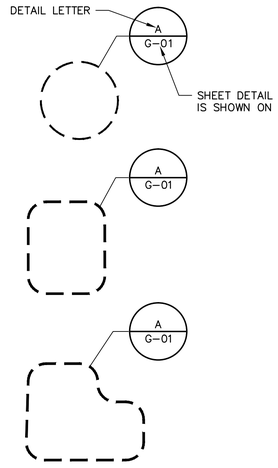
PIPE IDENTIFICATION



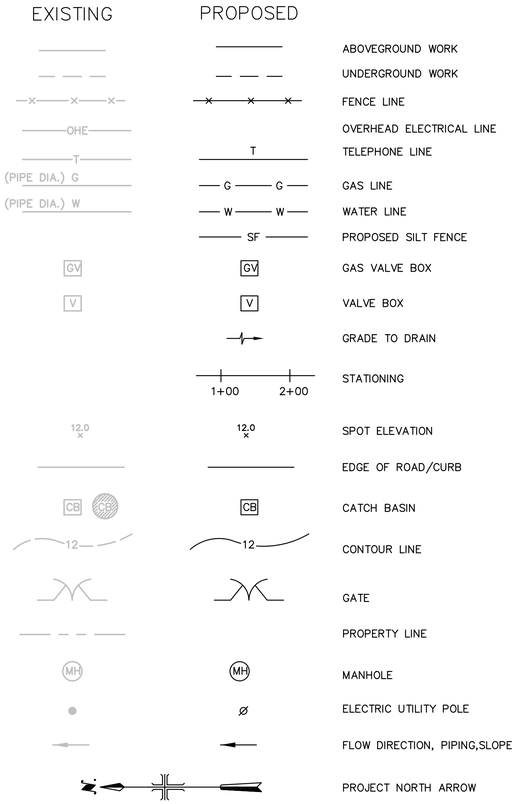
MATERIALS LEGEND



DETAIL MARKERS



LEGEND



NOTES:

1. THE SYMBOLS AND ABBREVIATIONS LISTED ON THIS SHEET IS A COMPREHENSIVE STANDARD GUIDE INTENDED FOR GENERAL USE ON ALL PROJECTS. NOT ALL THE SYMBOLS AND ABBREVIATIONS CONTAINED ARE NECESSARILY USED.
2. SEE MECHANICAL LEGENDS FOR PROCESS EQUIPMENT VALVE SYMBOLS AND PIPE DESIGNATIONS.
3. SEE ELECTRICAL LEGENDS FOR SYMBOLS AND CONDUIT DESIGNATIONS.

LEGEND

- GATE VALVE
- CHECK VALVE
- SAFETY RELIEF VALVE
- BALL VALVE
- PLUG VALVE

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G:\CADD\ACADPROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\01-GENERAL\G-03.dwg LAYOUT: G-03 SAVED: 7/1/2016 8:51 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:14 AM BY: NEGRON-VIEIRA, VANESSA

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Professional Engineer's Name: SEAN K. CHAPARRO, P.E.
Professional Engineer's No.: 75865
State: FL | Date Signed: | Project Mgr.: SKC
Designed by: SLJ | Drawn by: KAK | Checked by: DAO

SEAN K. CHAPARRO
P.E. NO. 75865

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

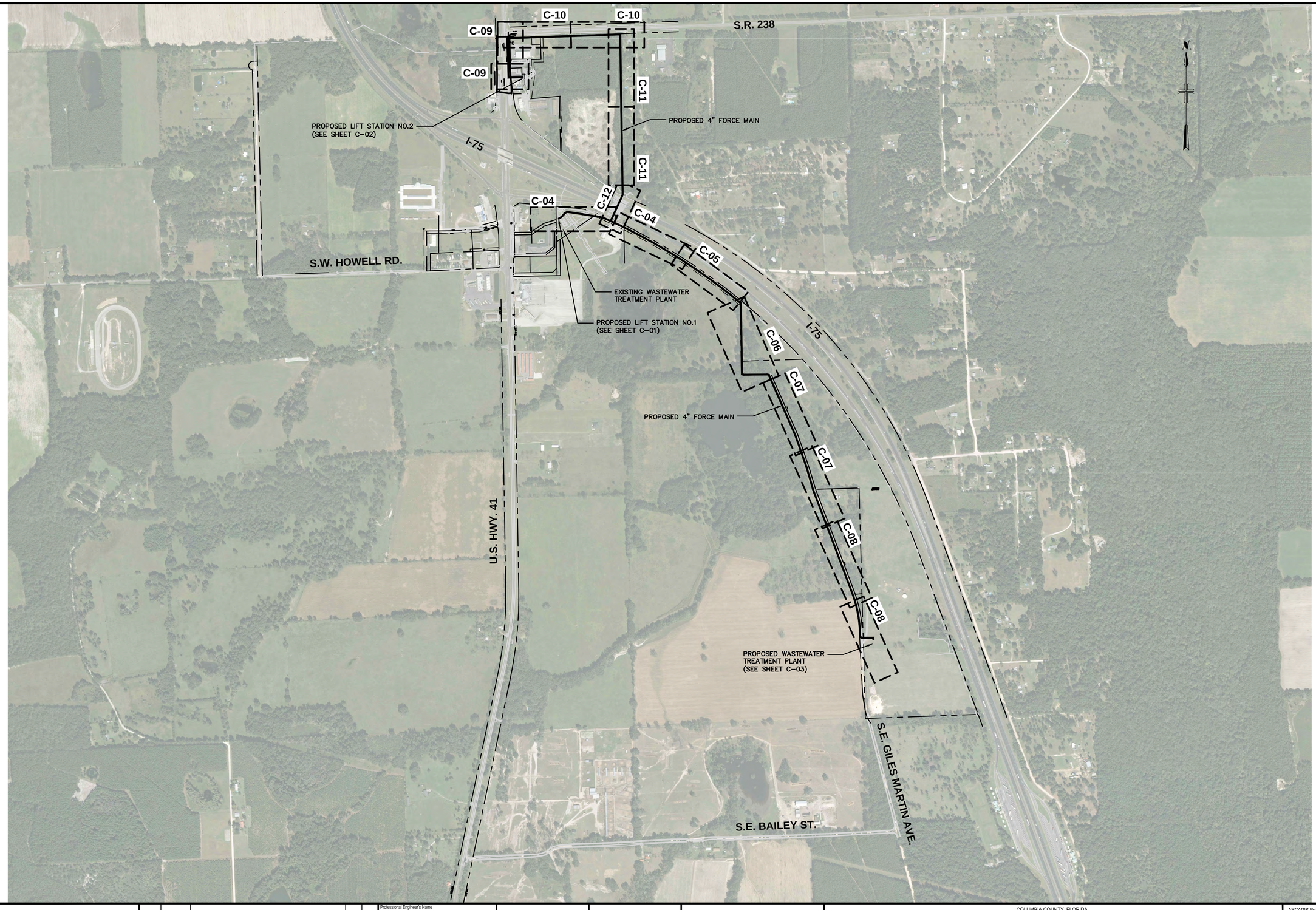
ABBREVIATIONS, LEGEND & SYMBOLS

ARCADIS Project No.
06704010.0000

Date
OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

G-03



0 500' 1000'

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State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
SLJ	KAK	DAO

SEAN K. CHAPARRO
P.E. NO. 75865

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ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

KEY MAP

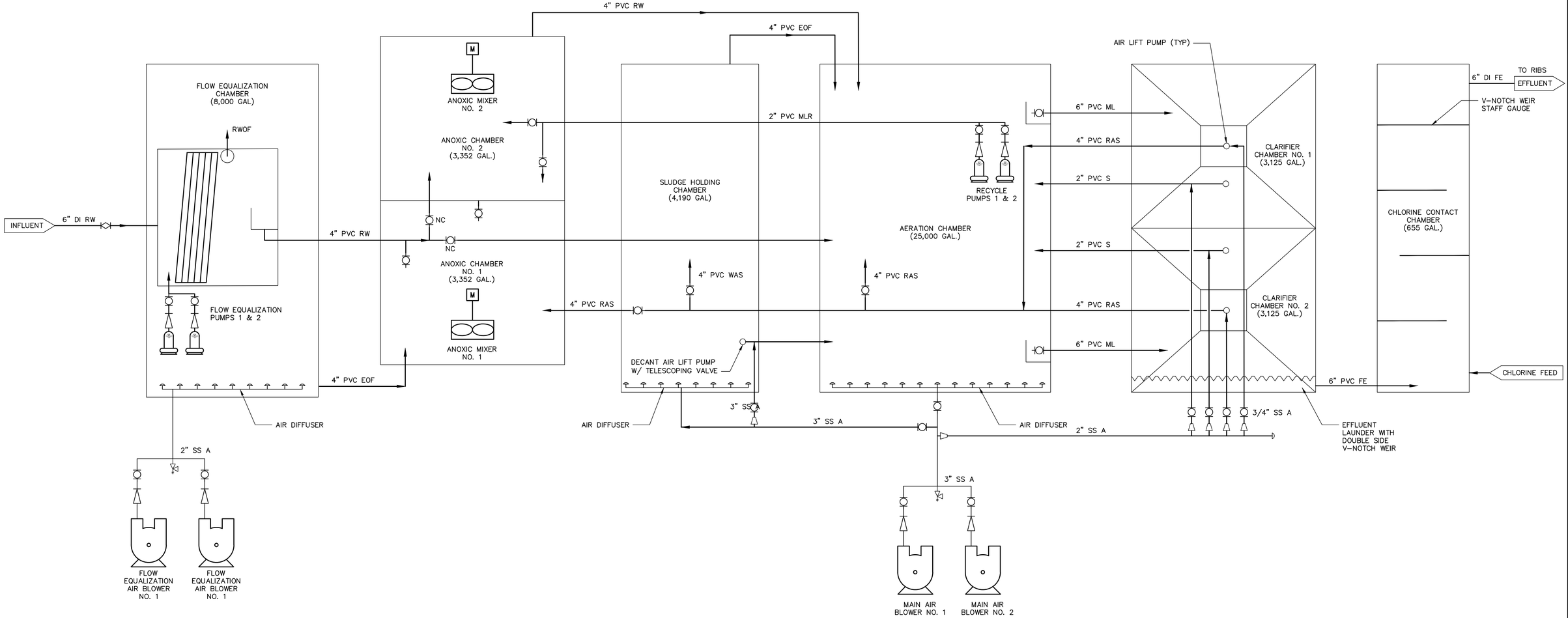
ARCADIS Project No.
06704010.0000

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OCTOBER 2016

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TEL. 813.903.3125

G-04

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EQUIPMENT REQUIREMENTS (25,000gpd)

Equipment	Maximum Capacity	Pressure	Power
Flow Equalization Pump No. 1	60 gpm	**	0.5 HP
Flow Equalization Pump No. 2	60 gpm	**	0.5 HP
Flow Equalization Blower No. 1	40 scfm	5 psi	3.0 HP
Flow Equalization Blower No. 2	40 scfm	5 psi	3.0 HP
Anoxic Chamber Mixer No. 1	-	-	0.5 HP
Anoxic Chamber Mixer No. 2	-	-	0.5 HP
Aeration Chamber (Main) Blower No. 1	150 scfm	5 psi	7.5 HP
Aeration Chamber (Main) Blower No. 2	150 scfm	5 psi	7.5 HP
Aeration Chamber Recycle Pump No. 1	90 gpm	**	0.75 HP
Aeration Chamber Recycle Pump No. 2	90 gpm	**	0.75 HP

* MINIMUM EQUIPMENT REQUIREMENTS.
** WWTP VENDOR TO ADVISE.
(NOTE 4)

DESIGN CRITERIA (25,000gpd)

Number of WWTPs	1
Flow:	
Average daily design flow (gpd)	25,000
Peak day design flow (gpd)	62,500
Influent Characteristics:	
Influent CBOD5 (mg/L)	200
Influent TSS (mg/L)	200
Influent TKN (mg N/L)	40
Influent Ammonia (as N, mg N/L)	27
Influent Total Phosphorus (mg P/L)	8
Maximum Effluent Requirements:	
Effluent CBOD5 (mg/L)	30
Effluent TSS (mg/L)	30
Effluent Nitrate (as N, mg N/L)	12

(NOTE 3,4)

NOTES:

1. ALL STAINLESS STEEL PIPE SHALL BE TYPE 316, ASTM A312.
2. SEE SPECIFICATION SECTION 46 07 53 – PACKAGED WASTEWATER TREATMENT PLANT, FOR DETAILED DESIGN CRITERIA.
3. SEE SPECIFICATION SECTION 46 07 53 – PACKAGED WASTEWATER TREATMENT PLANT, FOR DETAILED EQUIPMENT REQUIREMENTS.

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Professional Engineer's Name: SEAN K. CHAPARRO, P.E.
Professional Engineer's No.: 75865
State: FL | Date Signed: | Project Mgr.: SKC
Designed by: JAR | Drawn by: KAK | Checked by: DAO

SEAN K. CHAPARRO
P.E. NO. 75865

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

PROCESS FLOW DIAGRAM

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

G-05

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NOTES:

1. CONTRACTOR TO LOCATE AIR RELEASE VALVES AT HIGH POINTS ALONG FORCE MAIN AS DETERMINED DURING INSTALLATION.
2. SITE DEMOLITION: REMOVE ALL VALVE BOXES, CAP ALL OPEN ENDS OF PIPES AND CONDUITS. BACKFILL AND COMPACT ALL DISTURBED AREAS.
3. CONTRACTOR TO RESTORE ALL DISTURBED AREAS, RE-ESTABLISH SITE DRAINAGE AND BAHIA SOD.
4. STATIONING SHOWN IS ALONG CENTERLINE OF PROPOSED 4" PVC FORCE MAIN.
5. CONTRACTOR TO PUMP AND HAUL REMAINING WASTE FROM ALL TANKS PRIOR TO ABANDONMENT.
6. TRANSFER EXISTING WWTP MIXED LIQUOR VIA NEW LIFT STATION TO NEW WWTP.
7. DRAIN AND TRANSFER REMAINING PLANT LIQUID FOLLOWING NEW WWTP STARTUP.
8. CONTRACTOR TO REMOVE AND DISPOSE OF REMAINING GRIT AND SOLIDS IN APPROPRIATE MANNER AS APPROVED BY OWNER.
9. SITE ACCESS HEIGHT RESTRICTION OF 13'-6" DUE TO OVERHEAD ELECTRICAL LINES.
10. EXISTING EFFLUENT LINES EXTENDING FROM PLANT TO EACH POND SHALL BE FULLY REMOVED.

I-75

N

S 84°57'06" E
617.10'

12" PALM TREE

PROTECT EXISTING DRAINAGE DITCH (DO NOT INSTALL FILL OR BLOCK FLOW DURING CONSTRUCTION)

R.O.W. LINE

FDOT Conc. Ditch

R=1577.02'
L=258.44'
Δ=9°23'22"

U/G FOC MARKER
4" WOOD POLE STMD

PLS CMF 3628

CONST. 4" PVC (C-900) FORCE MAIN (SEE SHEET C-04)

PPT

12+00

13+00

14+00

Hopeful Baptist Church & Econo Lodge Billboard

POND

PROPOSED LIFT STATION NO.1
℄ WET WELL STA. 10+00
N=367912.82
E=2571349.08
TOP SLAB EL. 63.50
(SEE SHEET M-01 FOR DETAILS)

CONVERT EXISTING LIFT STATION TO MANHOLE (SEE SHEET C-14)

PP

PPT

4" 10.0° 10.0°

Alarm

Tank

NKRP, INC.
TAX PARCEL #09575-000

Headwall (Sandbag deteriorated)

Elec. Box

Conc.

INSTALL NEW 1" SCH. 80 PVC WATER SERVICE, REDUCED PRESSURE BACKFLOW PREVENTOR AND 3/4" HOSE BIB W/ HOSE RACK

REMOVE EXISTING TANK AND EQUIPMENT

REMOVE EXISTING BACKFLOW DEVICE AND CONNECT TO EXIST. WATER METER AS REQ'D.

SEE ELECTRICAL SHEETS FOR DETAILS

MH

SEWER LINE

Existing WWTP

Pump

SPM

Elec. Panel

Gen.

Storage Shed

6"PVC PIPE

32"CMP
N. Inv. = 59.77
S. Inv. = 59.82

Tank

BM15
EL. = 62.62

S 65°24'40" W
582.20'

4' Fieldwire Fence

ABANDON AND FILL EXISTING TANKS WITH SAND

INSTALL AND MAINTAIN SILT FENCE THROUGHOUT CONSTRUCTION

INSTALL AND MAINTAIN SILT FENCE THROUGHOUT CONSTRUCTION

LEVEL BERMS TO MATCH EXISTING GRADE. FILL AND COMPACT FOUR EXISTING PONDS AS SHOWN TO 95% MAXIMUM DENSITY PER AASHTO T-180. FULLY SOD ALL DISTURBED AREAS (TYP.)

S M MAPPS, INC.
TAX PARCEL #09588-000

10' 2-Rut Driveway

20'

LEGEND

EXISTING PONDS TO BE FILLED

0 10' 20' 40'

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Professional Engineer's Name		
SEAN K. CHAPARRO, P.E.		
Professional Engineer's No.		
75865		
State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
SLJ	KAK	DAO

SEAN K. CHAPARRO
P.E. NO. 75865

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS

ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA

ELLISVILLE WASTEWATER TREATMENT PLANT

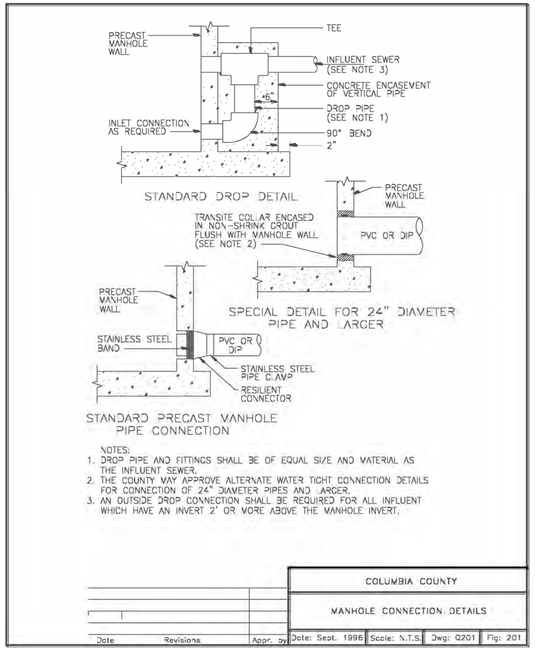
LIFT STATION NO. 1 - SITE PLAN

ARCADIS Project No.
06704010.0000

Date
OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

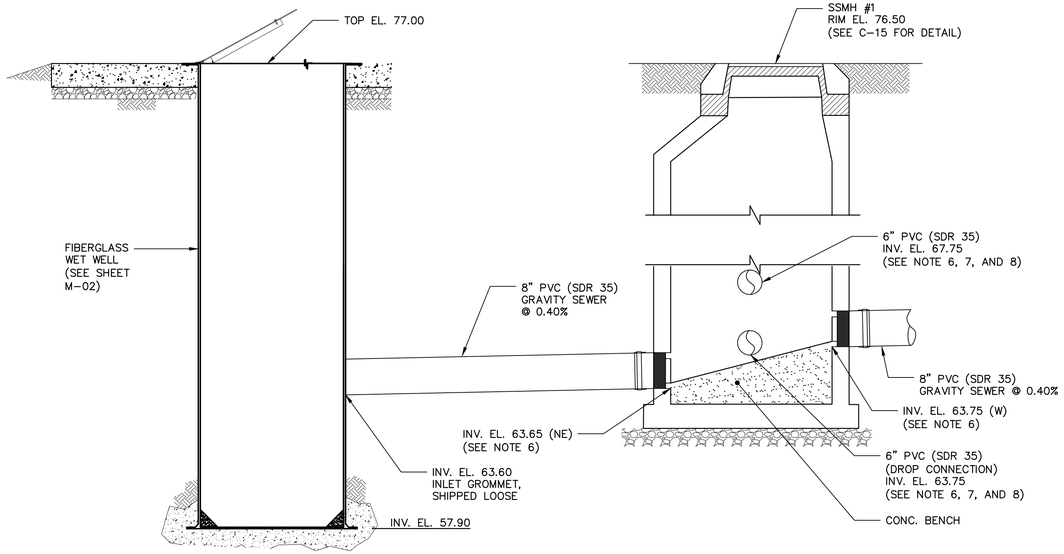
C-01



NOTES:
1. DROP PIPE AND FITTINGS SHALL BE OF EQUAL SIZE AND MATERIAL AS THE INFLUENT SEWER.
2. THE COUNTY MAY APPROVE ALTERNATE WATER TIGHT CONNECTION DETAILS FOR CONNECTION OF 24" DIAMETER PIPES AND LARGER.
3. AN OUTSIDE DROP CONNECTION SHALL BE REQUIRED FOR ALL INFLUENT WHICH HAVE AN INVERT 2' OR MORE ABOVE THE MANHOLE INVERT.

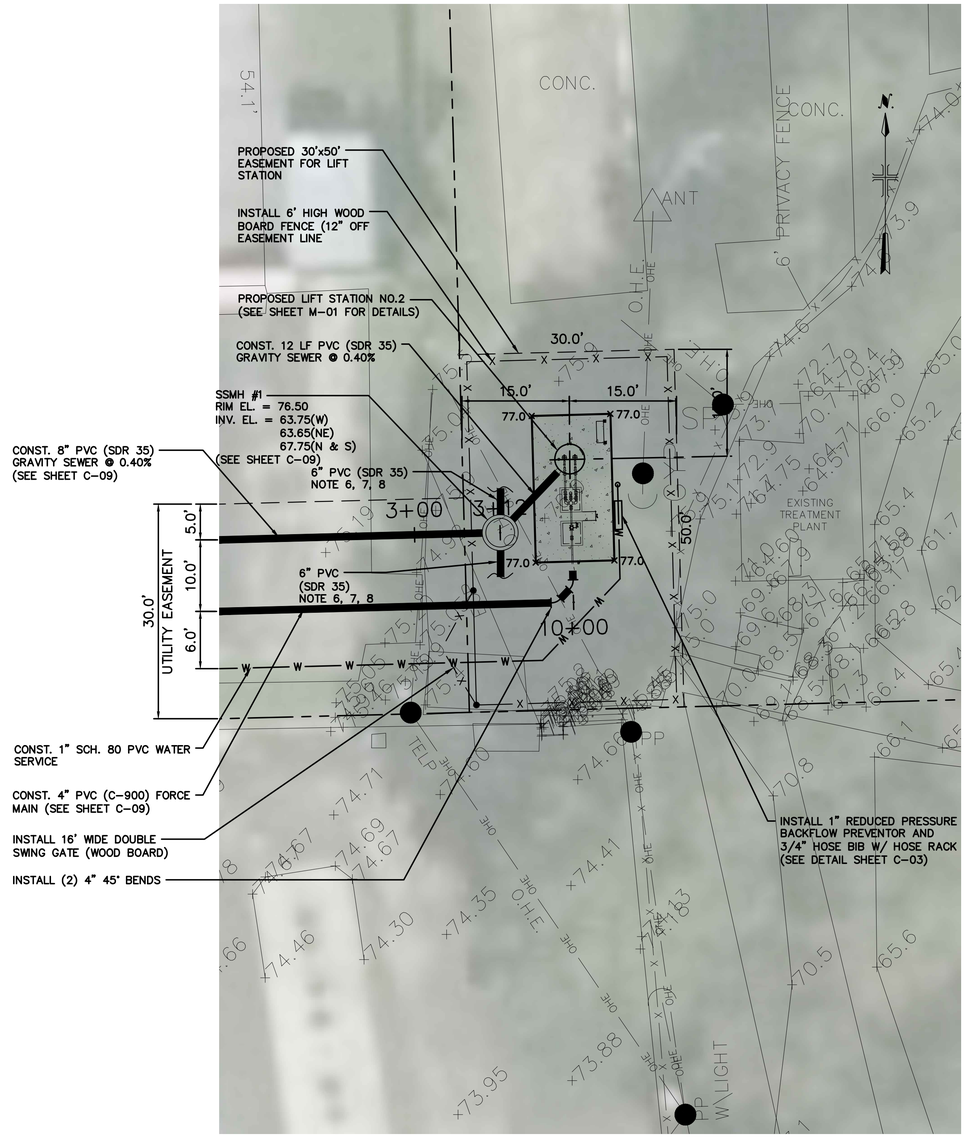
Date	Revisions	Appr. By	COLUMBIA COUNTY			
			MANHOLE CONNECTION DETAILS			
			Date: Sept. 1996	Scale: N.T.S.	Dwg: Q201	Fig: 201

NOTES:
1. CONTRACTOR SHALL PROTECT EXISTING POLES, GUY WIRES AND OVERHEAD ELECTRICAL FACILITIES WITHIN THE LIFT STATION SITE. THIS EFFORT SHALL BE COORDINATED WITH THE APPLICABLE UTILITY OWNER.
2. SITE SHALL BE CLEARED AND GRUBBED PRIOR TO CONSTRUCTION.
3. CONTRACTOR MAY UTILIZE SUITABLE FILL OBTAINED FROM MANHOLE AND WET WELL EXCAVATIONS FOR SITE FILL AND GRADING.
4. SITE SHALL BE FULLY RESTORED WITH BAHIA SOD.
5. REMOVE EXISTING BOARD FENCE WHERE REQUIRED TO ALLOW FOR INSTALLATION OF PROPOSED IMPROVEMENTS.
6. INSTALL RESILIENT CONNECTOR WITH STAINLESS STEEL BAND AND STAINLESS STEEL PIPE CLAMP ON PRECAST MANHOLE.
7. CONTRACTOR TO FIELD LOCATE AND RE-ROUTE EXISTING SEWER LINES THAT SERVICE THE ADJACENT BUSINESSES. THESE LINES PRESENTLY EXTEND TO THE EXISTING DREAM INN WWTF. THE PROPOSED WORK WILL INCLUDE RE-REOUTING THESE LINES TO CONNECT TO PROPOSED SANITARY SEWER MANHOLE SSHM #1 AS SHOWN ON THIS SHEET. THE CONTRACTOR SHALL POTHOLE AND LOCATE THE EXISTING LINES AS REQUIRED (HORIZONTALLY & VERTICALLY) IN THE VICINITY OF THE NEW LIFT STATION SITE AND PROVIDE A RE-ROUTING PLAN TO THE ENGINEER FOR APPROVAL.
   THE FOLLOWING ARE THE ASSUMED EXISTING SEWER SERVICE LINE SIZES:
   FROM NORTH OF PROPOSED MANHOLE/LIFT STATION NO. 2:
   4" PVC PIPE FROM EXISTING RESTAURANT
   4" PVC PIPE FROM EXISTING TRAVELERS INN
   FROM SOUTH OF PROPOSED MANHOLE/LIFT STATION NO. 2:
   6" PVC PIPE FROM EXISTING EXXON STATION AND DREAM INN.
8. FOR BIDDING PURPOSES, THE CONTRACTOR SHALL ASSUME THE ESTIMATED QUANTITIES FOR RE-REOUTING THE SANITARY SEWER SERVICE LINES:
   150 LF OF 4" PVC (SDR 35)
   100 LF OF 6" PVC (SDR 35)
   (6) – 4" 45° PVC BEND
   (4) – 4"x4"x6"x WYE
   (4) – 4" CLEANOUT
   (4) – 6" 45° PVC BEND
   (2) – 6" CLEANOUT



PROPOSED MANHOLE CONNECTION TO LIFT STATION NO. 2

SCALE: N.T.S.



SITE PLAN

0 10' 20'

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Designed by	Drawn by	Checked by
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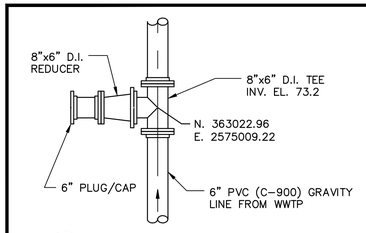
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COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

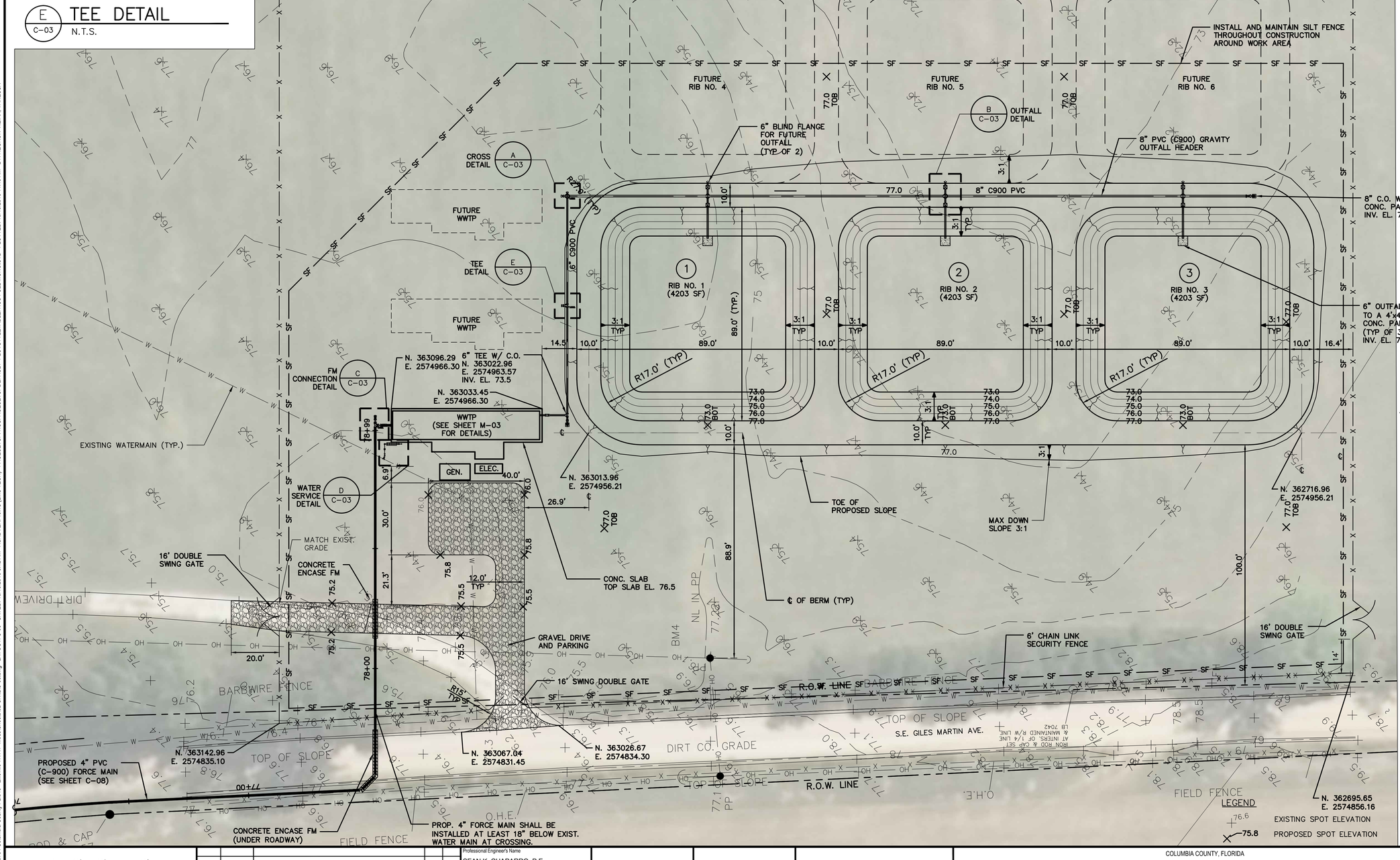
LIFT STATION NO. 2 - SITE PLAN, SECTION AND DETAIL

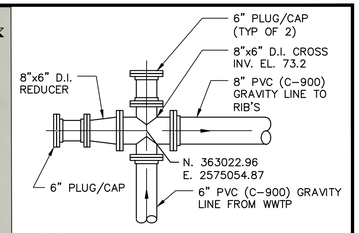
ARCADIS Project No.	06704010.0000
Date	OCTOBER 2016
ARCADIS	3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350 TAMPA, FLORIDA 33607 TEL. 813.903.3125

C-02

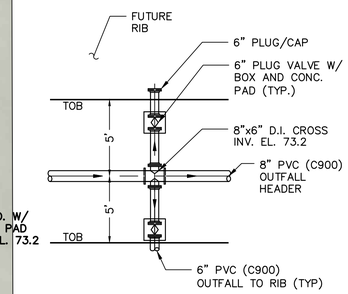


E C-03 **TEE DETAIL**
N.T.S.

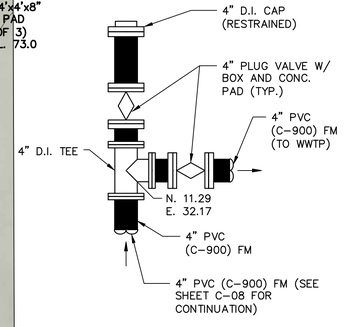




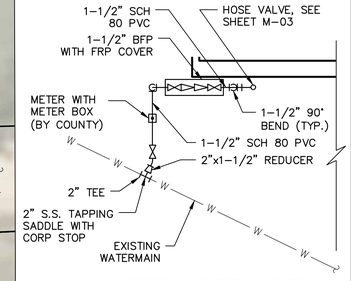
A C-03 **CROSS DETAIL**
N.T.S.



B C-03 **OUTFALL DETAIL**
N.T.S.



C C-03 **FM CONNECTION DETAIL**
N.T.S.



D C-03 **WATER SERVICE DETAIL**
N.T.S.

0 10' 20' 40'

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THIS DRAWING IS THE PROPERTY OF THE ARCADIS ENTITY IDENTIFIED IN THE TITLE BLOCK AND MAY NOT BE REPRODUCED OR ALTERED IN WHOLE OR IN PART WITHOUT THE EXPRESS WRITTEN PERMISSION OF SAME.

Professional Engineer's Name	SEAN K. CHAPARRO, P.E.
Professional Engineer's No.	75865
State	FL
Date Signed	
Project Mgr.	SKC
Designed by	SLJ
Drawn by	KAK
Checked by	DAO

SEAN K. CHAPARRO
P.E. NO. 75865

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

WASTEWATER TREATMENT PLANT - SITE PLAN

ARCADIS Project No.	06704010.0000
Date	OCTOBER 2016

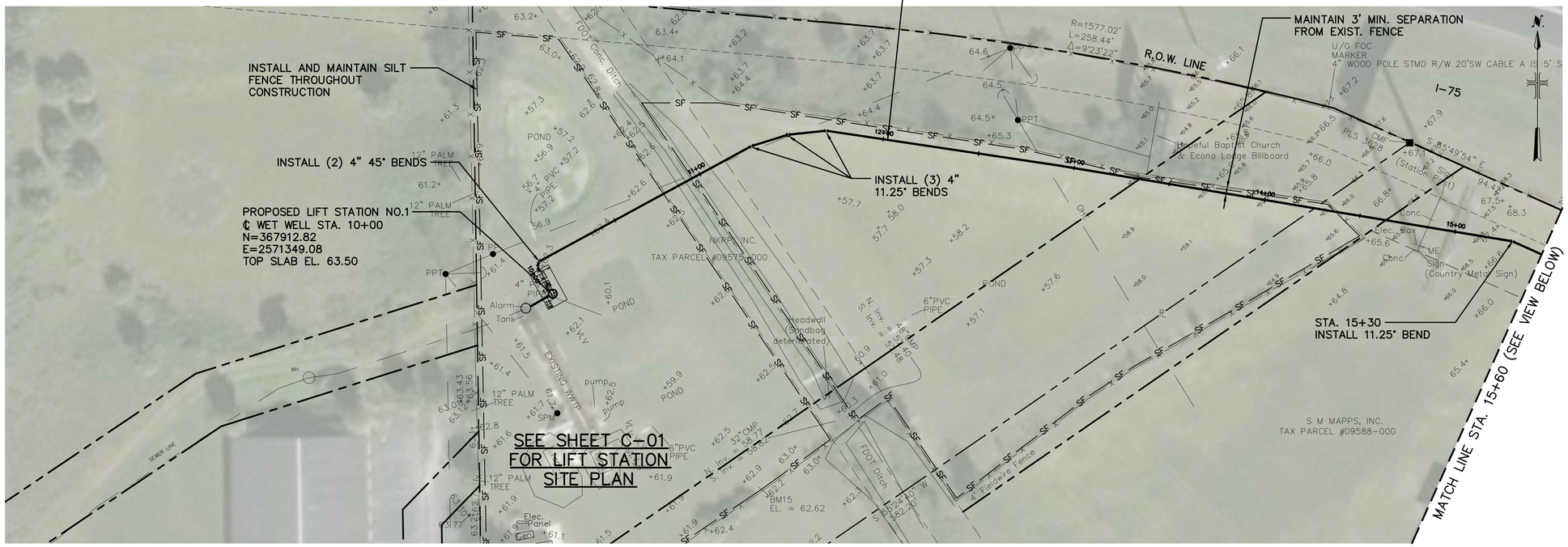
ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

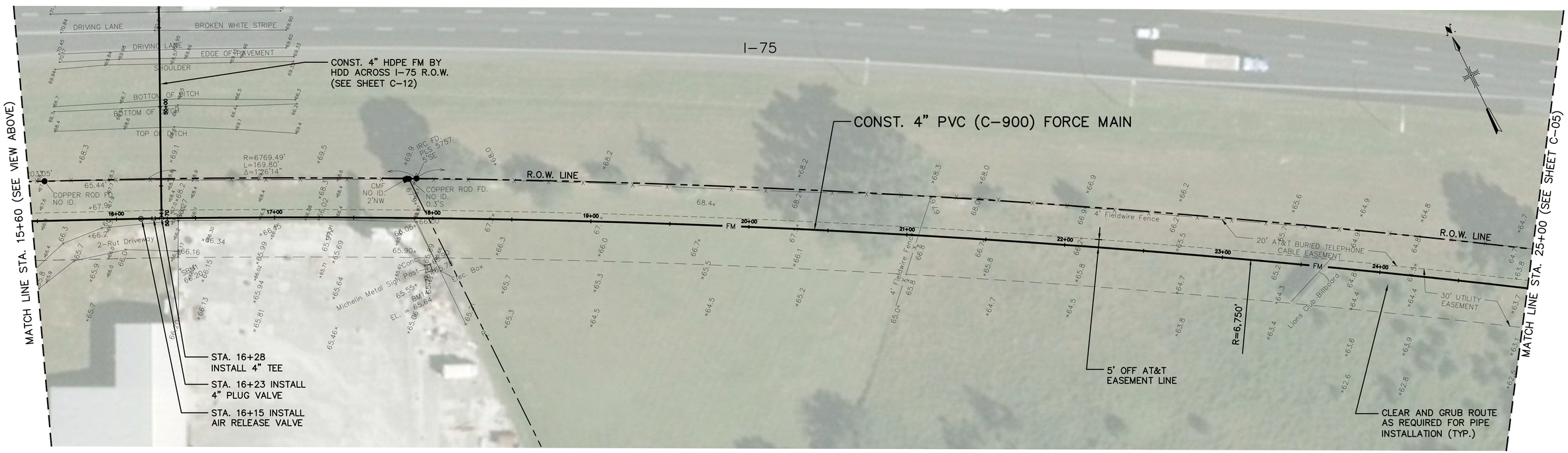
C-03

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON='*OFF-*REF' G:\CADD\ACAD\PROJ\67\04 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\02-CIVIL\C-03.dwg LAYOUT: C-03 SAVED: 10/10/2016 8:12 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:15 AM BY: NEGRON-VIERA, VANESSA

FORCE MAIN CONSTRUCTION NOTES:

1. MINIMUM COVER IS 36 INCHES.
2. FORCE MAIN MATERIAL SHALL BE 4-INCH PVC (C-900) DR 18 PIPE.
3. FITTINGS SHALL BE DUCTILE IRON, MECHANICAL JOINT MEETING ANSI/AWWA C153/A21.53 WITH PROTECTIVE INTERIOR CERAMIC EPOXY COATING PER SPECIFICATIONS.
4. DIRECTIONAL DRILLED FORCE MAIN SHALL BE 4-INCH HDPE DR 13.5.
5. ALL FORCE MAIN SHALL INCLUDE TRACER WIRE PER SPECIFICATION.
6. CONTRACTOR TO ENSURE THAT THE PROPOSED AIR RELEASE VALVES ARE INSTALLED AT HIGH POINTS ALONG FORCE MAIN AS DETERMINED DURING INSTALLATION.
7. STATIONING SHOWN IS ALONG CENTERLINE OF PROPOSED 4" FORCE MAIN.
8. CONTRACTOR TO RESTORE ALL DISTURBED AREAS, RE-ESTABLISH SITE DRAINAGE AND SOD.
9. CONTRACTOR SHALL CONTACT SUNSHINE STATE ONE CALL OF FLORIDA (SSOCOF) BY CALLING 811 OR 1-800-432-4770 AT LEAST 48 HOURS PRIOR TO EXCAVATION. ALL PROPOSED CONSTRUCTION SHALL BE WHITE-LINE PAINTED PRIOR TO CONTACTING SSOCOF.
10. FINAL ALIGNMENT MAY REQUIRE SLIGHT ADJUSTMENTS BASED ON FIELD CONDITIONS.
11. CONTRACTOR TO PROVIDE AS-BUILT HORIZONTAL AND VERTICAL SURVEY OF FINAL FORCE MAIN LOCATION AND PROVIDE TO ENGINEER IN AUTOCAD 2011 (OR LATER VERSION).
12. RESTORE ALL FENCES TO EQUAL OR BETTER CONDITION. NOTIFY PROPERTY OWNER PRIOR TO TEMPORARY FENCE REMOVAL.





0 30' 60'
SCALE: 1" = 30'

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Professional Engineer's No.: 75865

State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
SLJ	KAK	DAO

SEAN K. CHAPARRO
P.E. NO. 75865

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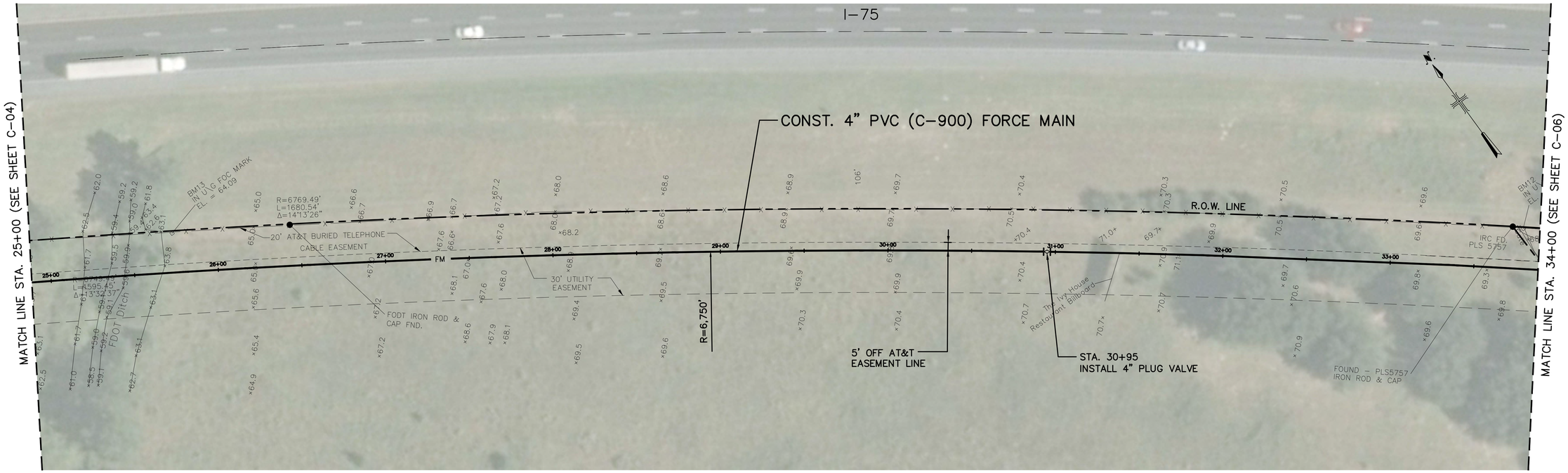
FORCE MAIN PLAN

ARCADIS Project No.
06704010.0000
Date
OCTOBER 2016
ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

C-04

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CAD\DACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\02-CIVIL\C-04-12.dwg LAYOUT: C-04 SAVED: 10/6/2016 5:53 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:15 AM BY: NEGRON-VIERA, VANESSA

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0 30' 60'
SCALE: 1" = 30'

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Professional Engineer's No.: 75865		
State: FL	Date Signed:	Project Mgr.: SKC
Designed by: SLJ	Drawn by: KAK	Checked by: DAO

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P.E. NO. 75865

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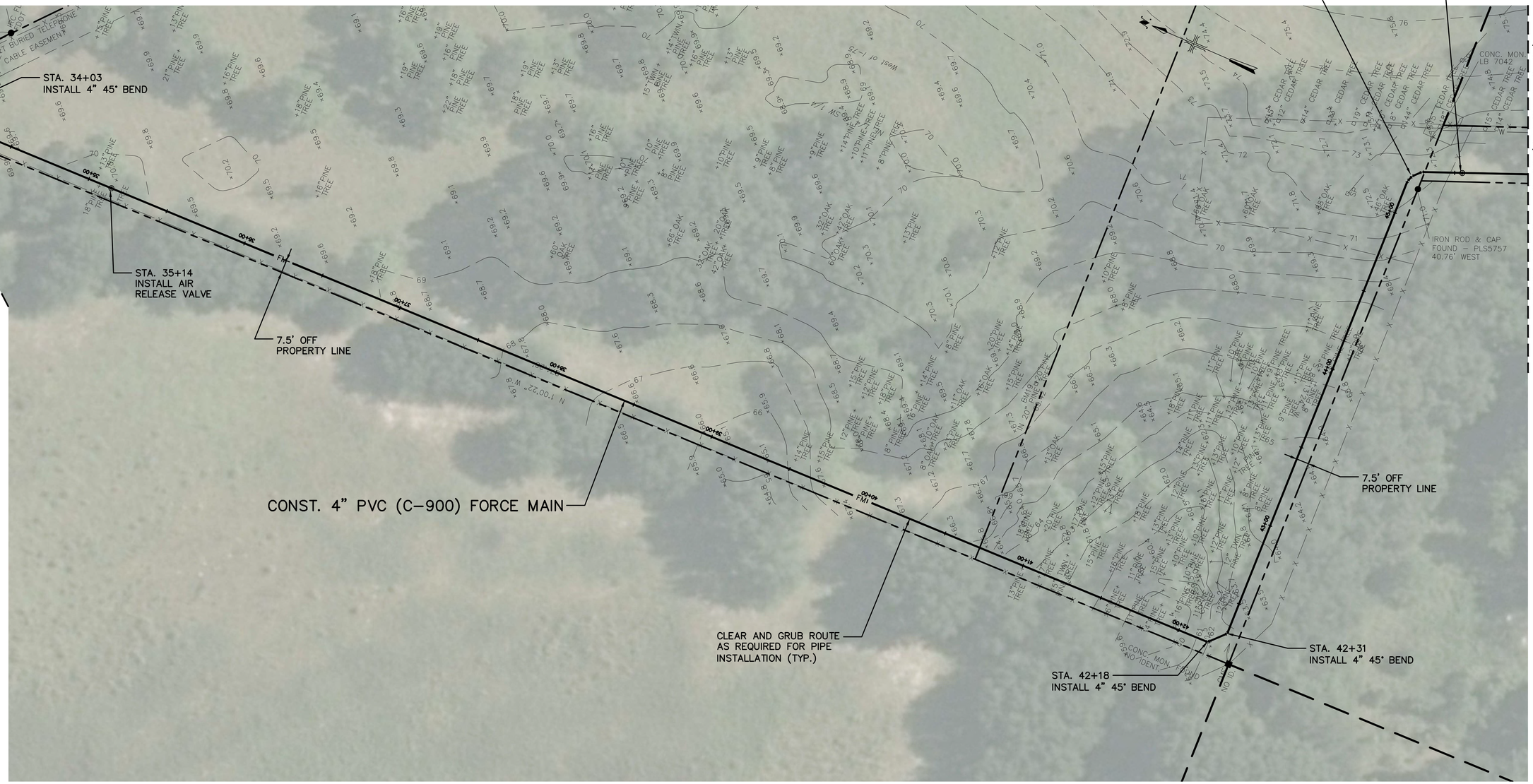
FORCE MAIN PLAN

ARCADIS Project No.
06704010.0000

Date
OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
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TEL. 813.903.3125

C-05



CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
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0 30' 60'
SCALE: 1" = 30'

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SEAN K. CHAPARRO
P.E. NO. 75865

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COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

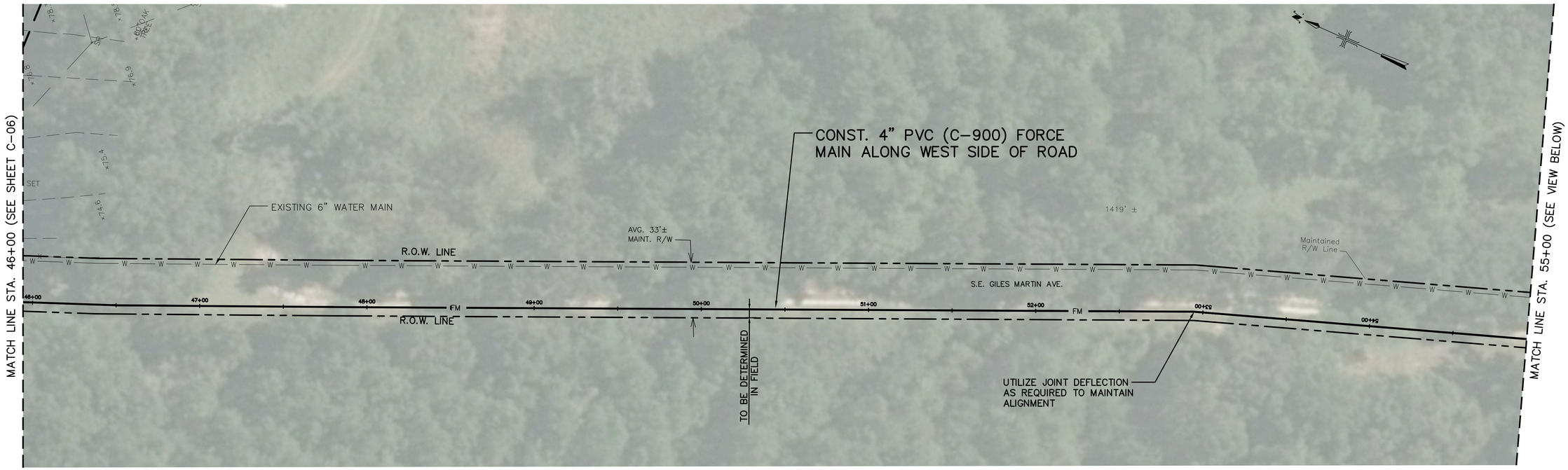
FORCE MAIN PLAN

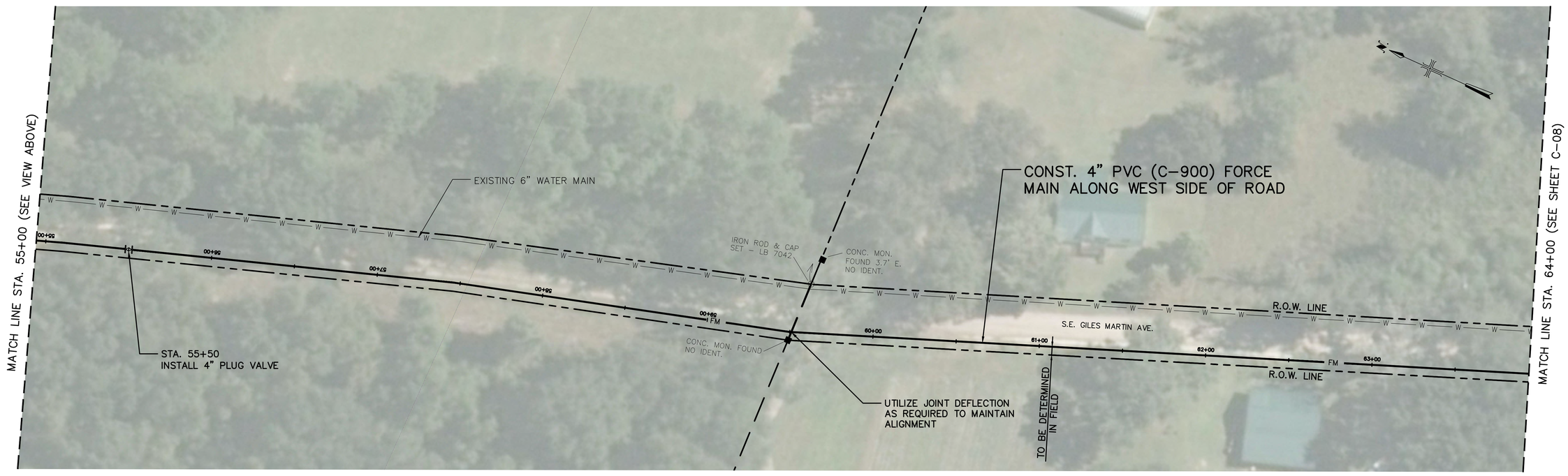
ARCADIS Project No.
06704010.0000

Date
OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
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C-06





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G:\CAD\DA\CAD\PROJ\67\04 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\02-CIVIL\C-04-12.dwg LAYOUT: C-07 SAVED: 10/6/2016 5:53 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:16 AM BY: NEGRON-VIERA, VANESSA

0 30' 60'
SCALE: 1" = 30'

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Professional Engineer's No.: 75865

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FL		SKC
Designed by	Drawn by	Checked by
SLJ	KAK	DAO

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P.E. NO. 75865

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COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

FORCE MAIN PLAN

ARCADIS Project No.
06704010.0000

Date
OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

C-07

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
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MATCH LINE STA. 64+00 (SEE SHEET C-07)

EXISTING 6" WATER MAIN

CONST. 4" PVC (C-900) FORCE MAIN ALONG WEST SIDE OF ROAD

MAINT. R/W AVG. 33'±

R.O.W. LINE

(Formerly Old Wire Road)

FND. – PLS5757 IRON ROD & CAP

S.E. GILES MARTIN AVE

R.O.W. LINE

TO BE DETERMINED IN FIELD

FND. – PLS5757 IRON ROD & CAP

STA. 72+57 INSTALL AIR RELEASE VALVE

MATCH LINE STA. 73+50 (SEE VIEW BELOW)

MATCH LINE STA. 73+50 (SEE VIEW ABOVE)

EXISTING 6" WATER MAIN

S.E. GILES MARTIN AVE

CONST. 4" PVC (C-900) FORCE MAIN ALONG WEST SIDE OF ROAD

TO BE DETERMINED IN FIELD

IRON ROD & CAP FND. – PLS5757

4" FORCE MAIN SHALL BE AT LEAST 18" BELOW EXISTING WATER MAIN AT CROSSING.

STA. 77+47
STA. 77+55
INSTALL 4" 45° BENDS

SEE SHEET C-03 FOR WASTEWATER TREATMENT PLANT SITE PLAN

WWTP

FUTURE RIB NO. 4

FUTURE RIB NO. 5

RIB NO. 1

RIB NO. 2

RIB NO. 3

N: 363013.96
E: 2574858.21

N: 362716.98
E: 2574858.21

SCALE: 1" = 30'

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Professional Engineer's No.	75865	
State: FL	Date Signed:	Project Mgr.: SKC
Designed by: SLJ	Drawn by: KAK	Checked by: DAO

SEAN K. CHAPARRO
P.E. NO. 75865

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FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA

ELLISVILLE WASTEWATER TREATMENT PLANT

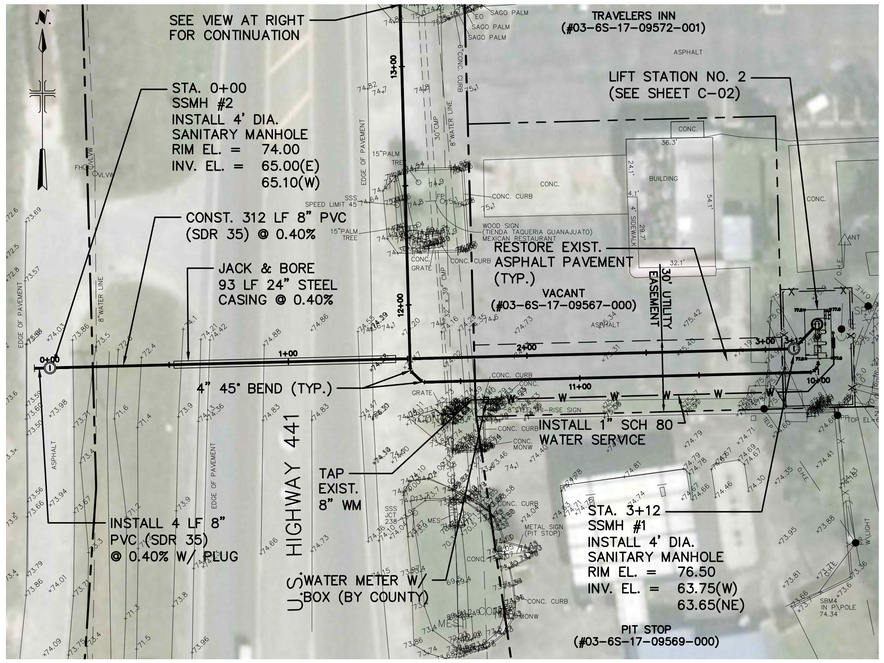
FORCE MAIN PLAN

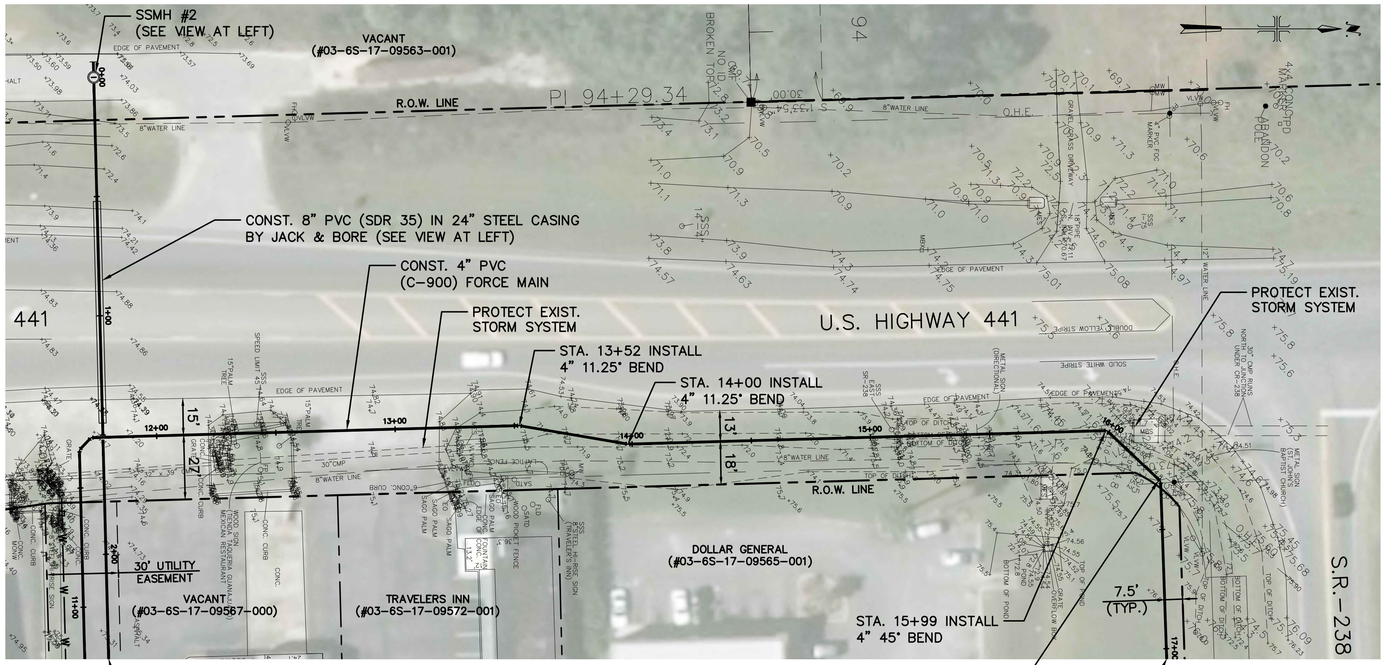
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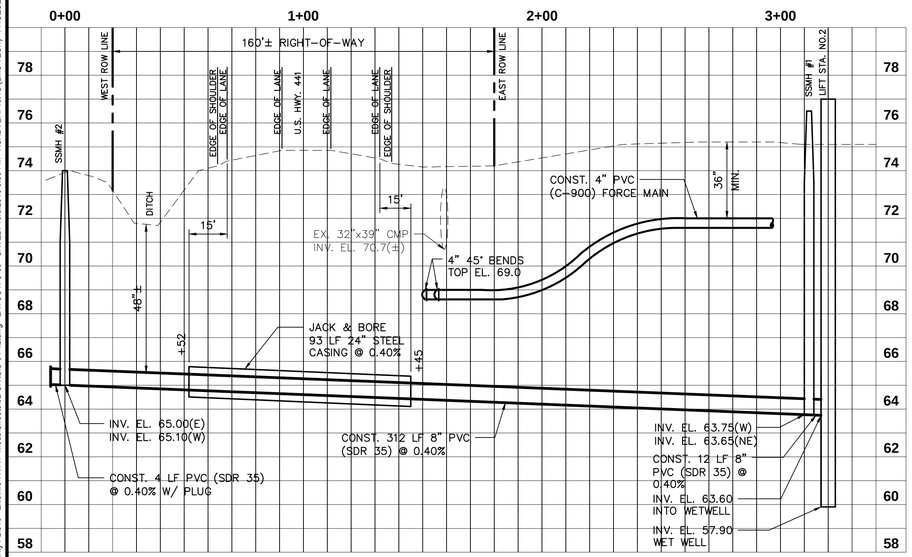
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C-08

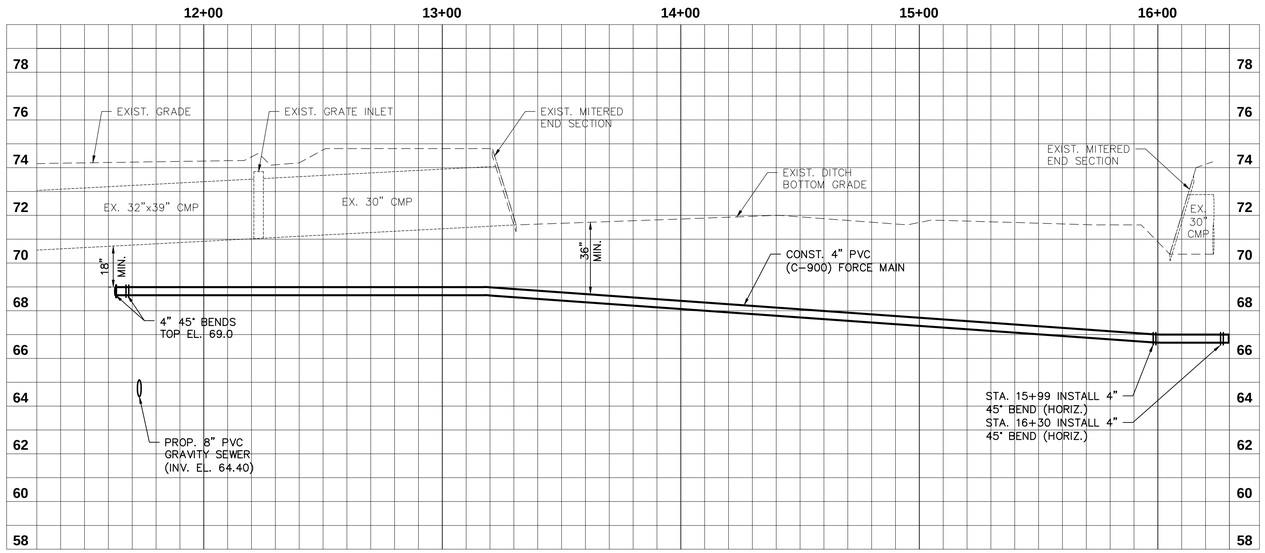




NOTE:
1. INSTALL THE GRAVITY SEWER AND CASING AT A MINIMUM SLOPE OF 0.40%.



(STATIONING SHOWN ABOVE IS ALONG PROPOSED GRAVITY SEWER)



(STATIONING SHOWN ABOVE IS ALONG PROPOSED FORCE MAIN)

SCALE: 1" = 30' (HORIZ.)
SCALE: 1" = 3' (VERT.)

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FORCE MAIN PLAN

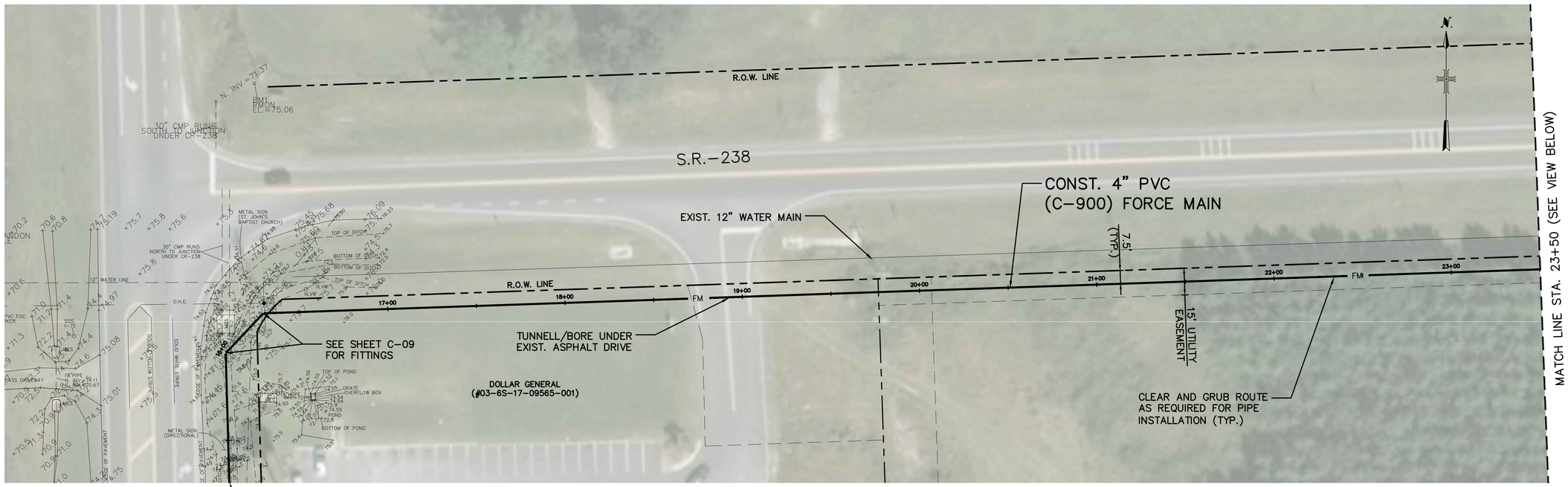
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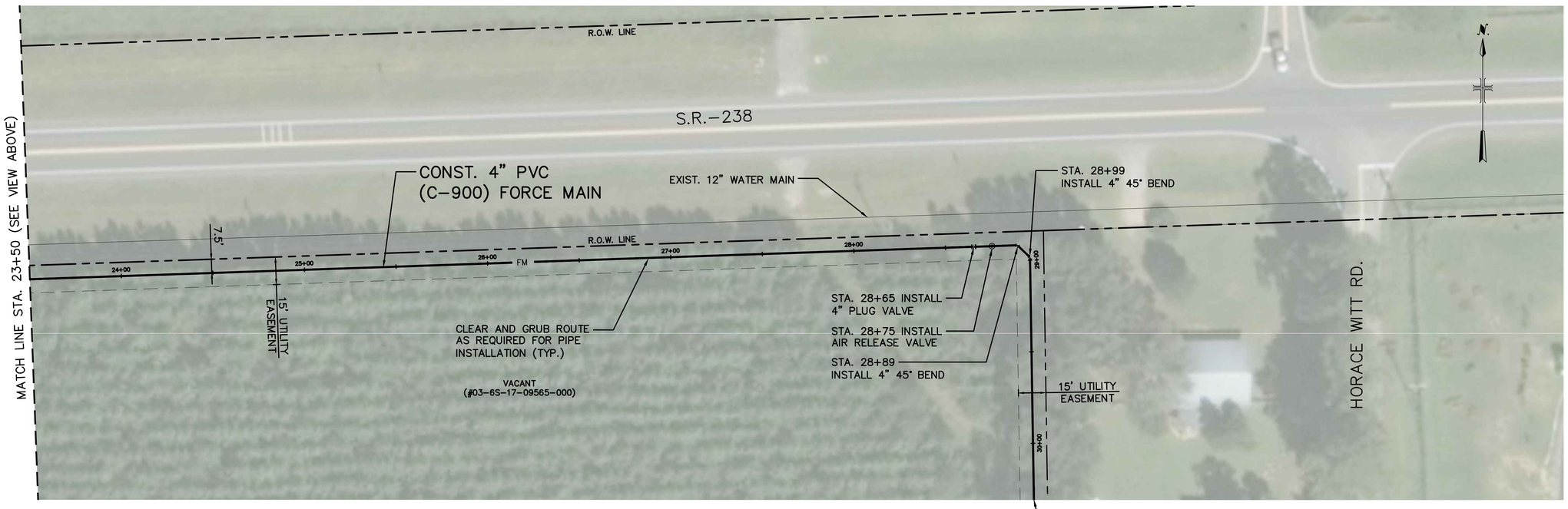
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C-09

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NOTE: NO EXISTING TOPOGRAPHIC SURVEY IS AVAILABLE FOR PIPELINE ROUTE FROM STA. 17+00 TO STA. 46.+50.



NOTE: EXISTING 12" WATER MAIN LOCATION IS APPROXIMATELY 10' FROM R.O.W. LINE AND IS SHOWN FOR ILLUSTRATION PURPOSES ONLY.

0 30' 60'
SCALE: 1" = 30'

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SLJ	KAK	DAO

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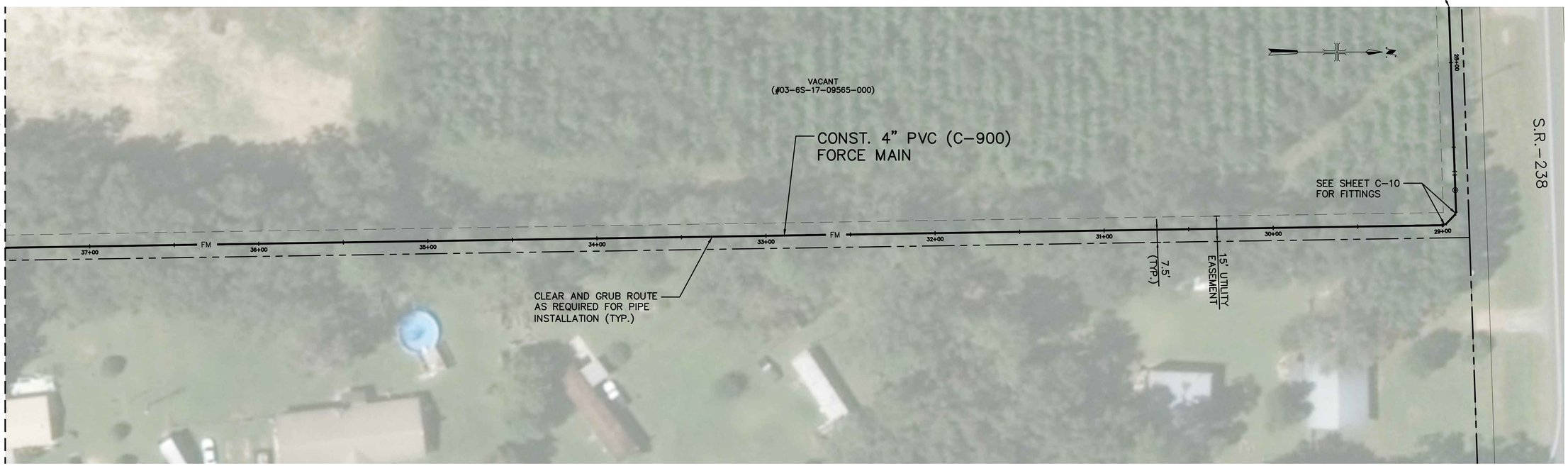
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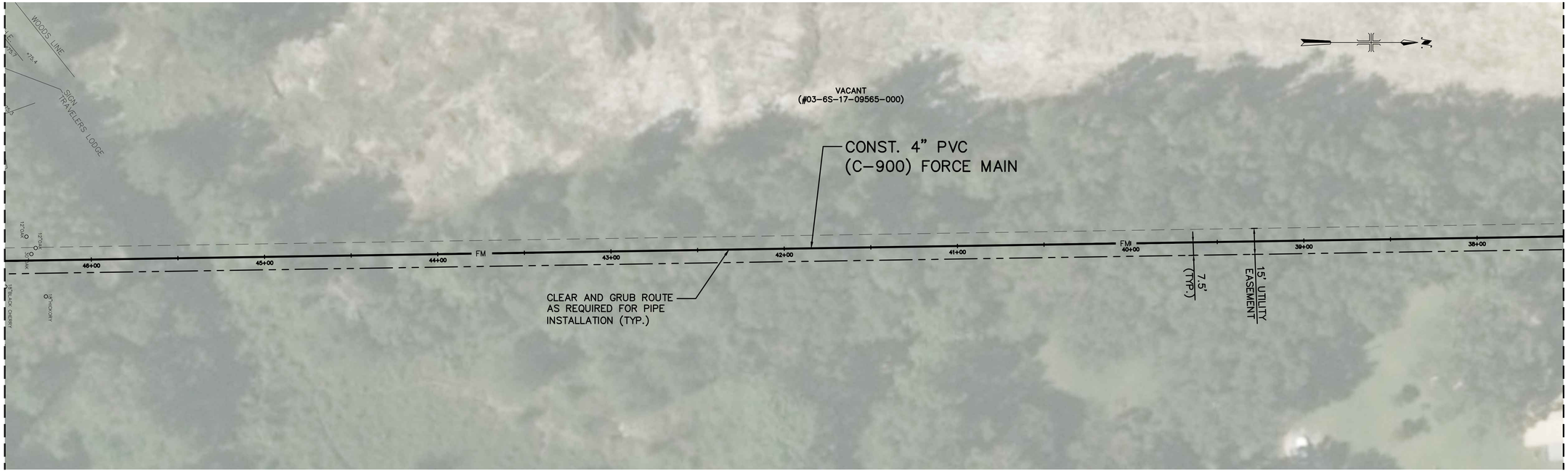
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C-10

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CAD\DACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\02-CIVIL\C-04-12.dwg LAYOUT: C-10 SAVED: 10/6/2016 5:53 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:16 AM BY: NEGRON-VIERA, VANESSA



NOTE: NO EXISTING TOPOGRAPHIC SURVEY IS AVAILABLE FOR PIPELINE ROUTE FROM STA. 17+00 TO STA. 46.+50.



0 30' 60'
SCALE: 1" = 30'

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Professional Engineer's Name: SEAN K. CHAPARRO, P.E.
Professional Engineer's No.: 75865

State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
SLJ	KAK	DAO

SEAN K. CHAPARRO
P.E. NO. 75865

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

FORCE MAIN PLAN

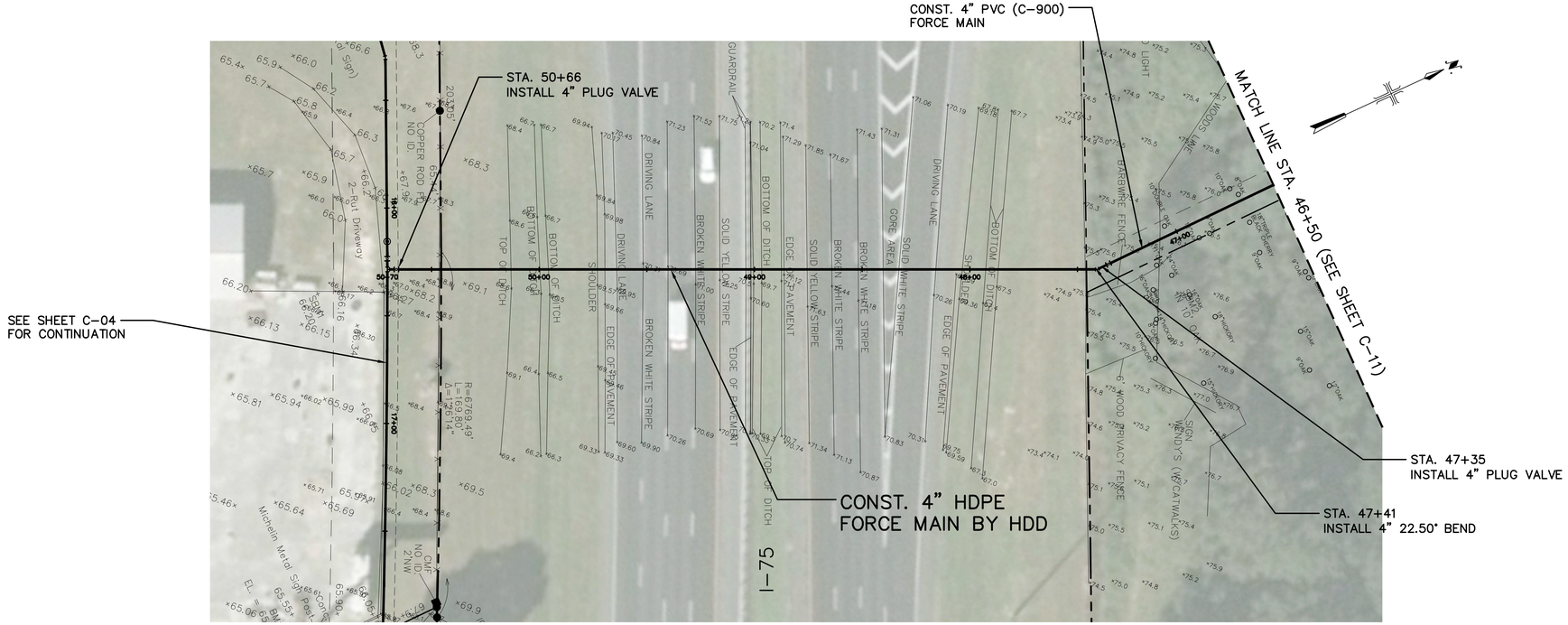
ARCADIS Project No.
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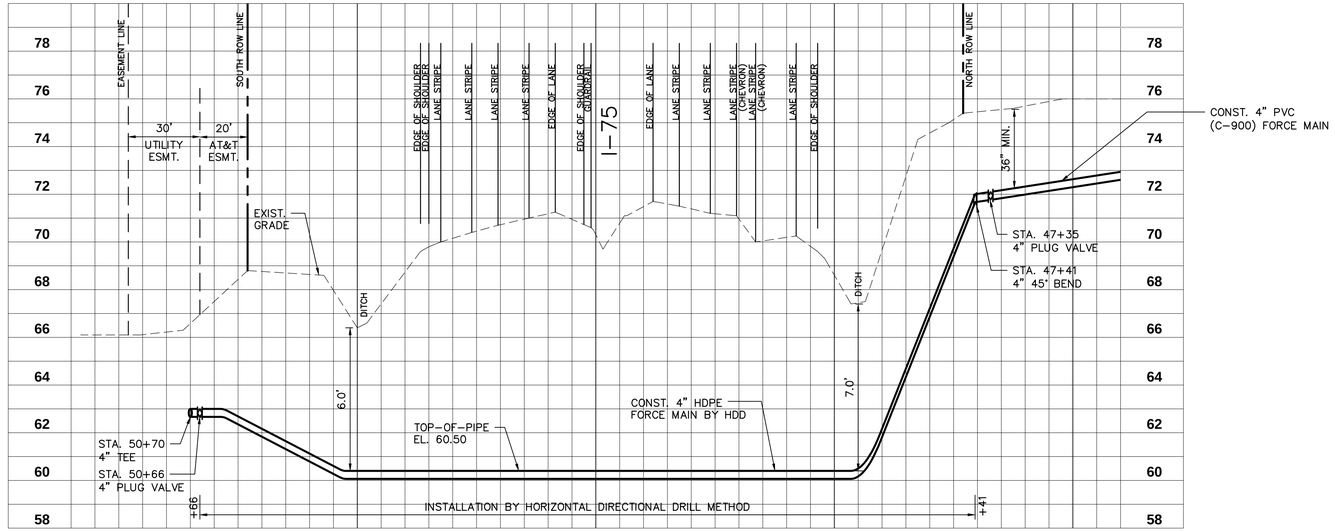
Date
OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

C-11

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0 30' 60'
SCALE: 1" = 30' (HORIZ.)
SCALE: 1" = 3' (VERT.)

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Professional Engineer's No.: 75865
State: FL | Date Signed: | Project Mgr.: SKC
Designed by: SLJ | Drawn by: KAK | Checked by: DAO

SEAN K. CHAPARRO
P.E. NO. 75865

ORIGINAL SIGNED AND SEALED SHEET ON FILE

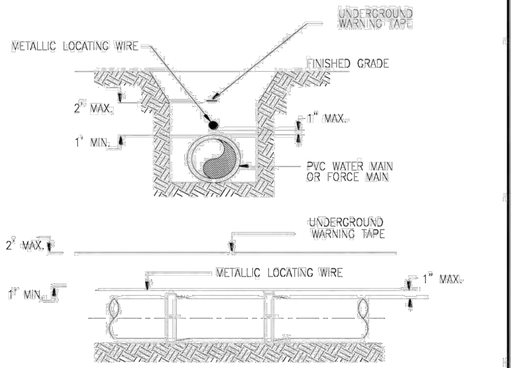
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ARCADIS U.S., INC.
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COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

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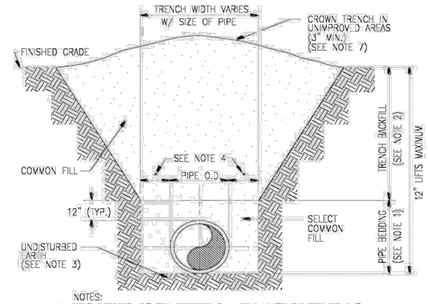
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ARCADIS
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C-12



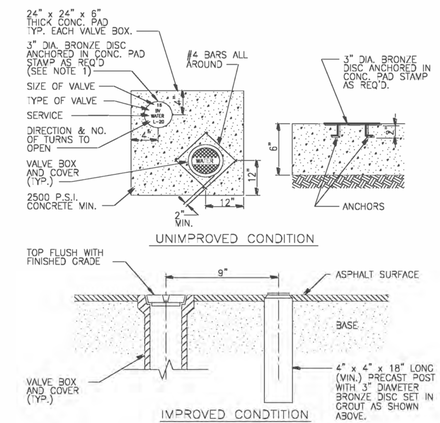
NOTES:
1. PVC PIPE SHALL REQUIRE INSULATED METALLIC LOCATING WIRE (14 GAUGE COPPER) CAPABLE OF DETECTION BY A CABLE LOCATOR AND SHALL BE BURIED DIRECTLY ABOVE THE CENTERLINE OF THE PIPE. LOCATING WIRE SHALL TERMINATE AT THE TOP OF EACH VALVE BOX AND BE CAPABLE OF EXTENDING 12" ABOVE TOP OF BOX IN SUCH A MANNER SO AS NOT TO INTERFERE WITH VALVE OPERATION. USE DUCT TAPE AS NECESSARY TO HOLD WIRE DIRECTLY ON THE TOP OF THE PIPE.
2. PROPERLY COLOR CODED UNDERGROUND WARNING TAPE SHALL BE PLACED AT A MINIMUM OF 1 FOOT ABOVE THE PIPE AND NO GREATER THAN 2 FEET ABOVE THE PIPE, FOR THE PURPOSE OF IDENTIFYING THE LOCATION OF UNDERGROUND UTILITY LINES.

		COLUMBIA COUNTY	
		PVC PIPE LOCATING WIRE DETAIL	
Date	Revisions	Appr. by	Date: FEB. 2010 | Scale: N.T.S. | Dwg: Q108 | Fig: 108



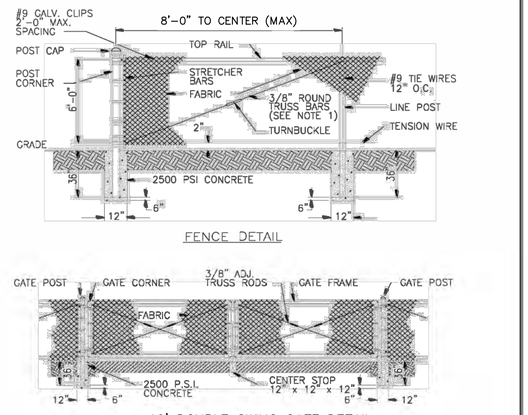
NOTES:
1. PIPE BEDDING: SELECT COMMON FILL COMPACTED TO 95% OF THE MAXIMUM DENSITY AS PER AASHTO T-180.
2. TRENCH BACKFILL: COMMON FILL COMPACTED TO 95% OF THE MAXIMUM DENSITY AS PER AASHTO T-180.
3. PIPE BEDDING UTILIZING SELECT COMMON FILL OR BEDDING ROCK IN ACCORDANCE WITH TYPE A BEDDING AND TRENCHING DETAIL MAY BE REQUIRED AS DIRECTED BY THE COUNTY.
4. (*): 15" MAX. FOR PIPE DIAMETER LESS THAN 24", AND 24" MAX. FOR PIPE DIAMETER 24" AND LARGER.
5. WATER SHALL NOT BE PERMITTED IN THE TRENCH DURING CONSTRUCTION.
6. ALL PIPE TO BE INSTALLED WITH BELL FACING UPSTREAM TO THE DIRECTION OF THE FLOW.
7. FINAL RESTORATION IN IMPROVED AREAS SHALL BE IN COMPLIANCE WITH ALL APPLICABLE REGULATIONS OF GOVERNING AGENCIES. SURFACE RESTORATION WITHIN THE COUNTY RIGHT-OF-WAY SHALL COMPLY WITH THE APPLICABLE REGULATIONS.
8. NO CROWN UNDER PAVED AREAS.

		COLUMBIA COUNTY	
		TYPE B BEDDING AND TRENCHING DETAIL	
8/14	NOTES	TRM	
Date	Revisions	Appr. by	Date: Sept. 1996 | Scale: N.T.S. | Dwg: Q100 | Fig: 100



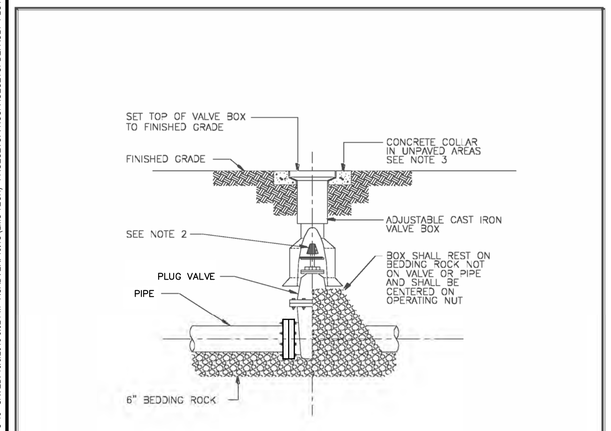
NOTES:
1. BRONZE IDENTIFICATION DISC SHALL BE REQUIRED FOR ALL VALVES.

		COLUMBIA COUNTY	
		VALVE COLLAR DETAIL	
Date	Revisions	Appr. by	Date: Sept. 1996 | Scale: N.T.S. | Dwg: Q107 | Fig: 107



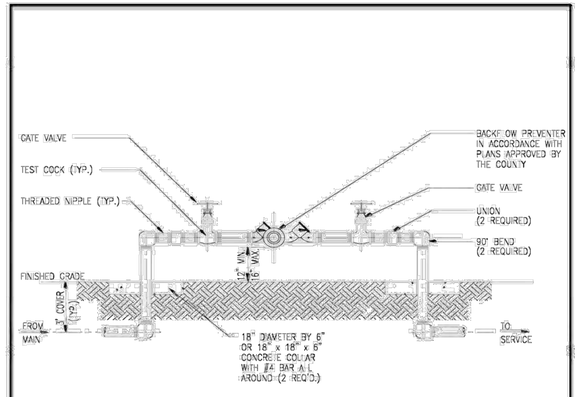
NOTES:
1. TRUSS BARS ARE REQUIRED FOR EACH GATE SECTION AND THE FIRST SPAN ON EACH SIDE OF A CORNER POST ONLY.

		COLUMBIA COUNTY	
		CHAIN LINK FENCE DETAIL	
Date	Revisions	Appr. by	Date: Sept. 1996 | Scale: N.T.S. | Dwg: Q307 | Fig: 307



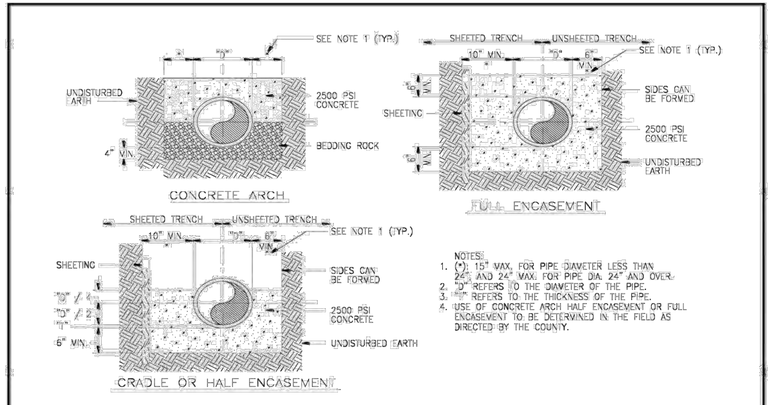
NOTES:
1. PVC EXTENSIONS SHALL NOT BE USED ON VALVE BOX INSTALLATION.
2. THE ACTUATING NUT FOR DEEPER VALVES SHALL BE EXTENDED TO COME UP TO 4 FOOT DEPTH BELOW FINISHED GRADE.
3. VALVE COLLAR SHALL BE 18"X18"X6" CONCRETE COLLAR W/4 - #4 BARS.

		COLUMBIA COUNTY	
		PLUG VALVE AND BOX DETAIL	
8/14	FLANGES AND TITLE	TRM	
Date	Revisions	Appr. by	Date: Sept. 1996 | Scale: N.T.S. | Dwg: Q400 | Fig: 400



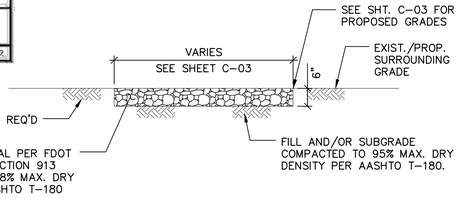
NOTES:
1. ALL PIPE AND FITTINGS 2" AND SMALLER SHALL BE THREADED SCHEDULE 40 GALVANIZED STEEL OR BRASS.

		COLUMBIA COUNTY	
		REDUCED PRESSURE BACKFLOW PREVENTER	
Date	Revisions	Appr. by	Date: Sept. 1996 | Scale: N.T.S. | Dwg: Q501 | Fig: 501



NOTES:
1. (*): 15" MAX. FOR PIPE DIAMETER LESS THAN 24", AND 24" MAX. FOR PIPE DIA. 24" AND OVER.
2. "D" REFERS TO THE DIAMETER OF THE PIPE.
3. "t" REFERS TO THE THICKNESS OF THE PIPE.
4. USE OF CONCRETE ARCH HALF ENCASEMENT OR FULL ENCASEMENT TO BE DETERMINED IN THE FIELD AS DIRECTED BY THE COUNTY.

		COLUMBIA COUNTY	
		CONCRETE ARCH and ENCASEMENT DETAILS	
Date	Revisions	Appr. by	Date: Jan. 2001 | Dwg: Q102 | Fig: 102



NOTES:
1. CLEAR AND GRUB LIMITS OF PROPOSED DRIVE/PARKING. REMOVE ALL ROOTS AND DELETERIOUS MATERIAL PRIOR TO SUBGRADE PREPARATION AND COMPACTION.
2. SELECT FILL WILL BE REQUIRED IN SOME AREAS UNDER SHELL DRIVE/PARKING TO RAISE SHELL SURFACE TO PROPOSED GRADES.

TYPICAL SHELL DRIVE & PARKING SECTION
N.T.S.

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Professional Engineer's No.: 75865
State: FL | Date Signed: | Project Mgr.: SKC
Designed by: SJ | Drawn by: KAK | Checked by: DAO

SEAN K. CHAPARRO
P.E. NO. 75865

ORIGINAL SIGNED AND SEALED SHEET ON FILE

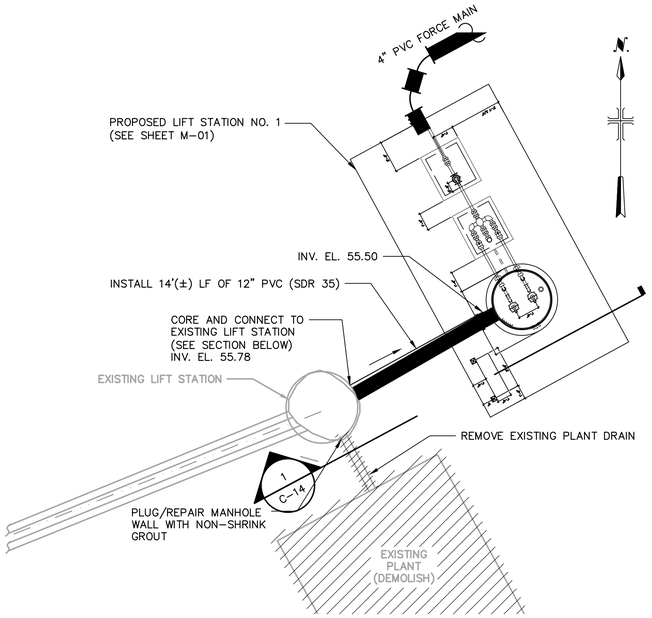
ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

CIVIL DETAILS I

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016
ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

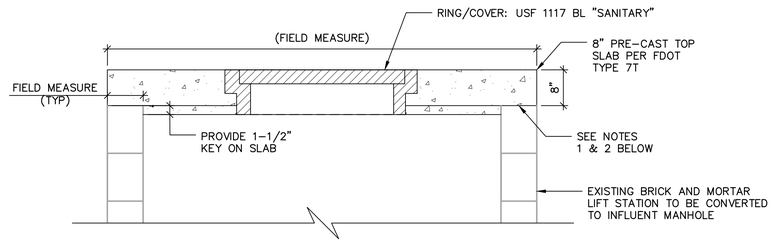
C-13



LIFT STATION NO. 1 PIPING DETAIL

SCALE: 1" = 5'-0"

0 5' 10'

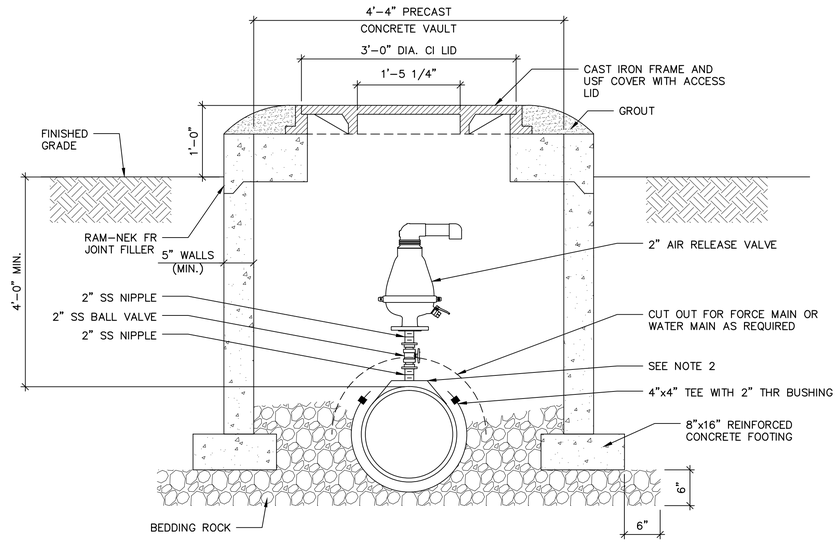


PRECAST CONCRETE TOP FOR INFLUENT MANHOLE

SCALE: 1" = 1'-0"

NOTES:

1. CONTRACTOR SHALL BUILD UP TOP OF EXISTING MANHOLE RIM AROUND ENTIRE CIRCUMFERENCE OF MANHOLE WITH MORTAR TO PROVIDE A LEVEL SURFACE ON WHICH TO PLACE PRECAST TOP.
2. INSTALL 1 LAYER OF RAM-NEK FR JOINT SEALANT BETWEEN MANHOLE RIM AND NEW PRECAST SLAB. SEALANT SHALL COVER FULL WIDTH OF MANHOLE WALL AND FULL CIRCUMFERENCE.
3. CONTRACTOR SHALL OBTAIN FIELD DIMENSIONS OF EXISTING MANHOLE AS REQUIRED AND PROVIDE TO PRECAST VENDOR TO ENSURE PROPER FIT. SHOP DRAWINGS SHALL BE SUBMITTED FOR APPROVAL PRIOR TO CASTING OF TOP. TOP SHALL BE PER H-20 LOADING.

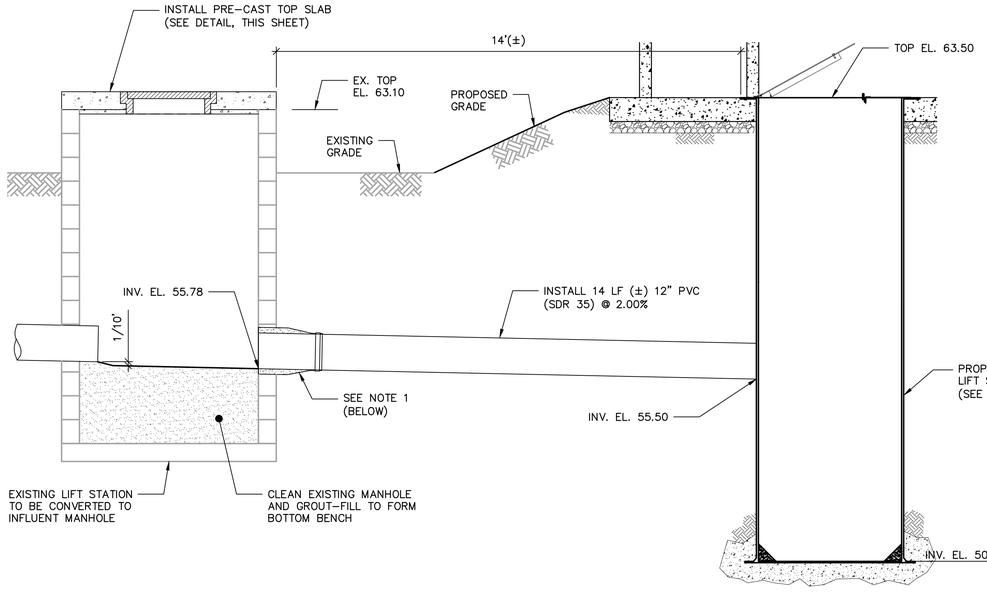


FORCE MAIN AIR RELEASE VALVE DETAIL

N.T.S.

NOTES:

1. ABOVE DETAIL IS BASED ON 2" COMBINATION AIR/VACUUM RELEASE VALVE. CHANGE PIPE AND FITTINGS ACCORDINGLY FOR OTHER VALVE SIZES AND TYPES. VALVE SIZES TO BE DETERMINED BY THE ENGINEER AND APPROVED BY THE COUNTY PRIOR TO INSTALLATION.
2. THE MINIMUM DIMENSION FROM TOP OF PIPE TO FINISHED GRADE SHALL BE 4.0 FEET.
3. AIR RELEASE VALVE SHALL BE 2" A.R.I. D-025 OR APPROVED EQUAL.
4. THIS DETAIL APPLIES TO ANY REQUIRED AIR RELEASE VALVE AT HIGH POINTS ALONG PROPOSED FORCE MAIN.

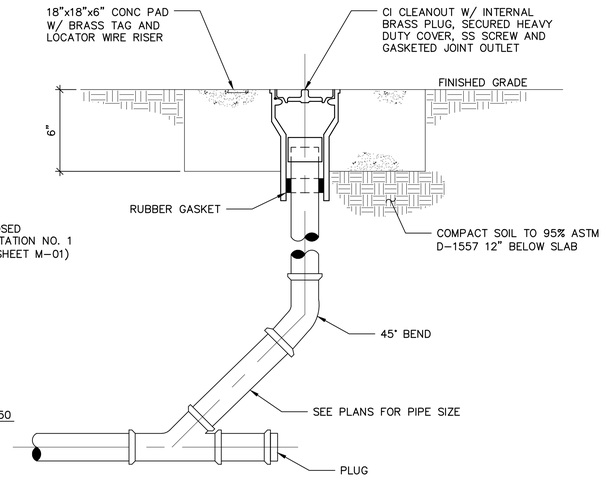


EXISTING MANHOLE CONNECTION TO LIFT STATION NO. 1

NOTE:
1. CORE EXISTING CONCRETE MANHOLE WALL AND INSTALL KOR-N-SEAL CONNECTOR (PACK ANNULAR SPACE BETWEEN BOOT AND PIPE W/ NON-SHRINK GROUT).

1 / C-14 SECTION

SCALE: 1/2" = 1'-0"



CLEANOUT DETAIL

SCALE: N.T.S.

LOCATION OF PUBLIC WATER SYSYEM MAINS IN ACCORDANCE WITH F.A.C. RULE 62-555.314

Other Pipe	Horizontal Separation	Crossings (1)	Joint Spacing @ Crossings (Full Joint Centered)
Storm Sewer, Stormwater Force Main, Reclaimed Water (2)	Water Main 3 ft. minimum	Water Main 12 inches is the minimum, except for storm sewer, then 6 inches is the minimum and 12 inches is preferred	Alternate 3 ft. minimum Water Main
Vacuum Sanitary Sewer	Water Main 10 ft. preferred 3 ft. minimum	Water Main 12 inches preferred 6 inches minimum	Alternate 3 ft. minimum Water Main
Gravity or Pressure Sanitary Sewer, Sanitary Sewer Force Main, Reclaimed Water (4)	Water Main 10 ft. preferred 6 ft. minimum (3)	Water Main 12 inches is the minimum, except for gravity sewer, then 6 inches is the minimum and 12 inches is preferred	Alternate 6 ft. minimum Water Main
On-Site Sewage Treatment & Disposal System	10 ft. minimum	---	---

(1) Water main should cross above other pipe. When water main must be below other pipe, the minimum separation is 12 inches.
(2) Reclaimed water regulated under Part III of Chapter 62-610, F.A.C.
(3) 3 ft. for gravity sanitary sewer where the bottom of the water main is laid at least 6 inches above the top of the gravity sanitary sewer.
(4) Reclaimed water not regulated under Part III of Chapter 62-610, F.A.C.

Disclaimer – This document is provided for your convenience only. Please refer to F.A.C. Rule 62-555.314 for additional construction requirements.

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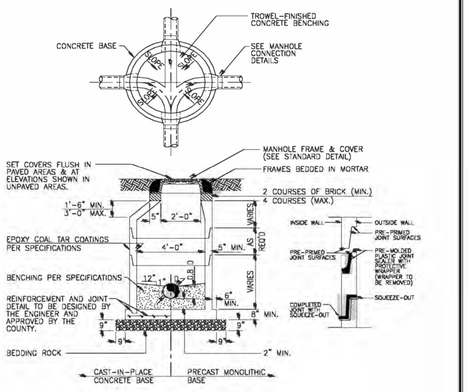
COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

CIVIL DETAILS II

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016

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3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
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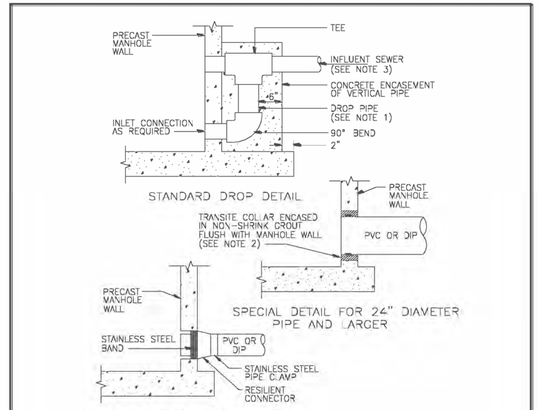
NOTES:
1. MANHOLE SHOWN IS FOR SEWER SIZE 8" THRU 24", SEE UTILITIES STANDARDS HANDBOOK FOR MANHOLE DIAMETER FOR SEWERS LARGER THAN 24".
2. DROP CONNECTIONS ARE REQUIRED WHENEVER INVERT OF INFLUENT SEWER IS 24" OR MORE ABOVE THE INVERT OF THE MANHOLE. SEE MANHOLE CONNECTION DETAILS.
3. APPROVED CONCENTRIC CONE DESIGN MAY BE USED AS AN ALTERNATIVE.

Date	Revisions	Appr. by

COLUMBIA COUNTY

PRECAST MANHOLE DETAIL

Date: Sept. 1996 | Scale: N.T.S. | Dwg: Q200 | Fig: 200



STANDARD PRECAST MANHOLE PIPE CONNECTION

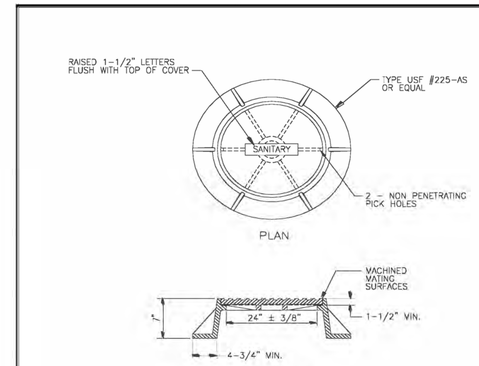
NOTES:
1. DROP PIPE AND FITTINGS SHALL BE OF EQUAL SIZE AND MATERIAL AS THE INFLUENT SEWER.
2. THE COUNTY MAY APPROVE ALTERNATE WATER TIGHT CONNECTION DETAILS FOR CONNECTION OF 24" DIAMETER PIPES AND LARGER.
3. AN OUTSIDE DROP CONNECTION SHALL BE REQUIRED FOR ALL INFLUENT WHICH HAVE AN INVERT 2' OR MORE ABOVE THE MANHOLE INVERT.

Date	Revisions	Appr. by

COLUMBIA COUNTY

MANHOLE CONNECTION DETAILS

Date: Sept. 1996 | Scale: N.T.S. | Dwg: Q201 | Fig: 201

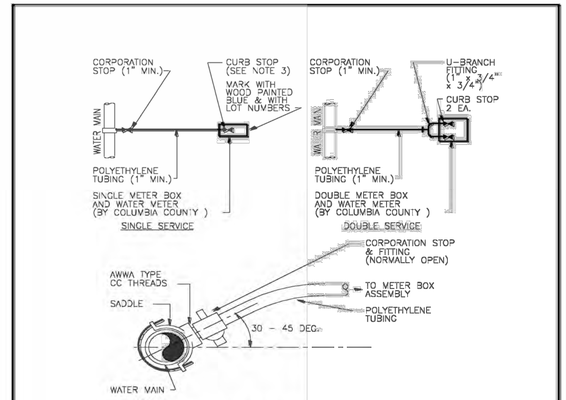


Date	Revisions	Appr. by

COLUMBIA COUNTY

SANITARY MANHOLE COVER

Date: Sept. 1996 | Scale: N.T.S. | Dwg: Q202 | Fig: 202



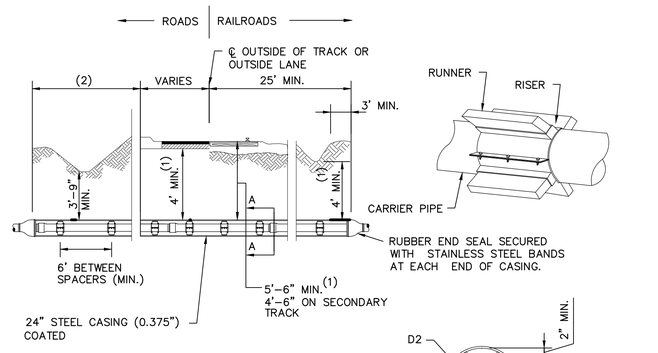
NOTES:
1. ALL FITTINGS SHALL BE BRASS WITH COMPRESSION/PACK JOINT TYPE CONNECTIONS.
2. NO SERVICE LINE SHALL TERMINATE UNDER A DRIVEWAY.
3. EACH SERVICE SHALL TERMINATE AT A CURB STOP(S) WHICH SHALL BE BURIED APPROXIMATELY 3" BELOW FINAL GRADE AND SHALL BE CLEARLY MARKED WITH A 2" X 2" X 18" STAKE WITH THE TOP PAINTED BLUE AND MARKED WITH THE NUMBER OF THE LOT(S) TO BE SERVED.
4. INDENT CURB WITH "W" AT EACH WATER SERVICE LOCATION

Date	Revisions	Appr. by

CITY OF LAKE CITY

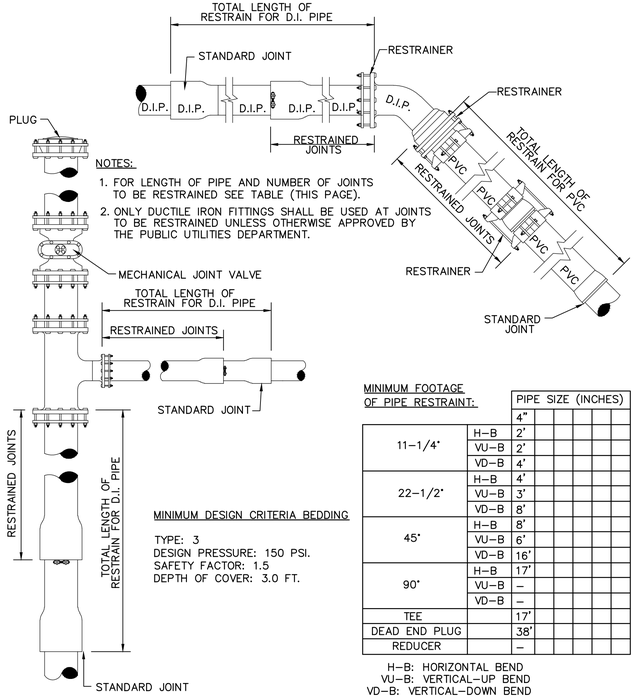
WATER SERVICE CONNECTION DETAILS

Date: Sept. 1996 | Scale: N.T.S. | Dwg: Q405 | Fig: 405



NOTES:
1. VERTICAL DIMENSIONS TYPICAL FOR CASINGS
2. WITH CURB: 6' STATE & 2' COUNTY ROADS MINIMUM WITHOUT CURB: 8' STATE & 4' COUNTY ROADS MINIMUM
3. STEEL CASING PIPE SHALL CONFORM TO THE REQUIREMENTS OF AWWA C-200 AND ASTM A-139, GRADE B.

JACK & BORE DETAIL



MINIMUM FOOTAGE OF PIPE RESTRAINT:

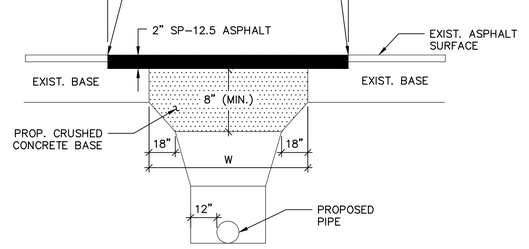
		PIPE SIZE (INCHES) 4"
11-1/4°	H-B	2'
	VU-B	2'
	VD-B	4'
22-1/2°	H-B	4'
	VU-B	3'
	VD-B	8'
45°	H-B	8'
	VU-B	6'
	VD-B	16'
90°	H-B	17'
	VU-B	–
	VD-B	–
TEE		17'
DEAD END PLUG		38'
REDUCER		–

H-B: HORIZONTAL BEND
VU-B: VERTICAL-UP BEND
VD-B: VERTICAL-DOWN BEND

MINIMUM DESIGN CRITERIA BEDDING

TYPE: 3
DESIGN PRESSURE: 150 PSI.
SAFETY FACTOR: 1.5
DEPTH OF COVER: 3.0 FT.

RESTRAINED JOINT DETAIL



BACKFILL, BASE AND PAVEMENT REPLACEMENT

1. ONE SET OF DENSITY TESTS IS REQUIRED EVERY 500 LINEAR FEET PER COMPACTED LAYER FOR LONGITUDINAL UTILITY INSTALLATIONS.
2. A MINIMUM OF TWO DENSITY TESTS PER LIFT IS REQUIRED FOR PERPENDICULAR UTILITY CROSSINGS.

BACKFILL PROCEDURE

THE BACKFILL AND BEDDING MATERIAL SHALL BE OF THE A-1, A-2, A-3, OR A-2-4 CLASSIFICATION PER AASHTO, UNLESS OTHERWISE APPROVED BY THE COUNTY ENGINEER.

THE BACKFILL SHALL BE COMPACTED IN 12" LAYERS WITH MECHANICAL TAMPERS TO THE FULL WIDTH OF THE TRENCH AND UP TO THE BOTTOM OF THE ROADWAY BASE. PARTICULAR ATTENTION MUST BE GIVEN TO THE ADEQUATE COMPACTION OF THE FILL BENEATH THE HAUNCHES OF THE PIPE. THE BACKFILL SHALL BE COMPACTED TO 98% MAXIMUM DENSITY AS DETERMINED BY AASHTO T-180-57. ONE DENSITY TEST SHALL BE TAKEN AT THE SPRING LINE OF THE PIPE, AT ONE FOOT ABOVE THE CROWN OF THE PIPE, AND EVERY FOOT VERTICALLY THEREAFTER. A MINIMUM OF TWO COMPLETE SETS OF BACKFILL DENSITY TESTS ARE REQUIRED. FLOWABLE FILL IN ACCORDANCE WITH SECTION 121 OF THE F.D.O.T. STANDARD SPECIFICATIONS MAY BE SUBSTITUTED.

IF WELL POINTS ARE USED TO PROVIDE A DRY TRENCH FOR LAYING THE UTILITY, THEY SHALL REMAIN IN OPERATION UNTILL THE BACKFILL IS COMPLETE AND TESTED.

PAVEMENT AND BASE REPLACEMENT

BASE SHALL BE INSTALLED IN 6" LIFTS. THE BASE SHALL BE COMPACTED TO 98% THE MAXIMUM DENSITY AS DETERMINED BY AASHTO T-180-57.

PAVEMENT JOINTS SHALL BE MECHANICALLY SAWED.
THE PATCH AREA SHALL BE A SMOOTH PLANE SUCH THAT A STRAIGHT EDGE PLACED ACROSS THE PATH, PARALLEL TO THE TRAFFIC FLOW AND EXTENDING TO UNDISTURBED PAVEMENT SHALL SHOW NO MORE THAN 1/4" IRREGULARITY. ANY IRREGULARITIES SHALL BE CORRECTED IN SUBSTANTIAL COMPLIANCE WITH F.D.O.T. SPECS.

PAVEMENT REPAIR DETAIL

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF* G:\CADD\ACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\02-CIVIL\C-15.dwg LAYOUT: C-15 SAVED: 10/6/2016 6:13 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:17 AM BY: NEGRON-VIEIRA, VANESSA

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

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Professional Engineer's Name: SEAN K. CHAPARRO, P.E.
Professional Engineer's No.: 75865
State: FL | Date Signed: | Project Mgr.: SKC
Designed by: SJ | Drawn by: KAK | Checked by: DAO

SEAN K. CHAPARRO
P.E. NO. 75865

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

CIVIL DETAILS III

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

C-15

ENVIRONMENTAL PROTECTION NOTES:

1. SILT BARRIERS, SYNTHETIC BALES, STAKED SILT FENCES OR FLOATING SILT SCREENS SHALL BE USED AS SILT BARRIERS. SEE NOTE NO. 7 ON THIS SECTION. THE EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSTALLED PRIOR TO THE BEGINNING OF CONSTRUCTION. THE CONTRACTOR SHALL MONITOR AND MAINTAIN THESE SILT BARRIERS DAILY AND CHECK FOLLOWING EACH STORM EVENT. SHOULD THE SILT BARRIERS BECOME LOOSE OR DAMAGED DURING THE CONSTRUCTION PERIOD, CONTRACTOR SHALL RECONSTRUCT AND CORRECT THEM, OR REPLACE THEM WITH A DIFFERENT TYPE IF NECESSARY, AT NO COST TO THE OWNER.

2. ALL WATER COLLECTED AND PUMPED DURING TRENCH DEWATERING ACTIVITIES SHALL BE DISPOSED OF ON UPLAND AREAS INTO DOUBLE STAKED HAY BALES. DISCHARGE LOCATIONS SHALL BE A MINIMUM OF 75 FEET FROM THE NEAREST WETLAND TO ALLOW FOR A MAXIMUM OVERLAND FILTRATION OF SOIL PARTICLES. ALL PERMITTING ASSOCIATED WITH CONTRACTOR'S DEWATERING ACTIVITIES SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.

3. EXCAVATION ACROSS ALL WETLANDS WITHIN ESTABLISHED LIMITS OF CONSTRUCTION SHALL BE ACCOMPLISHED BY STRIPPING THE TOP 10 INCHES OF ORGANIC SURFICIAL SOILS FROM THE FULL WIDTH OF THE AREA TO BE DISTURBED AND STOCKPILING THESE SOILS ON UPLAND AREAS. THE REMAINING EXCAVATIONS NECESSARY FOR PIPE INSTALLATION THAT SHALL BE USED FOR BACKFILL SHALL BE TEMPORARILY PLACED ADJACENT TO THE PIPE TRENCH. THE EXCAVATED MATERIAL THAT SHALL NOT BE USED FOR BACKFILL SHALL BE STOCKPILED SEPARATELY FROM SURFICIAL SOILS ON UPLAND AREAS OUTSIDE OFJURISDICTIONAL AREAS DESIGNATED ON THE DRAWINGS AT A MINIMUM DISTANCE OF 200 FEET FROM A WETLAND. BACKFILLING OPERATIONS SHALL PROCEED SUCH THAT SURFICIAL SOILS SHALL BE REPLACED LAST AND SHALL BE SPREAD ACROSS THE ENTIRE DISTURBED WETLAND AREA TO HELP PROMOTE NATIVE VEGETATIVE GROWTH. SURFICIAL SOILS SHALL NOT BE LEFT STOCKPILED IN EXCESS OF TWO WEEKS. ALL WETLAND CROSSINGS THAT ARE DISTURBED DURING CONSTRUCTION, SHALL HAVE AN ADEQUATE AMOUNT OF FILL REMOVED SO THAT THE WETLAND IS RESTORED TO THE ORIGINAL LINE, GRADE AND CROSS-SECTION AS INDICATED BY THESE DRAWINGS.

4. THE CONTRACTOR SHALL BE HELD LIABLE FOR THE VIOLATION OF ANY AND ALL ENVIRONMENTAL REGULATIONS AND PERMIT CONDITIONS, IN ACCORDANCE WITH THE GENERAL CONDITIONS AND GENERAL REQUIREMENTS SECTIONS OF THE CONTRACT DOCUMENTS.

5. BANKS SHALL BE PROTECTED FROM EROSION OR COLLAPSE DURING CONSTRUCTION. MATERIAL SHALL BE CAREFULLY PLACED FROM THE BANK AND NOT DUMPED FROM ABOVE IN AN UNCONTROLLED MANNER. EROSION CONTROL FABRIC SHALL BE USED FOR EROSION PROTECTION WHERE SOD SHALL NOT HOLD OR BECOME ESTABLISHED IN TIME TO PROTECT THE BANKS. UPON COMPLETION OF CONSTRUCTION, BANKS AND WATERWAYS SHALL BE RESTORED TO THEIR PRE-CONSTRUCTION CONFIGURATION AND PROTECTED FROM EROSION.

6. THESE ENVIRONMENTAL NOTES ARE APPLICABLE TO THE COMPLETE PROJECT. HOWEVER, THE CONTRACTOR SHALL TAKE EXTRA PRECAUTIONS WHERE SPECIFIC REFERENCES ARE MADE WITHIN THE DRAWINGS.

7. SILTATION ACCUMULATIONS GREATER THAN THE LESSER OF 12 INCHES OR ONE-HALF THE DEPTH OF THE SILTATION CONTROL BARRIER SHALL BE IMMEDIATELY REMOVED AND PLACED IN UPLAND AREAS.

EROSION CONTROL NOTES

1. ALL CONSTRUCTION ACTIVITIES SHALL INCORPORATE BEST MANAGEMENT PRACTICES TO CONTROL EROSION, SEDIMENTATION, AND THE POTENTIAL FOR DOWNSTREAM WATER QUALITY DEGRADATION. CONSTRUCTION PRACTICES INCLUDE:

   A. CONSTRUCT TEMPORARY SEDIMENTATION BASINS OR EARTHEN BERMS AT DOWNGRADIENT ENDS OF NEWLY GRADED AREAS TO PROVIDE FOR SEDIMENT AND TURBIDITY REMOVAL.
   B. LIMIT SITE CLEARING TO THOSE AREAS REQUIRED FOR A PARTICULAR PHASE OF CONSTRUCTION. EXISTING TREES AND VEGETATION TO REMAIN WHEREVER POSSIBLE.
   C. TURBIDITY BARRIERS, SYNTHETIC BALES AND OTHER EROSION CONTROL MEASURES SHALL REMAIN IN PLACE UNTIL CONSTRUCTION ACTIVITIES ARE COMPLETE AND THE POTENTIAL FOR EROSION IS ELIMINATED.

2. SOLID SOD DITCH AND SWALE BANKS AS SOON AS POSSIBLE AFTER CONSTRUCTION IN ORDER TO STABILIZE THE SLOPES AND MINIMIZE EROSION. IN AREAS DELINEATED AS "WETLANDS," REVEGETATE IN ACCORDANCE WITH PERMIT CONDITIONS.

3. DO NOT EMPLOY SILT FENCES IN A MANNER TO CAUSE THEM TO ACT AS A DAM ACROSS PERMANENTLY FLOWING WATERCOURSES. USE SILT FENCES AT UPLAND LOCATIONS, AND TURBIDITY BARRIERS IN PERMANENT WATER BODIES, REGARDLESS OF WATER DEPTH.

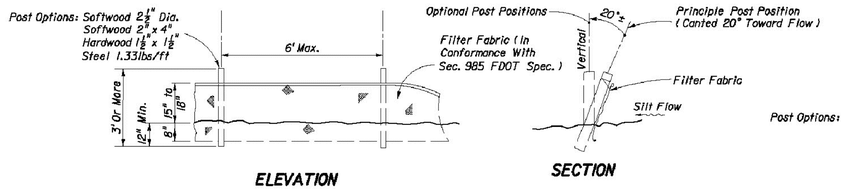
4. TURBIDITY BARRIERS FOR WATER BODIES MAY BE EITHER FLOATING OR STAKED TYPE, OR ANY COMBINATION OF TYPES THAT WILL SUIT SITE CONDITIONS, AND MEET EROSION CONTROL AND WATER QUALITY REQUIREMENTS. INSTALL POSTS IN STAKED TURBIDITY BARRIERS IN THE VERTICAL POSITION UNLESS OTHERWISE NOTED.

5. TURBIDITY IN ALL WATER BODIES TO BE CONTROLLED TO PREVENT VIOLATION OF WATER QUALITY PURSUANT TO RULE 62-302.510(5)(r), FLORIDA ADMINISTRATIVE CODE. TURBIDITY SHALL NOT EXCEED 29 NEPHELOMETRIC TURBIDITY UNITS ABOVE NATURAL BACKGROUND CONDITIONS.

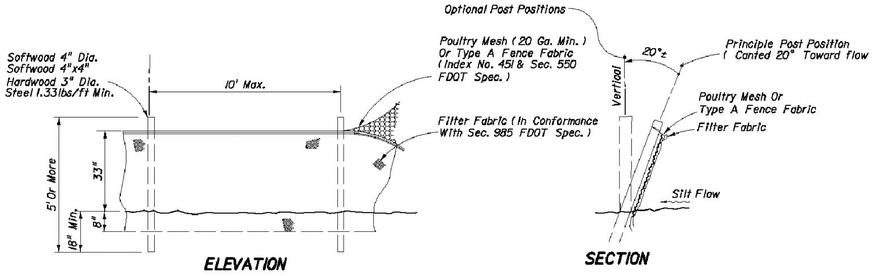
6. FOR EROSION CONTROL DETAILS, REFER TO FLORIDA DEPARTMENT OF TRANSPORTATION (FDOT) "ROADWAY AND TRAFFIC DESIGN STANDARDS":

   A. TRASH RETAINER AND SEDIMENT BASIN -- INDEX NO. 101
   B. BAILED HAY OR STRAW BARRIERS AND SILT FENCES -- INDEX NO. 102 (ALSO SHOWN THIS SHEET).
   C. TURBIDITY BARRIERS -- INDEX NO. 103.

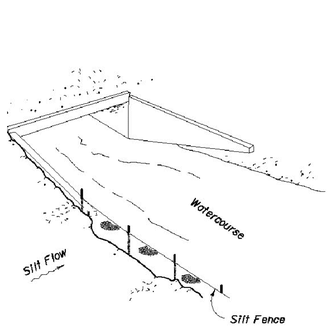
   ADDITIONALLY, COMPLY WITH FDOT "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION," SECTION 104 - PREVENTION, CONTROL, AND ABATEMENT OF EROSION AND WATER POLLLUTION.

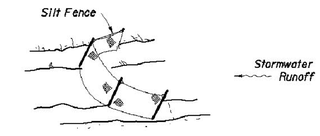


TYPE III SILT FENCE

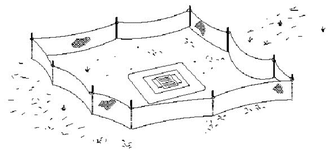


TYPE IV SILT FENCE



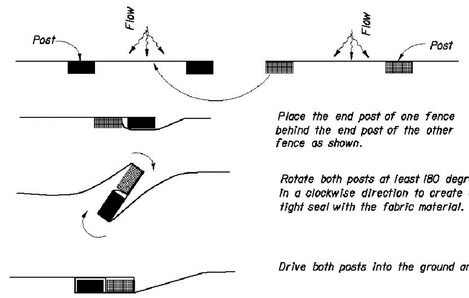


Silt Fence Protection in Ditches with Intermittent Flow



Silt Fence Protection Around Ditch Bottom Inlets.

SILT FENCE APPLICATIONS



PLAN VIEW

JOINING TWO SILT FENCES

NOTES FOR SILT FENCES

1. TYPE III SILT FENCE TO BE USED AT MOST LOCATIONS. WHERE USED IN DITCHES THE SPACING FOR TYPE III SILT FENCE SHALL BE IN ACCORDANCE WITH CHART I, SHEET I.

2. TYPE IV SILT FENCE TO BE USED WHERE LARGE SEDIMENT LOADS ARE ANTICIPATED. SUGGESTED USE IS WHERE FILL SLOPE IS 1:2 OR STEEPER AND LENGTH OF SLOPE EXCEEDS 25 FEET. AVOID USE WHERE THE DETAINED WATER MAY BACK INTO TRAVEL LANES OR OFF THE RIGHT OF WAY.

3. DO NOT CONSTRUCT SILT FENCES ACROSS PERMANENT FLOWING WATERCOURSES. SILT FENCES ARE TO BE AT UPLAND LOCATIONS AND TURBIDITY BARRIERS USED AT PERMANENT BODIES OF WATER

4. WHERE USED AS SLOPE PROTECTION, SILT FENCE IS TO BE CONSTRUCTED ON 0% LONGITUDINAL GRADE TO AVOID CHANNELIZING RUNOFF ALONG THE LENGTH OF THE FENCE.

5. PERIMETER SILT FENCE SHALL BE TRENCHED 8-10 INCHES DEEP EXCEPT AROUND THE DRIPLINEOF LARGE TREES WHERE YOU SHOULD REFER TO THE TREE PROTECTION BARRIER DETAIL.

MAINTENANCE

A. INSPECT SILT BARRIERS IMMEDIATELY AFTER EACH RAINFALL AND AT LEAST ONCE A DAY DURING PERIODS OF PROLONGED RAINFALL. MAKE NEEDED REPAIRS IMMEDIATELY.
B. SHOULD THE FABRIC ON A SILT BARRIER DECOMPOSE OR BECOME INEFFECTIVE PRIOR TO THE END OF THE EXPECTED USABLE LIFE AND IF THE BARRIER IS STILL NEEDED, REPLACE THE FABRIC IMMEDIATELY.
C. REMOVE SEDIMENT DEPOSITS AFTER EACH STORM EVENT.
D. ANY SEDIMENT DEPOSITS IN PLACE AFTER THE SILT FENCE OR FILTER BARRIER IS NO LONGER REQUIRED SHALL BE DRESSED TO CONFORM TO THE EXISTING GRADE, AND PREPARED FOR SEEDING OR SODDING.

STORMWATER NOTES:

1. STORMWATER DESIGN SHALL COMPLY WITH PROPERTY OWNERS STORMWATER REQUIREMENTS.
2. UNDER THE PROVISIONS OF THE CLEAN WATER ACT, AS AMENDED, FEDERAL LAW PROHIBITS DISCHARGES OF POLLUTANTS IN STORMWATER FROM CONSTRUCTION ACTIVITIES WITHOUT A NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT (NPDES). THE CONTRACTOR SHALL COMPLETE AND SUBMIT AN FDEP NOI FORM 62-621.300 (4) (b) TO THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION (FDEP) AT LEAST 48 HOURS PRIOR TO ANY CONSTRUCTION ACTIVITIES TO OBTAIN COVERAGE UNDER A CONSTRUCTION GENERAL PERMIT.

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON="OFF-REF"
G:\CADD\ACAD\PROJ\67104 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\02-CIVIL\C-16.dwg LAYOUT: C-16 SAVED: 10/6/2016 6:15 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:17 AM BY: NEGRON-VIEIRA, VANESSA

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Professional Engineer's Name: SEAN K. CHAPARRO, P.E.
Professional Engineer's No.: 75865

State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
SJ	KAK	DAO

SEAN K. CHAPARRO
P.E. NO. 75865

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

EROSION CONTROL DETAILS

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

C-16



NOTES:

1. SITE DEMOLITION: REMOVE ALL VALVE, PIPES, PUMPS, ELECTRICAL PANELS, CONDUITS, ABOVE GROUND STRUCTURES AND STAIRWAYS. BACKFILL AND COMPACT ALL DISTURBED AREAS.
2. CONTRACTOR TO RESTORE ALL DISTURBED AREAS, RE-ESTABLISH SITE DRAINAGE AND RESTORE WITH BAHIA SOD.
3. CONTRACTOR TO PUMP AND HAUL REMAINING LIQUID WASTE FROM ALL TANKS AND PONDS PRIOR TO ABANDONMENT.
4. TRANSFER EXISTING WWTP MIXED LIQUOR VIA NEW LIFT STATION NO. 2 TO NEW WWTP.
5. DRAIN AND TRANSFER REMAINING PLANT LIQUID FOLLOWING NEW WWTP STARTUP.
6. SITE ACCESS HEIGHT RESTRICTION OF 13'-6" DUE TO OVERHEAD ELECTRICAL LINES.
7. EXISTING EFFLUENT LINES EXTENDING FROM PLANT TO EACH POND SHALL BE FULLY REMOVED.
8. ALL DEMOLITION PHOTOGRAPHS ILLUSTRATE MAJOR PIPING, ELECTRICAL EQUIPMENT AND STRUCTURES ONLY. ANY OTHER PIPING NOT SHOWN IN THESE PHOTOGRAPHS SHALL ALSO BE DEMOLISHED AND REMOVED FROM SITE.
9. EXISTING WWTF SHALL REMAIN OPERATIONAL UNTIL THE NEW LIFT STATION IS OPERATIONAL AND ACCEPTED BY THE OWNER.
10. ALL CONDUCTORS, CABLES, ETC. SHALL BE DEMOLISHED BACK TO THEIR SOURCE OR ORIGIN. ALL EXISTING EQUIPMENT TO BE DEMOLISHED SHALL BE DE-ENERGIZED PRIOR TO DISCONNECTION AND REMOVAL FROM THE SITE.
11. DEMOLITION SHALL INCLUDE THE DISCONNECTION OF ELECTRICAL SERVICE TO THE WWTF. CONTRACTOR SHALL COORDINATE WITH THE OWNER AND THE UTILITY (CLAY ELECTRIC) FOR THE REMOVAL OF UTILITY SERVICE. SERVICE POWER POLE SHALL NOT BE REMOVED UNLESS APPROVED BY THE OWNER AND THE UTILITY.

LEGEND

EXISTING PONDS TO BE FILLED

0 10' 20'

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COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

DREAM INN WWTF - DEMOLITION PLAN

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
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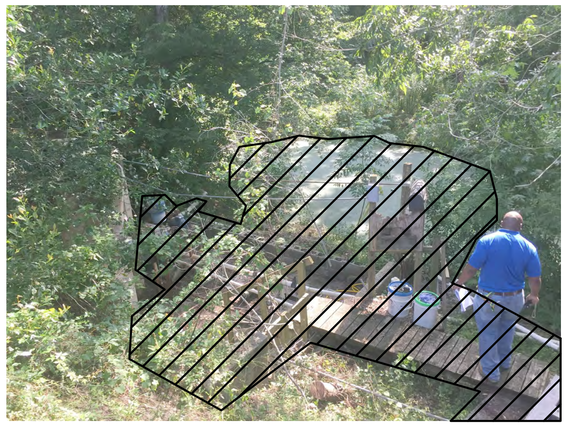


FIGURE 1

DEMOLISH AND REMOVE. FILL AND COMPACT IMPORTED SOIL TO MATCH EXISTING GRADE.

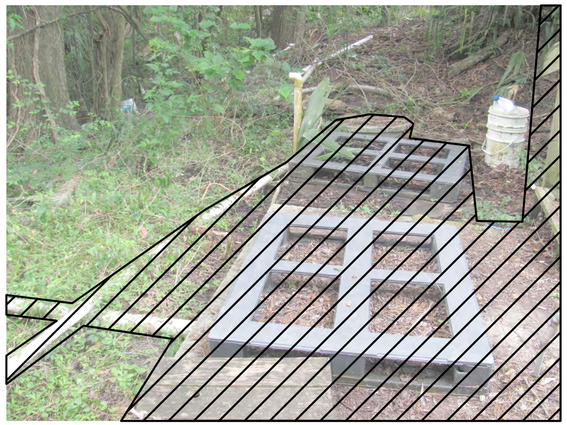


FIGURE 2

DEMOLISH AND REMOVE EXISTING CONCRETE TANKS LIDS AND PIPING. FILL AND COMPACT IMPORTED SOIL TO MATCH EXISTING GRADE.



FIGURE 3

DEMOLISH AND REMOVE ALL PIPING, ELECTRICAL EQUIPMENT, CMU WALL, TOP OF CONCRETE TANKS. FILL AND COMPACT IMPORTED SOIL TO MATCH EXISTING GRADE.

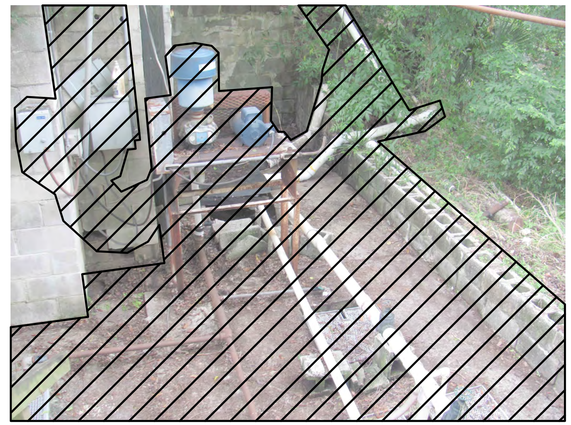


FIGURE 4

DEMOLISH AND REMOVE ALL PIPING, ELECTRICAL EQUIPMENT, TOP OF CONCRETE TANKS. FILL AND COMPACT IMPORTED SOIL TO MATCH EXISTING GRADE.

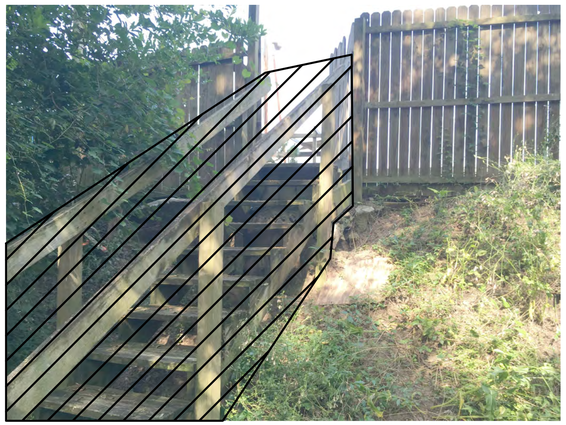


FIGURE 5

DEMOLISH AND REMOVE EXISTING STAIRWAY. FILL AND COMPACT IMPORTED SOIL TO MATCH EXISTING GRADE.

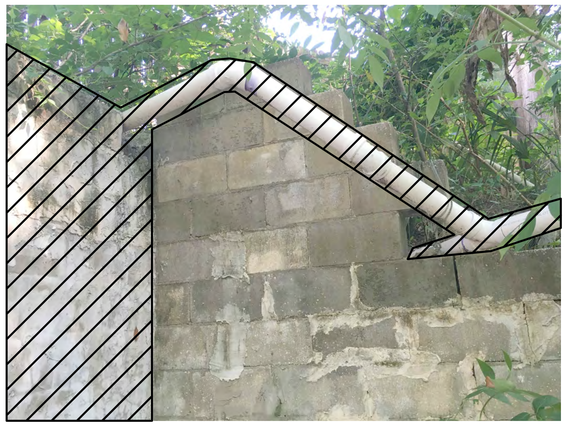


FIGURE 6

DEMOLISH AND REMOVE ALL EXISTING PIPING. ANY CMU USED AS RETAINING WALL TO REMAIN. FILL AND COMPACT IMPORTED SOIL TO MATCH EXISTING GRADE.

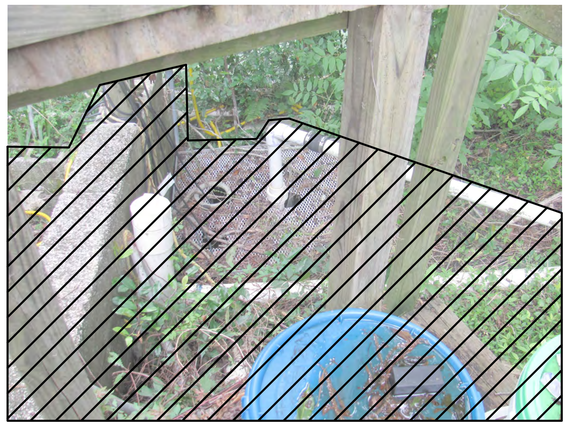


FIGURE 7

DEMOLISH AND REMOVE TANK GRATING AND PIPING. FILL AND COMPACT IMPORTED SOIL TO MATCH EXISTING GRADE.



FIGURE 8

DEMOLISH AND REMOVE CMU WALL, STAIRWAY, AND PIPING. FILL AND COMPACT IMPORTED SOIL TO MATCH EXISTING GRADE.

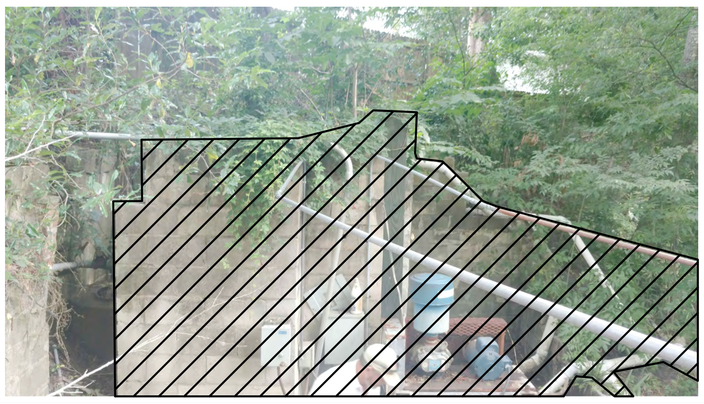


FIGURE 9

DEMOLISH AND REMOVE ALL EXISTING PIPING, TANKS AND ELECTRICAL EQUIPMENT. ANY CMU WALL USED AS RETAINING WALL TO REMAIN. FILL AND COMPACT IMPORTED SOIL TO MATCH EXISTING GRADE AS NEEDED.

CITY: DIV/GROUP; DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CAD\DA\CAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\02-CIVIL\C-18.dwg LAYOUT: C-18 SAVED: 9/18/2016 8:31 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:17 AM BY: NEGRON-VIEIRA, VANESSA

0 10' 20'

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No.	Date	Revisions	By	Ckd

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Professional Engineer's Name: SEAN K. CHAPARRO, P.E.
Professional Engineer's No.: 75865

State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
JAR	VNV	DAO

SEAN K. CHAPARRO
P.E. NO. 75865

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

DREAM INN WWTF - DEMOLITION FIGURES

ARCADIS Project No.
06704010.0000

Date
OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

C-18

GENERAL

G–1 THESE NOTES ARE GENERAL AND SUPPLEMENTAL TO THE SPECIFICATIONS. THESE NOTES APPLY TO THE ENTIRE PROJECT UNLESS MODIFIED OR NOTED OTHERWISE IN THE CONTRACT DOCUMENTS.

G–2 TYPICAL DETAILS, SHOWN ON DRAWING S–05 SHALL BE USED WHEN REFERRED TO, OR WHEN NO DETAILS ARE SHOWN ON THE DRAWINGS.

G–3 DESIGN IS IN ACCORDANCE WITH AND CONSTRUCTION SHALL COMPLY WITH THE 2014 FLORIDA BUILDING CODE (5TH EDITION) EXCEPT WHERE OTHER APPLICABLE CODES AND THE CONTRACT DOCUMENTS ARE MORE RESTRICTIVE.

G–4 LIVE LOADS:
FLOOR LIVE LOAD = 250 PSF
STAIRS, WALKWAYS,
ELEVATED PLATFORMS: 100 PSF (U.O.N.)
PLATFORMS WITH EQUIPMENT: 150 PSF (U.O.N.)

G–5 WIND DESIGN:
ULTIMATE DESIGN WIND SPEED = 130 MPH
EXPOSURE CATEGORY = C
RISK CATEGORY = III
ENCLOSURE CLASSIFICATION = N/A

G–6 ALL DIMENSIONS INDICATED (*) ARE TO BE VERIFIED EITHER BY FIELD MEASUREMENTS FOR EXISTING STRUCTURES OR BY SHOP DRAWINGS FOR EQUIPMENT FURNISHED. STRUCTURAL DIMENSIONS NOT SHOWN BUT CONTROLLED BY OR RELATED TO EQUIPMENT SHALL BE VERIFIED BY THE CONTRACTOR WITH THE MANUFACTURER PRIOR TO CONSTRUCTION.

G–7 EQUIPMENT ANCHOR BOLT SIZES, TYPES, AND PATTERNS SHALL BE VERIFIED WITH THE MANUFACTURER. ALL BOLT PATTERNS SHALL BE TEMPLATED TO INSURE ACCURACY OF PLACEMENT.

G–8 STRUCTURAL DRAWINGS SHALL BE USED IN COORDINATION WITH DRAWINGS OF ALL OTHER DISCIPLINES AND MANUFACTURER'S SHOP DRAWINGS.

G–9 IF A CONFLICT IS FOUND BETWEEN DIFFERENT PORTIONS OF THE CONTRACT DOCUMENTS, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY. CONTINUED CONSTRUCTION OF THE AREA IN CONFLICT SHALL BE AT THE CONTRACTOR'S OWN RISK UNTIL THE CONFLICT IS RESOLVED BY THE ENGINEER.

G–10 STRUCTURES HAVE BEEN DESIGNED FOR OPERATIONAL LOADS ON THE COMPLETED STRUCTURE. DURING CONSTRUCTION, THE STRUCTURES SHALL BE PROTECTED BY BRACING AND TEMPORARY SUPPORTS WHEREVER EXCESSIVE CONSTRUCTION LOADS MAY OCCUR. OVERSTRESSING OF ANY STRUCTURAL ELEMENT IS PROHIBITED.

G–11 NO BACKFILL SHALL BE PLACED AGAINST ANY WALL UNLESS ALL SUPPORTING ELEMENTS OF THE STRUCTURE HAVE BEEN CONSTRUCTED AND HAVE REACHED THE SPECIFIED MINIMUM CONCRETE STRENGTH.

G–12 NO COLD WEATHER CONSTRUCTION OR HOT WEATHER CONSTRUCTION, AS DEFINED IN SPECIFICATIONS, IS PERMITTED WITHOUT WRITTEN APPROVAL OF THE ENGINEER.

G–13 OPENINGS AND PENETRATIONS:
THE CONTRACTOR SHALL SUBMIT COMPOSITE DRAWINGS INDICATING ALL FLOOR OPENINGS AND PENETRATIONS THROUGH STRUCTURAL MEMBERS REQUIRED TO ACCOMMODATE ALL OTHER WORK. THE CONTRACTOR SHALL FOLLOW THE TYPICAL FRAMING DETAILS AT OPENINGS AND REINFORCEMENT DETAILS AT PENETRATIONS THROUGH STRUCTURAL MEMBERS. ACCORDINGLY, THE CONTRACTOR SHALL SUBMIT SHOP DETAILS TO THE ENGINEER FOR REVIEW.

FOUNDATIONS

F–1 ALL FOUNDATION WORK SHALL BE PER GEOTECHNICAL ENGINEERING REPORT FOR ELLISVILLE WWTP – NEW WATER STORAGE STRUCTURES, ISSUED BY CAL–TECH TESTING, INC.

F–2 FOUNDATION WORK SHALL FOLLOW THE PROCEDURES RECOMMENDED IN THE GEOTECHNICAL REPORT.

F–3 THE CONTRACTOR SHALL PROVIDE ADEQUATE PROTECTION TO EXISTING UNDERGROUND UTILITIES. VERIFY UTILITIES LOCATION BEFORE PROCEEDING WITH FOUNDATION EXCAVATION.

F–4 ALL CONSTRUCTION OPERATIONS DEALING WITH EARTHWORK SHALL BE INSPECTED BY AN EXPERIENCED GEOTECHNICAL ENGINEER OR TECHNICIAN APPROVED BY THE COUNTY AND AT THE CONTRACTOR'S EXPENSE.

F–5 SLAB AND FOUNDATIONS PARAMETERS:
A) UNIT WEIGHT OF BACKFILL = 110 PSF
B) UNIT WEIGHT OF BACKFILL = 47 PSF (BUOYANT)
C) MINIMUM DEPTH OF FOUNDATION BEARING = 16" BELOW GRADE
D) MAXIMUM ALLOWABLE NET SOIL PRESSURE = 2500 PSF
E) MODULUS OF SUBGRADE REACTIONS FOR SLABS–ON–GRADE = 100 PSI/IN

F–6 COMPACTED #57 STONE AND COMPACTED EXCAVATION BOTTOM AS SHOWN ON THE DRAWINGS SHALL BE UNDER THE ENTIRE FOUNDATION FOOTPRINT.

CONCRETE

C–1 CONCRETE 28–DAY COMPRESSIVE STRENGTH: 4000 PSI

C–2 REINFORCEMENT: ASTM A615, GRADE 60, OR ASTM A706, GRADE 60 WHERE REINFORCEMENT IS TO BE WELDED.

C–3 CONCRETE COVER FOR REINFORCING:

A)	SURFACES CAST AGAINST SUBGRADE	3" MIN
B)	TOP SURFACES OF SLABS WHERE PVC WATERSTOP IS REQUIRED IN WALLS	3" MIN
C)	FORMED SURFACES IN CONTACT WITH WEATHER, SOIL, OR LIQUID	2" MIN
D)	BOTTOM SURFACES OF SLABS OVER LIQUID	2" MIN
E)	SURFACES NOT IN CONTACT WITH WEATHER, SOIL, OR LIQUID	1 1/2" MIN

C–4 CONSTRUCTION JOINTS SHALL BE LOCATED AS SHOWN ON THE DRAWINGS. WHERE NOT SHOWN, CONSTRUCTION JOINTS SHALL BE LOCATED AT NO MORE THAN 40' ON CENTER. CONSTRUCTION JOINT LOCATIONS SHALL BE AS APPROVED BY THE ENGINEER.

C–5 EQUIPMENT SUPPORTS, ANCHORAGES, OPENINGS, RECESSES AND REVEALS NOT SHOWN ON THE STRUCTURAL DRAWINGS BUT REQUIRED BY OTHER CONTRACT DOCUMENTS, SHALL BE PROVIDED FOR PRIOR TO PLACING CONCRETE.

C–6 AT ALL TYPICAL CURBS, EQUIPMENT PADS, AND PIPE SUPPORT PIERS, REINFORCING DOWELS SHOWN MAY BE REPLACED WITH MATCHING DOWELS SET IN EPOXY IN DRILLED HOLES AS SPECIFIED. DOWELS LOCATED CLOSER THAN 3" FROM ANY EDGE OF CONCRETE SHALL NOT BE REPLACED WITH DRILLED DOWELS.

C–7 WHERE DRILLED EPOXY DOWELS ARE SHOWN TO BE PLACED INTO HARDENED CONCRETE, ADJUST THE DOWEL LOCATIONS AS NEEDED TO AVOID DRILLING THROUGH ANY REINFORCING BARS. IF THE DOWEL LOCATION NEEDS TO BE MODIFIED, CONTACT THE ENGINEER.

C–8 WHERE HORIZONTAL CONSTRUCTION JOINTS, LOCATED ABOVE THE FOUNDATION SLAB, EXTEND BEYOND WHERE NEEDED, THEY SHALL BE TERMINATED AT A VERTICAL CONSTRUCTION JOINT AS APPROVED BY THE ENGINEER.

C–9 DOWELS, ANCHOR BOLTS, PIPES, AND OTHER EMBEDDED ITEMS SHALL BE HELD SECURELY IN POSITION WHILE CONCRETE IS BEING PLACED.

C–10 CONDUITS AND PIPES SHALL NOT BE EMBEDDED IN OR PASS THROUGH COLUMNS OR BEAMS UNLESS INDICATED OTHERWISE OR AUTHORIZED BY ENGINEER.

C–11 ALL EXPOSED CORNERS SHALL HAVE A 3/4" CHAMFER OR A 1/2" RADIUS TOOLED CORNER.

C–12 LAP SPLICES SHALL BE IN ACCORDANCE WITH THE TABLE SHOWN ON THIS DRAWING.

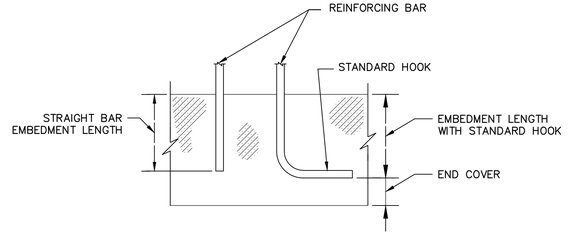
ABBREVIATIONS

AB	ANCHOR BOLTS
ADD'L	ADDITIONAL
AL	ALUMINUM
ALT	ALTERNATE
APPROX	APPROXIMATE
ARCH	ARCHITECTURAL
BAL	BALANCE
BL	BUILDING LINE
BLDG	BUILDING
BM	BEAM
BOT	BOTTOM
BRG	BEARING
C	CHANNEL STRUCTURAL SHAPE
CANT'L	CANTILEVER
CJ	CONSTRUCTION JOINT
CL	CLEAR
COL	COLUMN
COMP	COMPRESSIBLE
CONC	CONCRETE
CONN	CONNECTION
CONST	CONSTRUCTION
CONT	CONTINUOUS
CSTG	CASTING
C/C	CENTER TO CENTER
CTR	CENTER
DET	DETAIL
DIA	DIAMETER
DIAG	DIAGONAL
DIM	DIMENSION
DL	DEAD LOAD
DN	DOWN
DP	DEEP
DWG	DRAWING
DWL	DOWEL
E	EAST
EA	EACH
EF	EACH FACE
EJ	EXPANSION JOINT
EL	ELEVATION
ELEC	ELECTRICAL
EMB	EMBEDMENT
ENCL	ENCLOSURE
EQ	EQUAL
EQUIP	EQUIPMENT
ES	EACH SIDE
EW	EACH WAY
EW T&B	EACH WAY TOP & BOTTOM
EXIST	EXISTING
EXP	EXPANSION
EXT	EXTERIOR
FB	FLOOR BEAM
FDN	FOUNDATION
FF	FAR FACE
FIN	FINISH
FL	FLOOR
FTG	FOOTING
GA	GAUGE
GALV	GALVANIZE
GB	GRADE BEAM
GD	GRADE
GRTG	GRATING
H	HIGH
HT	HEIGHT
HORZ	HORIZONTAL
HP	HIGH POINT
HS	HIGH STRENGTH
HSS	HOLLOW STRUCTURAL SECTION
ID	INSIDE DIAMETER
IF	INSIDE FACE
INV	INVERT
JT	JOINT
L	ANGLE (STRUCTURAL SHAPE)
LL	LIVE LOAD
LLH	LONG LEG HORIZ
LLV	LONG LEG VERT
LOC	LOCATION
LP	LOW POINT
LW	LONG WAY
MAX	MAXIMUM
MECH	MECHANICAL
MFR	MANUFACTURE, MANUFACTURER
MH	MANHOLE
MID	MIDDLE
MIN	MINIMUM
N	NORTH
NF	NEAR FACE
#	NUMBER
NTS	NOT TO SCALE
OC	ON CENTER
OD	OUTSIDE DIAMETER
OF	OUTSIDE FACE
OPNG	OPENING
OPP	OPPOSITE
PC	PRECAST CONCRETE
PL	PLATE
PSF	POUNDS PER SQUARE FOOT
PVC	POLYVINYL CHLORIDE
R	RADIUS, RISER
REINF	REINFORCEMENT
REQD	REQUIRED
RM	ROOM
RO	ROUGH OPENING
S	SOUTH
SECT	SECTION
SH	SHEET
SIM	SIMILAR
SL	SLAB
SPEC	SPECIFICATION
SQ	SQUARE
SS	STAINLESS STEEL
STD	STANDARD
STIR	STIRRUP
STL	STEEL
STRUCT	STRUCTURAL
SW	SHORT WAY
T&B	TOP AND BOTTOM
TOC	TOP OF CONCRETE
THK	THICK
T/	TOP OF
T	TREAD
TYP	TYPICAL
UON	UNLESS OTHERWISE NOTED
VERT	VERTICAL
W/	WITH
WP	WORKING POINT
WS	WATERSTOP
WWF	WELDED WIRE FABRIC

REINFORCING LAP SPLICE & EMBEDMENT LENGTH

BAR SIZE	MIN LAP LENGTH (IN) TOP BARS CLASS A	MIN LAP LENGTH (IN) TOP BARS CLASS B	MIN LAP LENGTH (IN) OTHER BARS CLASS A	MIN LAP LENGTH (IN) OTHER BARS CLASS B	MIN EMBEDMENT LENGTH (IN) STRAIGHT BARS TOP BARS	MIN EMBEDMENT LENGTH (IN) STRAIGHT BARS OTHER BARS	MIN EMBEDMENT LENGTH (IN) WITH STD HOOK
SLABS & WALLS WITH 2" + COVER							
#3	16	21	12	16	16	12	6
#4	16	21	12	16	16	12	7
#5	20	25	15	19	20	15	9
#6	24	30	18	23	24	18	10
#7	33	43	25	33	33	25	12
#8	38	49	29	37	38	29	14
#9	49	63	37	48	49	37	15
#10	60	78	46	60	60	46	17
#11	75	97	57	74	75	57	19
SLABS & WALLS WITH < 2" COVER							
#3	16	21	12	16	16	12	8
#4	16	21	12	16	16	12	10
#5	20	25	15	19	20	15	12
#6	24	30	18	23	24	18	15
#7	38	49	29	37	38	29	17
#8	47	62	36	47	47	36	19
#9	58	76	44	58	58	44	22
#10	71	91	54	70	71	54	25
#11	85	110	65	84	85	65	27
BEAMS & COLUMNS WITH 3.75" CLEAR SPACING **							
#3	16	21	12	16	16	12	6
#4	16	21	12	16	16	12	7
#5	20	25	15	19	20	15	9
#6	24	30	18	23	24	18	10
#7	33	43	25	33	33	25	12
#8	39	51	30	39	39	30	14
#9	50	64	38	49	50	38	15
#10	60	78	46	60	60	46	17
#11	72	94	55	72	72	55	19

** FOR BAR CLEAR SPACING LESS THAN 3.75", ADD 46%
FOR BAR CLEAR SPACING LESS THAN 2.25", ADD 104%



NOTES:

1. NOTES FOR SPLICE AND EMBEDMENT TABLE:
   A. THE MINIMUM LENGTH OF LAPS FOR SPLICES SHALL BE AS GIVEN IN THE TABLE FOR CLASS "B" LAPS UNLESS SHOWN OTHERWISE ON THE DRAWINGS. PROVIDE CLASS "A" LAPS ONLY WHERE NOTED ON THE DRAWINGS.
   B. THE SPLICE AND EMBEDMENT LENGTHS FOR WALLS AND SLABS ARE BASED ON A 5" MINIMUM ON CENTER BAR SPACING. SEE THE DRAWINGS FOR SPLICE AND EMBEDMENT WHERE BARS ARE SPACED CLOSER THAN 5".
   C. HOOK EMBEDMENTS APPLY ONLY WHERE THE SIDE COVER (NORMAL TO THE HOOK PLANE) IS AT LEAST 2.5". THE COVERS REFERENCED ON THE TABLE ARE FROM THE HOOK EXTENSION TO THE FACE OF THE CONCRETE.
   D. THE TABLE DOES NOT APPLY TO LIGHTWEIGHT CONCRETE OR EPOXY COATED REINFORCING BARS. SEE ACI 318 FOR APPROPRIATE ADDITIONAL MULTIPLIERS FOR THOSE CASES.
2. WHERE SPLICES ARE REQUIRED BETWEEN BARS OF DIFFERENT SIZES, THE LAP LENGTH SHALL BE NO LESS THAN THE EMBEDMENT LENGTH OF THE LARGER BAR OR THE LAP LENGTH OF THE SMALLER BAR, WHICHEVER IS GREATER.
3. VERTICAL REINFORCEMENT FOR CONCRETE SHALL BE SPLICED WITH DOWEL BARS OF THE SAME SIZE AND SPACING FROM THE FOUNDATION USING A STANDARD SPLICE LENGTH.
4. DOWELS SHOWN EXTENDING FROM PREVIOUSLY PLACED CONCRETE SHALL EXTEND ONE SPLICE LENGTH BEYOND THE JOINT, UNLESS DIMENSIONED OTHERWISE. WHERE A DIMENSION IS PROVIDED, THE BAR SPLICING TO THE DOWEL SHALL END ONE SPLICE LENGTH FROM THE END OF THE DOWEL.

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Professional Engineer's Name: ADARSH B. SHAH, P.E.
Professional Engineer's No.: 79948

State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
ABS	KAK	DAO

ADARSH B. SHAH
P.E. NO. 79948

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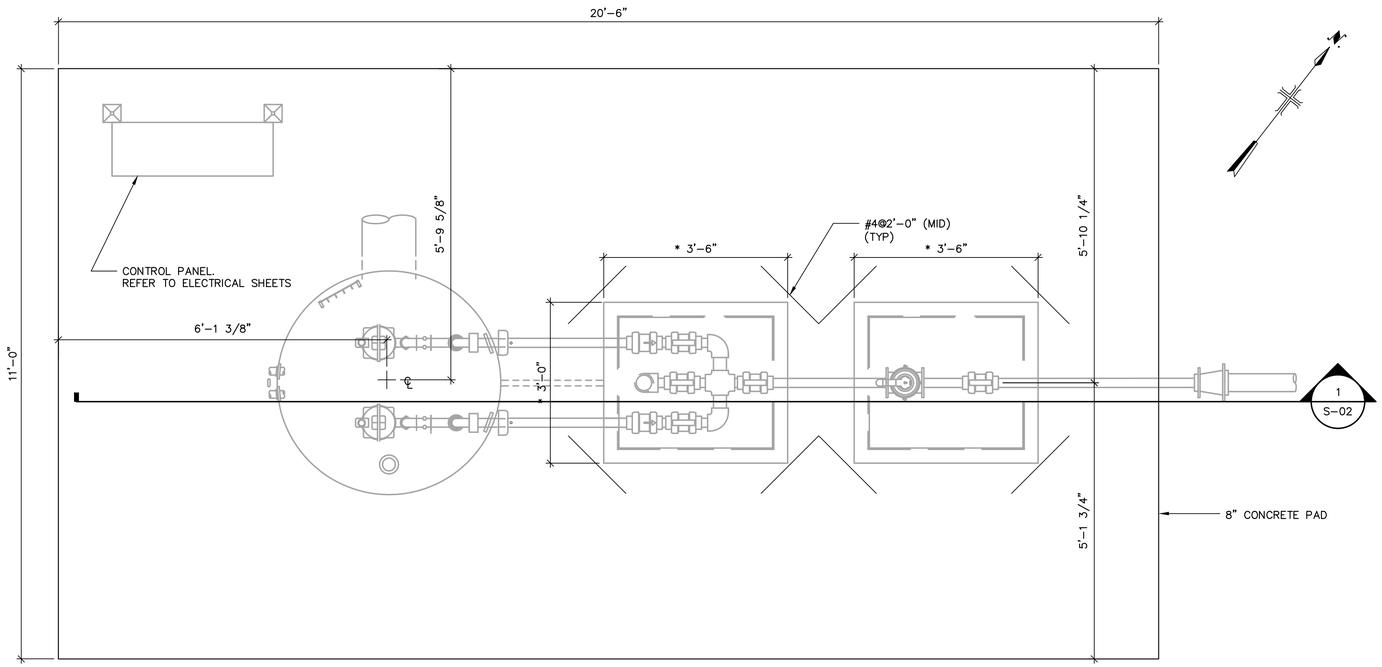
COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

STRUCTURAL NOTES, LEGEND & ABBREVIATIONS

ARCADIS Project No.
06704010.0000
Date
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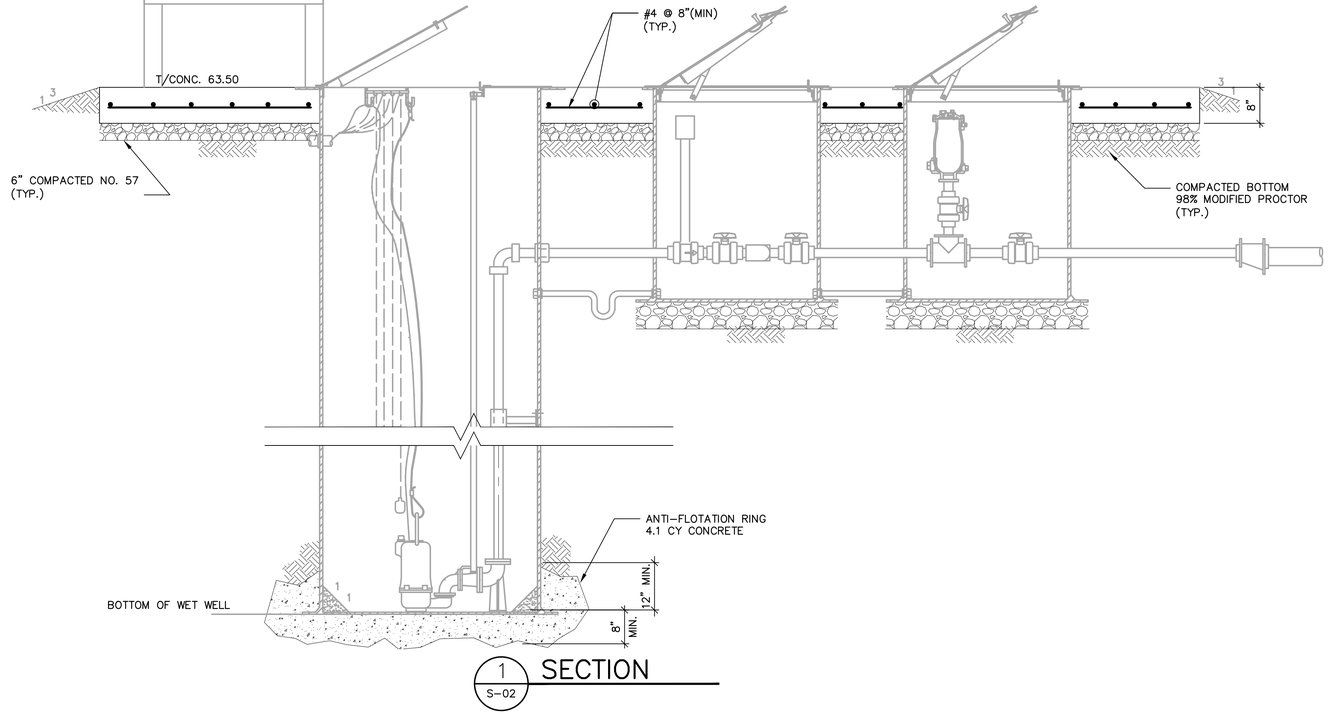
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TAMPA, FLORIDA 33607
TEL. 813.903.3125

S-01



PLAN

SCALE: 3/4" = 1'-0"



1 S-02 SECTION

NOTE:
1. ALLOWABLE BEARING PRESSURE = 2500 PSF.

0 1' 2' 3'

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Professional Engineer's Name: ADARSH B. SHAH, P.E.
Professional Engineer's No.: 79948

State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
VV	KAK	TRM

ADARSH B. SHAH
P.E. NO. 79948

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COLUMBIA COUNTY, FLORIDA
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LIFT STATION NO. 1 - PLAN & SECTION

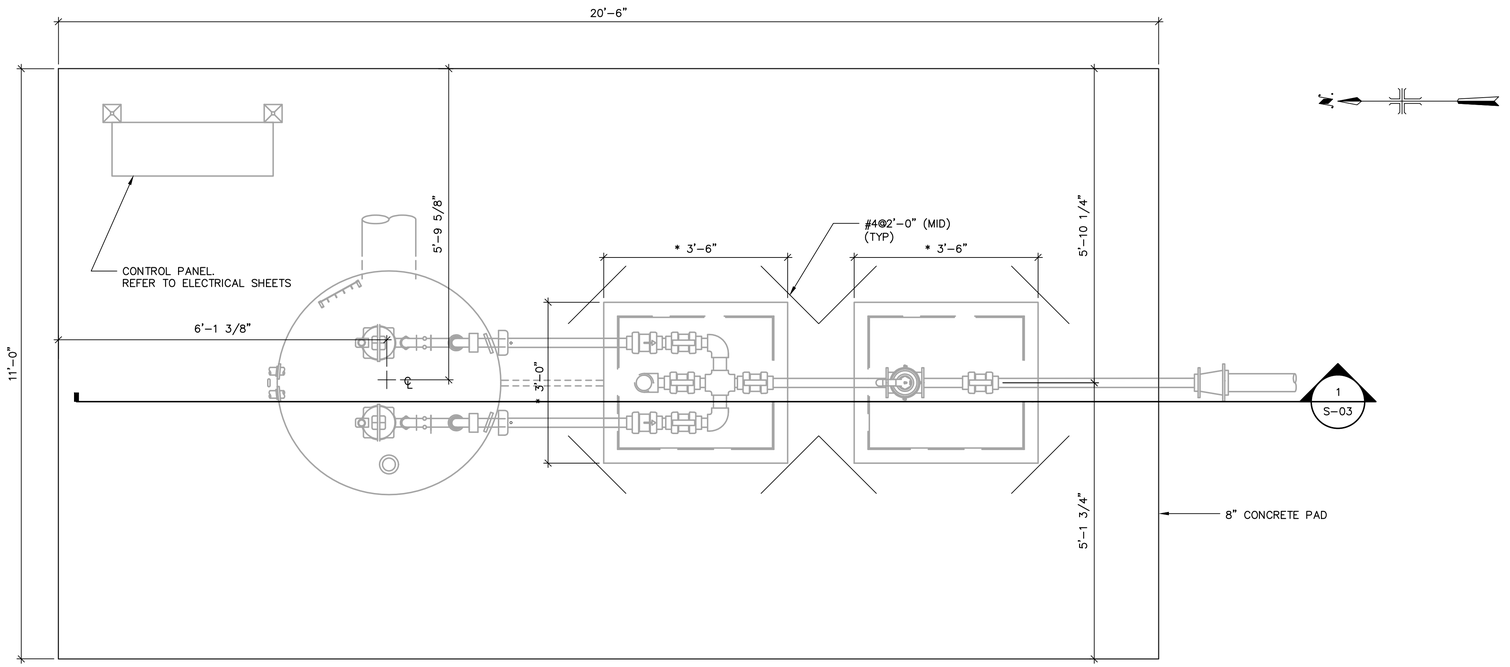
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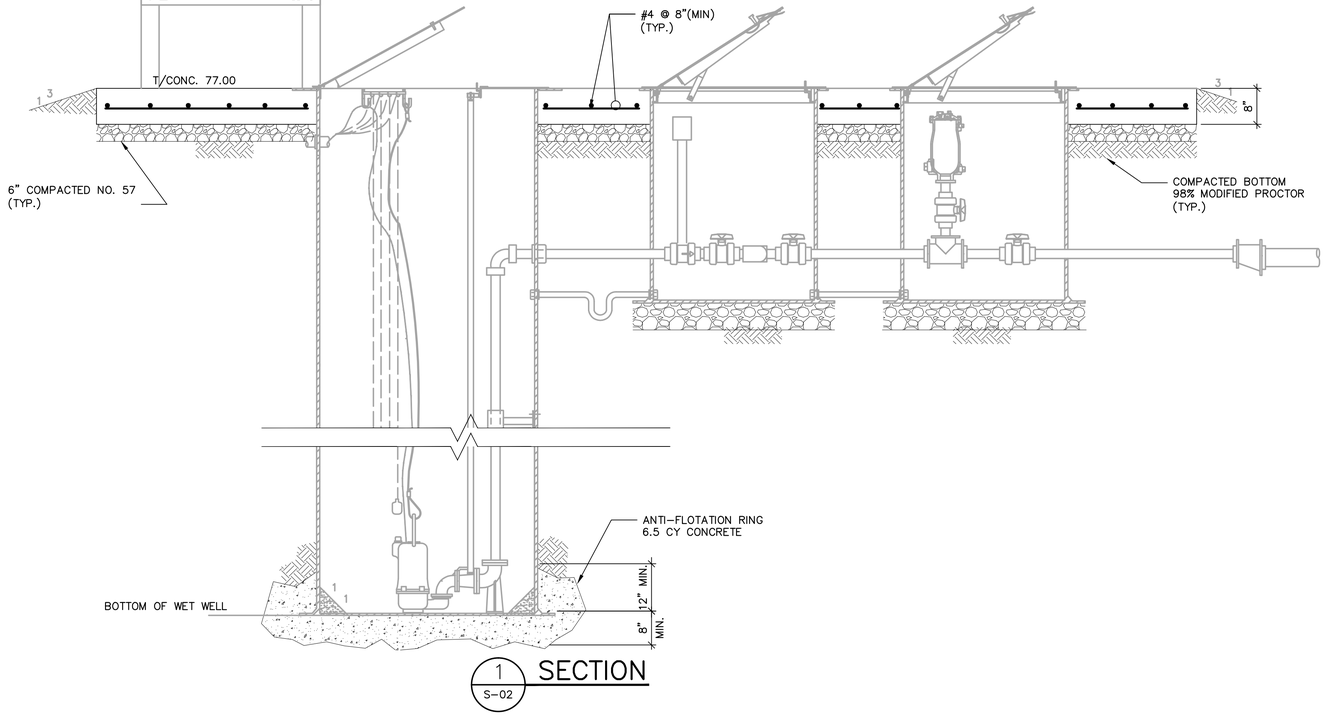
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PLAN

SCALE: 3/4" = 1'-0"



1 S-02 SECTION

NOTE:
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Professional Engineer's Name: ADARSH B. SHAH, P.E.		
Professional Engineer's No.: 79948		
State: FL	Date Signed:	Project Mgr.: SKC
Designed by: VV	Drawn by: KAK	Checked by: DAO

ADARSH B. SHAH
P.E. NO. 79948

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COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

LIFT STATION NO. 2 - PLAN & SECTION

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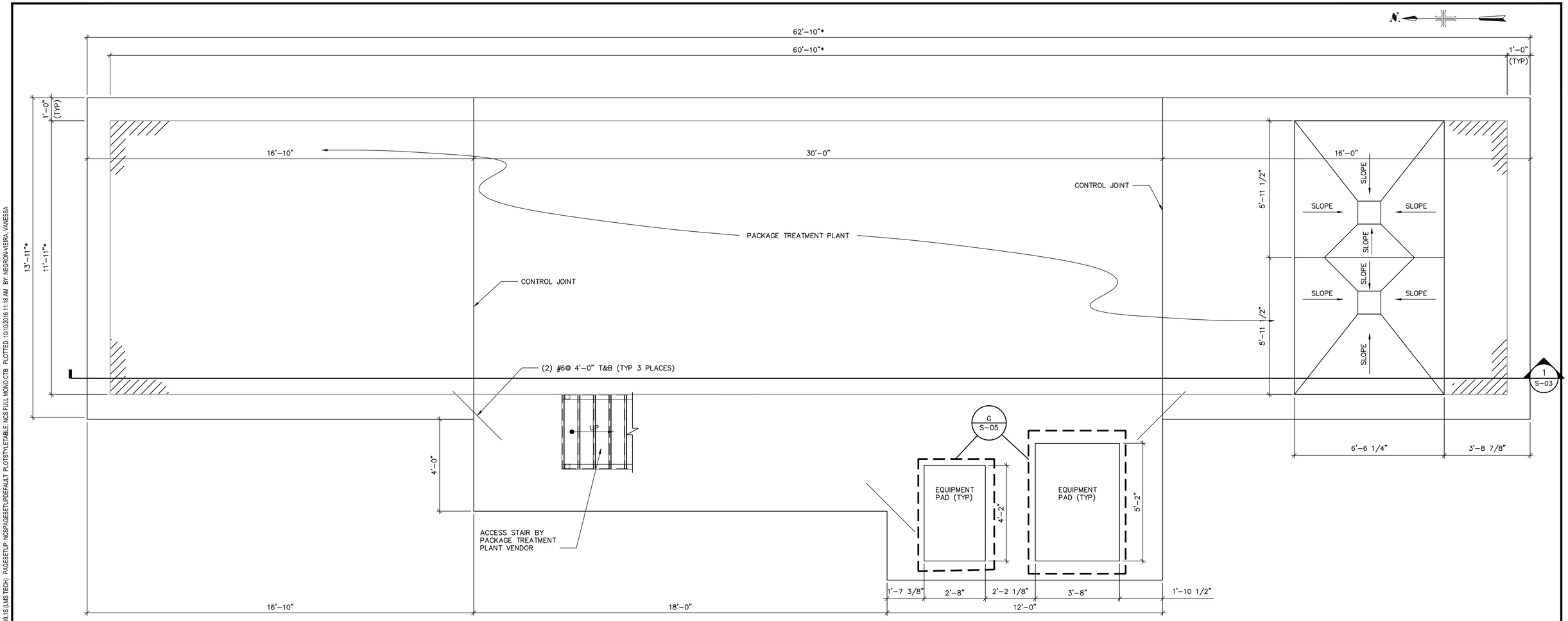
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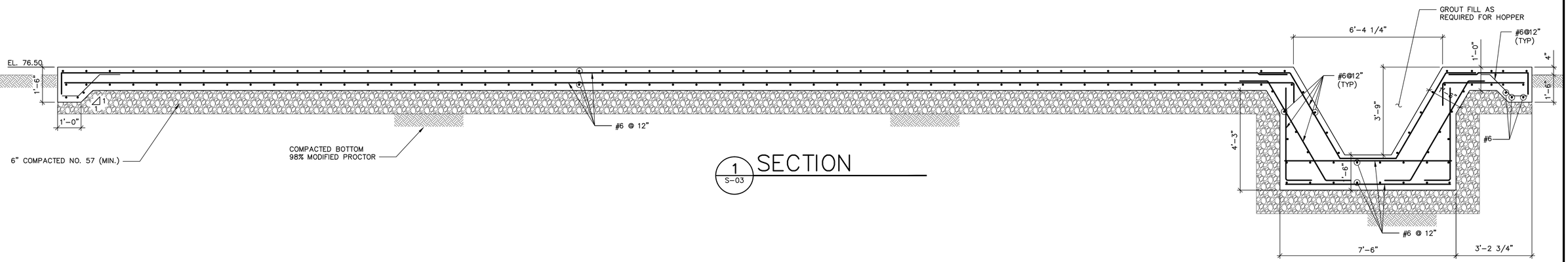
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FOUNDATION PLAN

NOTE:
1. ALLOWABLE BEARING PRESSURE = 2500 PSF



1 S-03 SECTION

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Professional Engineer's Name: ADARSH B. SHAH, P.E.		
Professional Engineer's No.: 79948		
State: FL	Date Signed:	Project Mgr.: SKC
Designed by: VV	Drawn by: KAK	Checked by: ABS

ADARSH B. SHAH
P.E. NO. 79948

ORIGINAL SIGNED AND SEALED SHEET ON FILE

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ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

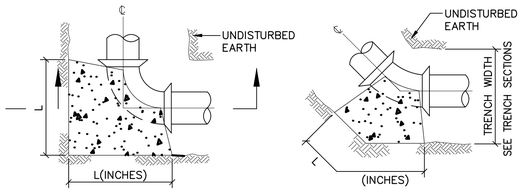
WASTEWATER TREATMENT PLANT - FOUNDATION PLAN & SECTION

ARCADIS Project No.
06704010.0000

Date
OCTOBER 2016

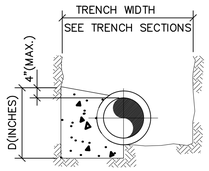
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S-04



PLAN 90° BENDS

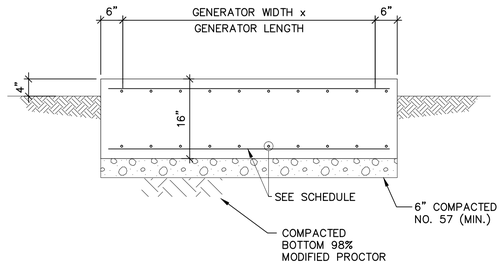
PLAN (BENDS LESS THAN 90°) AND SECTION (VERT. SAG)



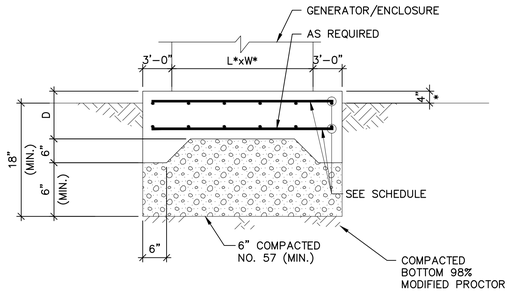
SECTION

SIZE OF RUN	DEGREE OF BEND							
	11 1/4°		22 1/2°		45°		90°	
	L	D	L	D	L	D	L	D
3"	4	3	6	4	10	4	10	4
4"	5	4	9	5	14	5	14	5
6"	8	6	12	7	20	8	18	9

A CONC. THRUST BLOCK
SCALE: NO SCALE



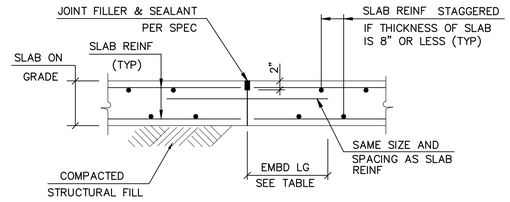
B GENERATOR PAD SECTION
SCALE: NO SCALE



C TYP. EQUIPMENT PAD SECTION
SCALE: NO SCALE

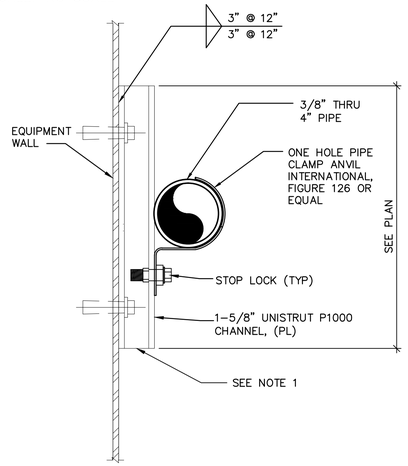
SITE EQUIPMENT SUPPORT SLAB SCHEDULE						
EQUIPMENT NAME	DIMENSIONS			REINFORCEMENT	T/ SLAB EL.	REMARKS
	L*	W*	D			
GENERATOR PAD	8'-0"	3'-4"	16"	#6@12" EW T & B	SEE CIVIL SHEETS	

NOTE:
1. REFER TO PLANS ON THIS SHEET FOR PLAN DIMENSIONS.
2. (*) INDICATES LENGTH AND WIDTH DIMENSIONS SHALL BE COORDINATED WITH EQUIPMENT AND PIPING ARRANGEMENT FURNISHED.



SECTION AT SLAB

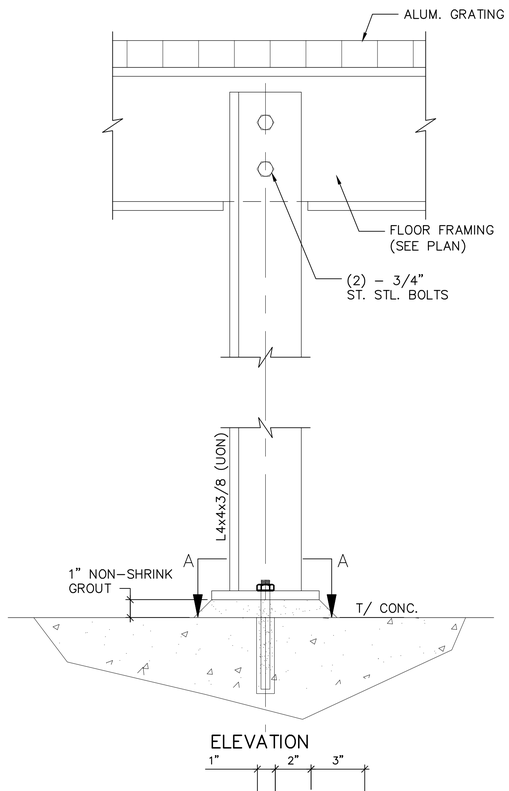
D CONTROL JOINT DETAILS
SCALE: NO SCALE



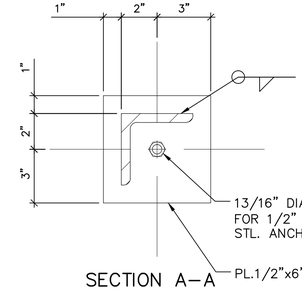
EQUIPMENT WALLS

E CONDUIT /PIPE SUPPORT DETAIL
SCALE: NO SCALE

NOTE:
1. UNISTRUT TO BE PROVIDED BY EQUIPMENT MANUFACTURER AND COATED SIMILAR TO EQUIPMENT FINISH.



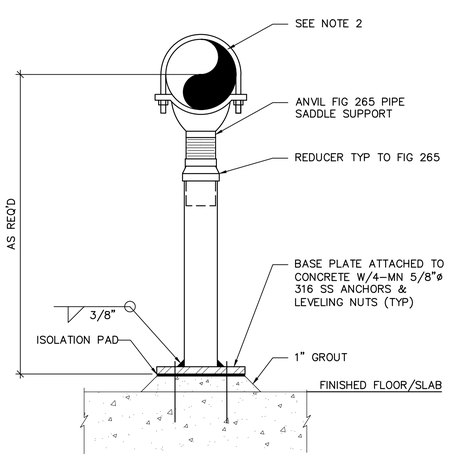
ELEVATION



SECTION A-A

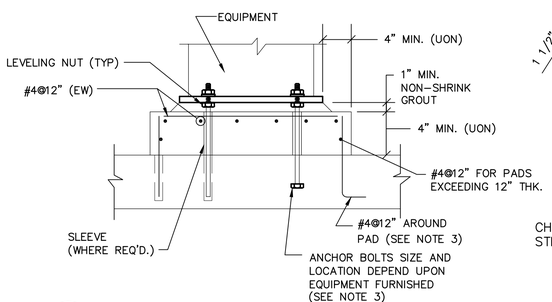
TYPICAL ANGLE POST DETAIL





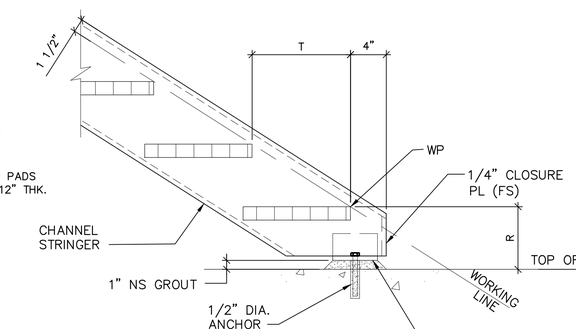
NOTES:
1. MAXIMUM RECOMMENDED LOAD: 1,500 LBS.
2. WELDED PIPE SUPPORT BRACKETS FOR SYSTEMS WEIGHING GREATER THAN 1,500 LBS: THE CONTRACTOR SHALL SUBMIT A BRACKET APPROVED BY A STRUCTURAL ENGINEER FOR REVIEW AS PER SHOP DRAWING SUBMITTAL PROCEDURES IN THE SPECIFICATIONS.
3. PROVIDE 1/8" NEOPRENE BEARING PAD.
4. PIPE SUPPORT TO BE 304 SS.

F ADJUSTABLE PIPE SUPPORT
SCALE: NO SCALE

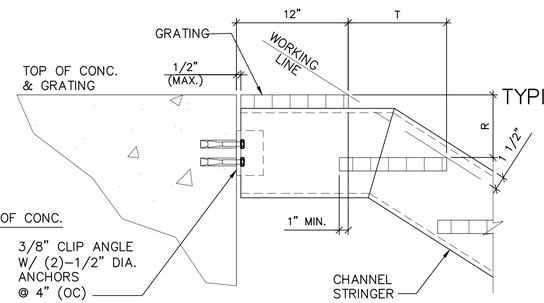


G EQUIPMENT PAD DETAIL
SCALE: NO SCALE

NOTES:
1. PROVIDE TYP. 4" MINIMUM CONCRETE SUPPORT PAD FOR ALL EQUIPMENT UNLESS OTHERWISE NOTED.
2. COORDINATE LOCATION AND SIZE OF PADS WITH OTHER DRAWINGS AND MANUFACTURER'S CERTIFIED DRAWINGS.
3. FOR EXISTING SLABS, DRILL HOLE DIAMETER AND DEPTH IN EXISTING SLAB PER MANUFACTURER'S REQUIREMENTS FOR ADHESIVE ANCHORAGE SYSTEM USED.
4. SEE ELECTRICAL SHEETS FOR OTHER SPECIFIC ELECTRICAL EQUIPMENT PAD REQUIREMENTS AND EMBEDDED ITEMS.



BOTTOM CONNECTION AT CONCRETE SUPPORT



TOP CONNECTION AT CONCRETE SUPPORT

TYPICAL METAL STAIR DETAILS



NOTES:
1. STAIR TREADS, GRATING AND STRUCTURAL SHAPES SHALL BE ALUMINUM.
2. RAILING NOT SHOWN, SEE "A" SHEETS FOR DETAILS.

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CADD\ACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\03-STRUCTURAL\S-05.dwg LAYOUT: S-05 SAVED: 7/21/2016 11:11 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:18 AM BY: NEGRON-VIEIRA, VANESSA

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Professional Engineer's Name: ADARSH B. SHAH, P.E.
Professional Engineer's No.: 79948
State: FL | Date Signed: | Project Mgr.: SKC
Designed by: JPS | Drawn by: KAK | Checked by: TRM

ADARSH B. SHAH
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ORIGINAL SIGNED AND SEALED SHEET ON FILE

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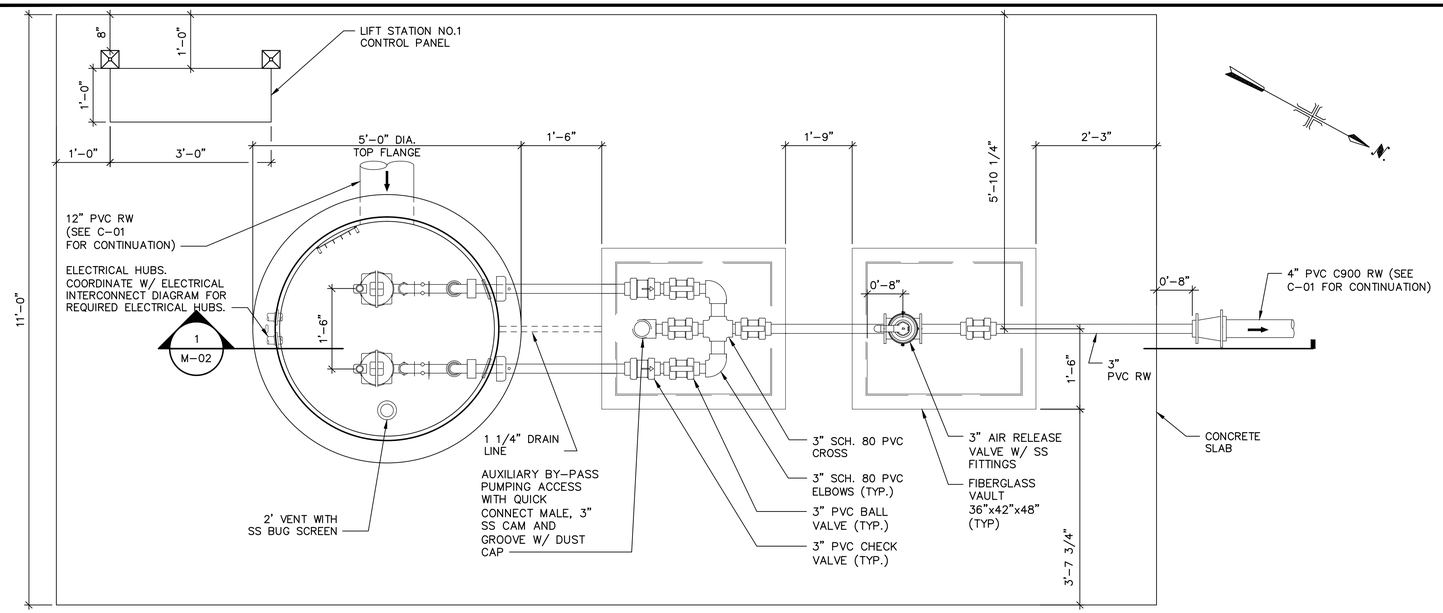
COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

TYPICAL STRUCTURAL DETAILS

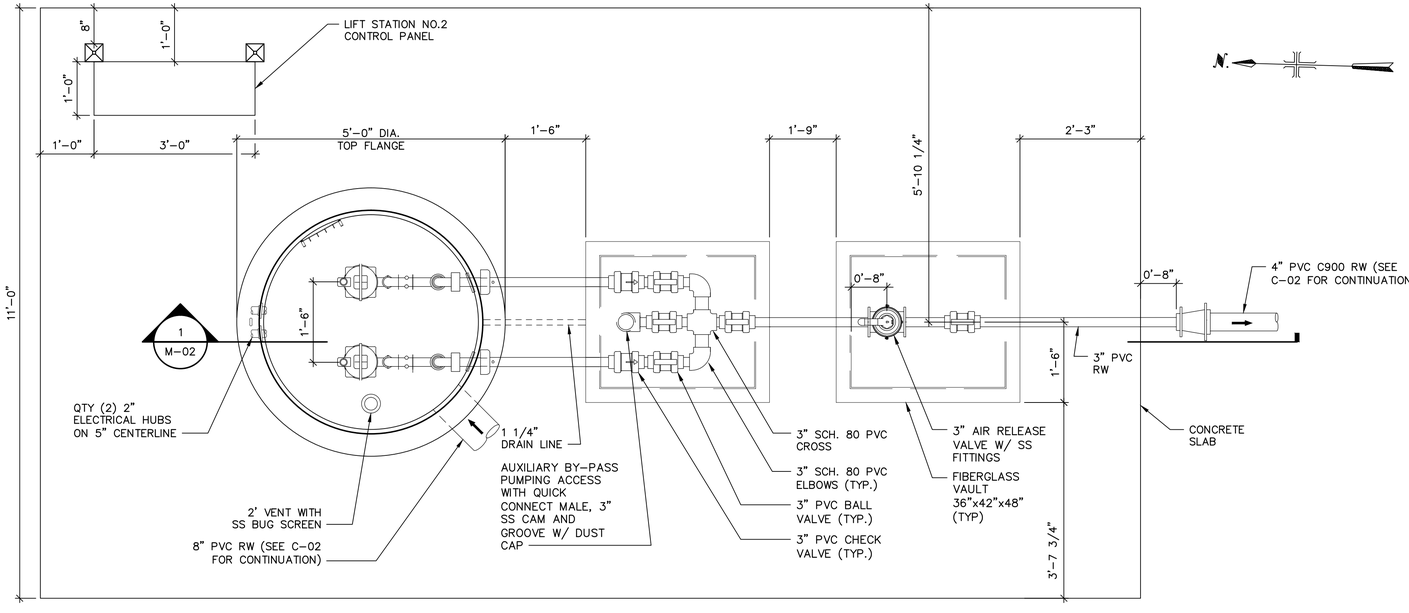
ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016

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S-05



LIFT STATION NO.1 – PLAN



LIFT STATION NO.2 – PLAN

NOTES:
1. ALL 3" DIA. AND SMALLER PVC PIPES SHALL BE SCH 80 UNLESS SPECIFIED.

GENERAL NOTES

1. CONTRACTOR SHALL FURNISH ALL LABOR, MATERIALS, EQUIPMENT AND INCIDENTALS AS SHOWN, SPECIFIED AND REQUIRED TO PROVIDE TWO DUPLEX SEMI-POSITIVE DISPLACEMENT GRINDER PUMP STATIONS COMPLETE AND OPERATIONAL WITH MOTORS, CONTROL EQUIPMENT AND ACCESSORIES AS SHOWN AND SPECIFIED.

2. MANUFACTURER SHALL HAVE A MINIMUM OF FIVE (5) YEARS EXPERIENCE PRODUCING SUBSTANTIALLY SIMILAR EQUIPMENT, AND SHALL BE ABLE TO SHOW EVIDENCE OF AT LEAST FIVE (5) INSTALLATIONS IN SATISFACTORY OPERATION FOR AT LEAST FIVE (5) YEARS. APPROVED MANUFACTURERS INCLUDE FLYGT, HYDROMATIC, ABS OR EMU.

3. THE FOLLOWING SHOP DRAWINGS SHALL BE SUBMITTED FOR REVIEW:
   - MANUFACTURER'S LITERATURE, ILLUSTRATIONS, SPECIFICATIONS AND ENGINEERING DATA.
   - WARRANTY.
   - MOTOR TESTS AND DATA.
   - INSTALLATION DRAWINGS AND REQUIREMENTS FOR GRINDER PUMP STATION.
   - FABRICATION, ASSEMBLY, CONTROL PANEL LAYOUTS, INSTALLATION AND WIRING DIAGRAMS FOR PUMP AND CONTROL PANEL.
   - REPORTS FOR RUNNING TESTS PERFORMED IN THE FIELD CERTIFYING THAT PUMP IS FULLY OPERATIONAL ACCORDING TO THE DESIGN REQUIREMENTS.

4. OBTAIN ALL LIFT STATION EQUIPMENT REGARDLESS OF THE COMPONENT MANUFACTURER FROM A SINGLE PACKAGE SUBMERSIBLE GRINDER PUMP STATION MANUFACTURER. ALL COMPONENTS SHALL BE SPECIFICALLY CONSTRUCTED FOR THE SPECIFIED SERVICE CONDITIONS AND SHALL BE INTEGRATED INTO THE OVERALL ASSEMBLY BY THE PACKAGE SUBMERSIBLE GRINDER PUMP STATION MANUFACTURER.

5. PUMP SUPPLIER SHALL PROVIDE SUBMERSIBLE GRINDER PUMPS, SLIDE RAIL ASSEMBLIES, FIBERGLASS BASIN AND VALVE BOXES, CONTROL PANEL, FLOAT SWITCHES, ALUMINUM HATCHES, AND ACCESSORIES TO ENSURE PROPER OPERATIONS AND WARRANTY. THE COMPLETE PACKAGE LIFT STATION SHALL HAVE PUMP BASES, RAIL ASSEMBLES, AND DISCHARGE PIPING ASSEMBLED READY FOR FIELD INSTALLATION.

6. DEWATER EXCAVATION DURING WET WELL INSTALLATION. CONTRACTOR TO USE TEMPORARY CHAIRS TO SUPPORT LIFT STATION OFF GROUND UNTIL FLOATATION RING IS POURED. CONTRACTOR SHALL SUPPORT TANK WALL TO PREVENT DEFLECTION DURING BACKFILLING WHICH MAY INCLUDE FILLING THE TANK WITH WATER.

7. THE PUMP SUPPLIER SHALL PROVIDE THE FIBERGLASS WET WELL WITH ALUMINUM LOCKABLE COVERS. THE GLASS FIBER-REINFORCED POLYESTER BASIN SHALL BE CONSTRUCTED OF A COMMERCIAL GRADE OF GLASS FIBER AND SHALL BE PROVIDED WITH FILLET AND ANTI-FLOATATION RING WITH A MINIMUM DIAMETER OF THREE INCHES LARGER THAN THE BASIN DIAMETER. THE RAIL SYSTEM, INTERNAL PIPING AND DISCHARGE CONNECTIONS SHALL BE PRE-INSTALLED BY THE PUMP SUPPLIER. WET WELL SHALL BE DESIGNED TO RESIST ALL PRESSURES INDUCED BY WATER, SOIL AND WHEEL LOADS WITH A MAXIMUM DEFLECTION OF ¼" INCH. ALL PIPE OPENINGS SHALL HAVE RESILIENT PIPE TO WET WELL SEALS.

8. THE GRINDER PUMPS SHALL BE CAPABLE OF GRINDING ALL MATERIALS FOUND IN NORMAL DOMESTIC SEWAGE, AS WELL AS OBJECTS SUCH AS PAPER, WOOD, PLASTIC, GLASS, AND RUBBER, TO FINELY-DEFINED PARTICLES WHICH WILL PASS FREELY THROUGH THE PASSAGES OF THE PUMP AND THE DISCHARGE PIPING.

9. EACH PUMP SHALL HAVE A STAINLESS STEEL NAMEPLATE INDICATING THE HP, AMPS, VOLTS, PHASE, RPM, SERVICE FACTOR, INSULATION CLASS, SERIAL NUMBER, MODEL NUMBER, GPM, TDH, AND IMPELLER NUMBER OR SIZE. A SELF-ADHESIVE ALUMINUM TAG SHALL BE MOUNTED INSIDE THE OUTER DOOR OF THE CONTROL CABINET FOR EACH PUMP INSTALLED. THE ALUMINUM TAG SHALL CONTAIN THE SAME INFORMATION AS THE STAINLESS STEEL NAMEPLATE.

10. THE GRINDER IMPELLER ASSEMBLY SHALL BE SECURELY FASTENED TO THE PUMP MOTOR SHAFT. THIS ASSEMBLY SHALL BE DYNAMICALLY BALANCED AND OPERATE WITHOUT OBJECTIONABLE NOISE OR VIBRATION OVER THE ENTIRE RANGE OF RECOMMENDED OPERATING PRESSURES.

11. THE GRINDER SHALL BE DIRECT-DRIVEN BY A SINGLE, ONE-PIECE STAINLESS STEEL MOTOR SHAFT. THE GRINDER WILL BE OF THE ROTATING TYPE WITH A STATIONARY HARDENED AND GROUND CHROME STEEL SHREDDING RING SPACED IN ACCURATE CLOSE ANNULAR ALIGNMENT WITH THE DRIVEN IMPELLER ASSEMBLY, WHICH SHALL CARRY TWO HARDENED TYPE 400 SERIES STAINLESS STEEL CUTTER BARS. THE GRINDER SHALL BE CONSTRUCTED SO AS TO ELIMINATE CLOGGING AND JAMMING UNDER ALL NORMAL OPERATING CONDITIONS INCLUDING STARTING. SUFFICIENT VORTEX ACTION SHALL BE CREATED TO SCOUR TANK FREE OF DEPOSITS OR SLUDGE BANKS WHICH WOULD IMPAIR THE OPERATION OF THE PUMP. THE INLET SHROUD SHALL HAVE A DIAMETER NO LESS THAN 5 INCHES. AT MAXIMUM FLOW THE AVERAGE INLET VELOCITY SHALL NOT EXCEED 0.2 FEET PER SECOND.

12. THE IMPELLER SHALL BE MULTI-VANE, SEMI-OPEN CONSTRUCTION. THE IMPELLER SHALL BE STATICALLY AND HYDRAULICALLY BALANCED. THE IMPELLER SHALL BE CONSTRUCTED OF GRAY CAST IRON, ASTM A48, CLASS 30. THE IMPELLER MECHANISM SHALL ROTATE AT A NOMINAL SPEED NO GREATER THAN 1800 RPM.

13. THE PUMP SHALL HAVE TWO MECHANICAL SEALS, MOUNTED IN TANDEM WITH AN OIL CHAMBER BETWEEN THE SEALS. THE PUMP SHALL BE EQUIPPED WITH A SEAL LEAK DETECTION PROBE AND WARNING SYSTEM BY USING A SEAL FAILURE SENSOR INSTALLED IN THE SEAL CHAMBER. THE LEADS FOR THE SENSOR(S) SHALL BE BROUGHT OUT THROUGH A WATERPROOF CONNECTION SUCH THAT THEY MAY BE INTERLOCKED WITH THE MOTOR CONTROL CIRCUIT.

14. ALL MOTORS SHALL BE BUILT IN ACCORDANCE WITH ALL CURRENT APPLICABLE STANDARDS OF NEMA, IEEE AND ANSI. MOTORS SHALL BE 10HP 3450 RPM 200V, 3 PHASE, 60 HZ, NEMA DESIGN B, WITH A SERVICE FACTOR OF 1.15. THE MOTOR SHALL BE MOUNTED IN A SEALED, SUBMERSIBLE TYPE HOUSING AND SHALL HAVE CLASS F INSULATION OR BETTER AND BE CERTIFIED AS SUCH BY THE MANUFACTURER. MOTOR SHALL BE NON-OVERLOADING FOR THE FULL RANGE OF ITS OPERATING CURVE. THE MOTOR SHALL BE CAPABLE OF A MINIMUM 10 STARTS PER HOUR. THE STATOR SHALL BE SECURELY HELD IN PLACE WITH A REMOVABLE END RING AND THREADED FASTENERS FOR EASE OF REMOVAL WITHOUT THE USE OF HEAT OR A PRESS. THE MOTOR WILL HAVE TWO HEAVY-DUTY BALL BEARINGS; ONE UPPER (RADIAL) AND ONE LOWER (THRUST) TO SUPPORT THE SHAFT. OVERTEMPERATURE CONDITIONS OF THE MOTOR STATOR WINDINGS SHALL BE SENSED BY THREE (3) BIMETALLIC THERMAL SWITCHES CONTAINED IN THE MOTOR WINDINGS. THE LEADS FOR THESE SENSORS SHALL BE BROUGHT OUT THROUGH A WATERPROOF CONNECTION SUCH THAT THEY MAY BE INTERLOCKED WITH THE MOTOR CONTROL CIRCUIT.

15. AIR RELEASE VALVES SHALL BE 2" A. R. I. D-025 THREADED COMBINATION AIR VALVE OR APPROVED EQUAL.

16. DUPLEX LIFT STATION SHALL INCLUDE A DUPLEX LIFT STATION LOCAL CONTROL PANEL (DLS-LCP). DLS-LCP SHALL BE A NEMA 4X, UL LISTED PANEL SUITABLE FOR WALL OR POLE MOUNTING WITH A HINGED, PAD LOCKABLE COVER, SECURED DEAD FRONT AND COMPONENT KNOCKOUTS. DLS-LCP CONFIGURATION SHALL BE AS SHOWN IN THE DRAWINGS AND AS SPECIFIED IN SECTION 40 60 05, INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS. DLS-LCP SHALL INCLUDE REQUIRED SWITCHES, INDICATOR LIGHTS, CONTROLLERS, ALARM HORNS, DRY CONTACTS FOR MONITORING, ETC. AS INDICATED ON SHEET I-02. THE ENCLOSURE SHALL INCLUDE A MAIN SERVICE DISCONNECT SIZED PER NEC. FOR EACH PUMP, THE DLS-LCP SHALL CONTAIN ONE (1) THREE POLE CIRCUIT BREAKER FOR THE POWER CIRCUIT, SIZED PER NEC.

16.1. THE VISUAL ALARM LAMP SHALL BE INSIDE A RED FLUTED LENS, MOUNTED TO THE TOP OF THE ENCLOSURE IN SUCH A MANNER AS TO MAINTAIN NEMA 4X RATING.

16.2. THE AUDIO ALARM SHALL BE EITHER MOUNTED ON THE INTERIOR OF THE PANEL, OR MOUNTED EXTERNALLY IN A WEATHERPROOF ENCLOSURE.

16.3. THE VISUAL ALARM AND THE AUDIO ALARM SHALL BE CAPABLE OF BEING DE-ACTIVATED AS STATED BELOW IN THE SEQUENCE OF OPERATION.

17. FLOAT SWITCHES SHALL BE AS SPECIFIED IN SECTION 40 60 05.

18. SEQUENCE OF OPERATION:
   - NUMBER ONE FLOAT SWITCH DE-ENERGIZES ALL PUMPS ON DROP OF LIQUID LEVEL IN WET WELL AND CLOSES CONTROL HOLDING CIRCUIT UPON RISE IN LIQUID LEVEL IN WETWELL.
   - NUMBER TWO FLOAT SWITCH STARTS LEAD PUMP OF DUPLEX SET THROUGH ELECTRICAL ALTERNATOR IN DLS-LCP UPON RISE OF LIQUID LEVEL IN WETWELL.
   - NUMBER THREE FLOAT SWITCH STARTS LAG PUMP OF DUPLEX SET UPON RISE OF LIQUID LEVEL IN SUMP FOR TWO-PUMP OPERATION.
   - NUMBER FOUR FLOAT SWITCH ACTUATES HIGH WETWELL LEVEL ALARM HORN AND INDICATION. THE ALARM HORN MAY BE SILENCED BY MEANS OF EXTERNALLY MOUNTED RESET PUSHBUTTON. INDICATION SHALL REMAIN ILLUMINATED UNTIL THE WET-WET LEVEL DROPS BELOW THE NUMBER FOUR FLOAT SWITCH.

20. MACHINED, POLISHED, AND NON FERROUS SURFACES SHALL BE COATED WITH CORROSION PREVENTION COMPOUND. ALL MATERIALS EXPOSED TO WASTEWATER SHALL HAVE INHERENT CORROSION PROTECTION (I.E., EPOXY POWDER COATED CAST IRON, FIBERGLASS, STAINLESS STEEL, HDPE, PVC).

21. GRINDER STATION SHALL BE INSTALLED WITH CAST-IN-PLACE CONCRETE ANTI-FLOTATION COLLAR AS PER MANUFACTURER'S RECOMMENDATIONS. MANUFACTURER'S REPRESENTATIVE SHALL CHECK AND APPROVE THE INSTALLATION PRIOR TO OPERATION. MANUFACTURER'S REPRESENTATIVE SHALL FIELD TEST AND CALIBRATE THE EQUIPMENT TO ASSURE THAT THE SYSTEM OPERATES TO THE SPECIFICATION. SUPPORT PIPING INDEPENDENT OF PUMP.

22. CONTRACTOR SHALL VERIFY THAT STRUCTURES, PIPES AND EQUIPMENT ARE COMPATIBLE. MAKE ADJUSTMENTS REQUIRED TO PLACE SYSTEM IN PROPER OPERATING CONDITION.

23. ALL EQUIPMENT WILL BE GIVEN RUNNING TESTS BY CONTRACTOR AT THE JOB SITE FOLLOWING INSTALLATION OF THE EQUIPMENT AND CONTROLS. RUNNING TESTS SHALL CONFIRM PUMP'S ABILITY TO MEET DESIGN POINT. RUNNING TESTS SHALL CONFIRM PROPER OPERATION OF AUTOMATIC LEVEL CONTROL MECHANISM AT ALL SET POINTS. SHOULD THE TESTS INDICATE MALFUNCTION, CONTRACTOR SHALL MAKE NECESSARY REPAIRS AND ADJUSTMENTS. SUCH TESTS AND ADJUSTMENTS SHALL BE REPEATED UNTIL, IN THE OPINION OF THE ENGINEER, THE INSTALLATION IS COMPLETE AND THE EQUIPMENT IS FUNCTIONING PROPERLY AND ACCURATELY, AND IS READY FOR PERMANENT OPERATION.

24. A FACTORY TRAINED REPRESENTATIVE SHALL BE PROVIDED FOR INSTALLATION SUPERVISION, START-UP AND TEST SERVICES AND OPERATION AND MAINTENANCE PERSONNEL TRAINING SERVICES. THE REPRESENTATIVE SHALL MAKE A MINIMUM OF TWO VISITS PER LIFT STATION, MINIMUM EIGHT HOURS ON-SITE FOR VISIT, TO THE SITE. THE FIRST VISIT SHALL BE FOR ASSISTANCE IN THE INSTALLATION OF EQUIPMENT. SUBSEQUENT VISITS SHALL BE FOR CHECKING THE COMPLETED INSTALLATION, START-UP AND TRAINING OF THE SYSTEM. MANUFACTURER'S REPRESENTATIVE SHALL TEST OPERATE THE SYSTEM IN THE PRESENCE OF THE ENGINEER AND VERIFY THAT THE EQUIPMENT CONFORMS TO THE REQUIREMENTS. REPRESENTATIVE SHALL REVISIT THE SITE AS OFTEN AS NECESSARY UNTIL ALL TROUBLE IS CORRECTED AND THE INSTALLATION IS ENTIRELY SATISFACTORY AT NO ADDITIONAL COST TO THE OWNER.

25. ALL COSTS, INCLUDING TRAVEL, LODGING, MEALS AND INCIDENTALS, SHALL BE CONSIDERED AS INCLUDED IN CONTRACTOR'S BID PRICE.

26. RUBBER BOOT TO BE ADDED AT ALL PIPE PENETRATIONS THROUGH FIBERGLASS BASINS.

SCALE: 3/4" = 1'-0"

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Professional Engineer's Name: SEAN K. CHAPARRO, P.E.
Professional Engineer's No.: 75865

State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
JAR	KAK	DAO

SEAN K. CHAPARRO
P.E. NO. 75865

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ELLISVILLE WASTEWATER TREATMENT PLANT

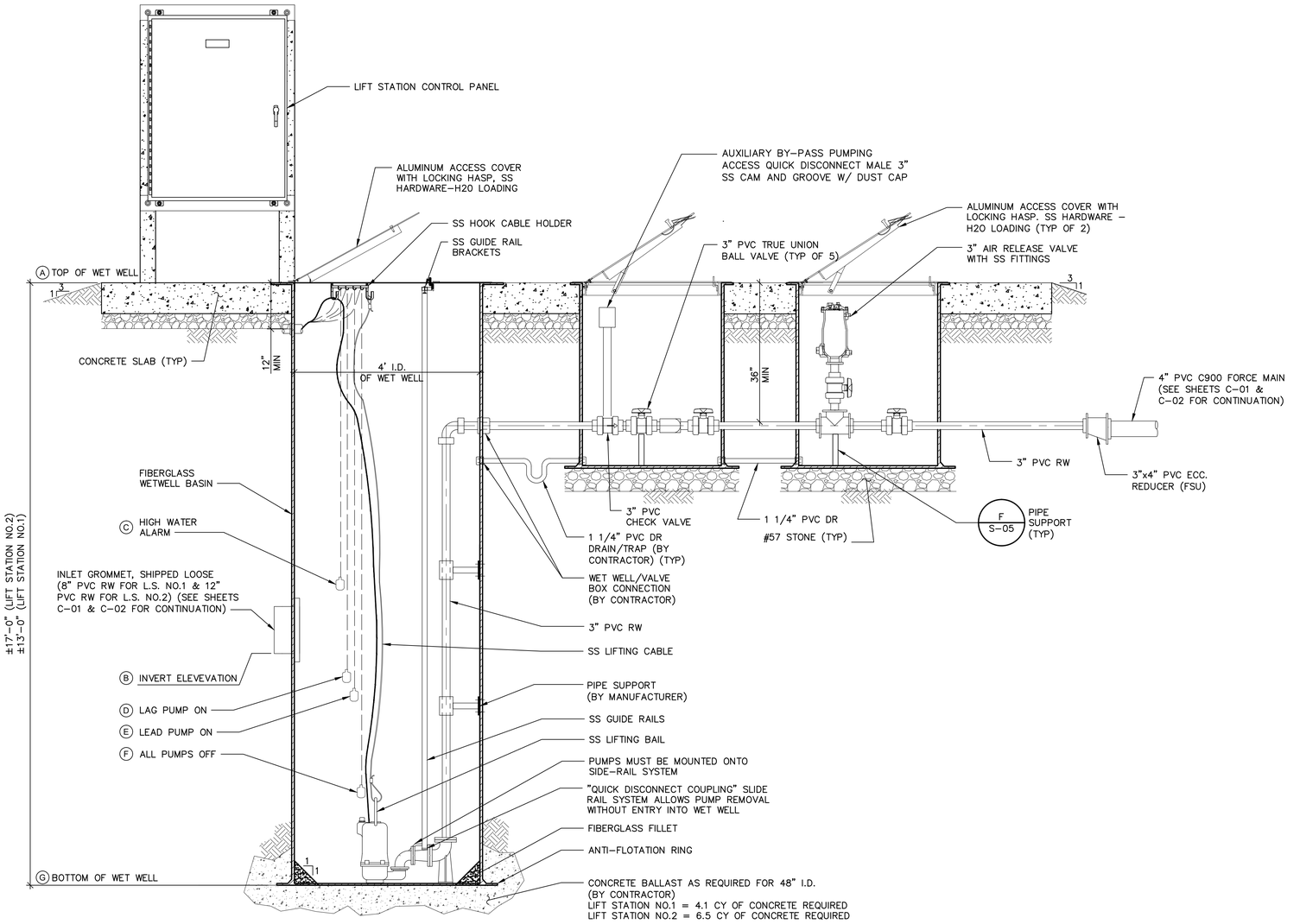
LIFT STATIONS - PLANS & NOTES

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016

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M-01

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G:\CADD\ACAD\PRO\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\04-MECH-HANDCALM-01.dwg LAYOUT: M-01 SAVED: 10/6/2016 6:21 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE:NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:18 AM BY: NEGRON-VIEIRA, VANESSA



1 / M–01 SECTION

LIFT STATION NO.1

PUMP DATA TABLE	
PUMP DESIGN CAPACITY	105 GPM
PUMP DESIGN TDH	166 FT
SECONDARY CAPACITY	70 GPM
SECONDARY TDH	185 FT
HORSE POWER	10 HP
VOLTAGE	208 V
PHASE	3 PH
DISCHARGE SIZE	3"

ELEVATIONS (ft)		
(A)	TOP OF WET WELL	63.50
(B)	INLET INVERT	55.50
(C)	HIGH WATER ALARM	57.70
(D)	LAG PUMP ON	55.70
(E)	LEAD PUMP ON	55.25
(F)	PUMP OFF	52.50
(G)	BOTTOM OF WET WELL	50.50

LIFT STATION NO.2

PUMP DATA TABLE	
PUMP DESIGN CAPACITY	105 GPM
PUMP DESIGN TDH	174 FT
SECONDARY CAPACITY	70 GPM
SECONDARY TDH	194 FT
HORSE POWER	10 HP
VOLTAGE	208 V
PHASE	3 PH
DISCHARGE SIZE	2"

ELEVATIONS (ft)		
(A)	TOP OF WET WELL	77.00
(B)	INLET INVERT	63.60
(C)	HIGH WATER ALARM	65.10
(D)	LAG PUMP ON	63.10
(E)	LEAD PUMP ON	62.65
(F)	PUMP OFF	59.90
(G)	BOTTOM OF WET WELL	57.90

NOTES:
1. ALL 3" DIA. AND SMALLER PVC PIPES SHALL BE SCH 80 PVC UNLESS SPECIFIED.

0 1' 2' 3'
SCALE: 3/4" = 1'–0"

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No.	Date	Revisions	By	Ckd

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Professional Engineer's Name: SEAN K. CHAPARRO, P.E.
Professional Engineer's No.: 75865
State: FL | Date Signed: | Project Mgr.: SKC
Designed by: JAR | Drawn by: KAK | Checked by: DAO

SEAN K. CHAPARRO
P.E. NO. 75865

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

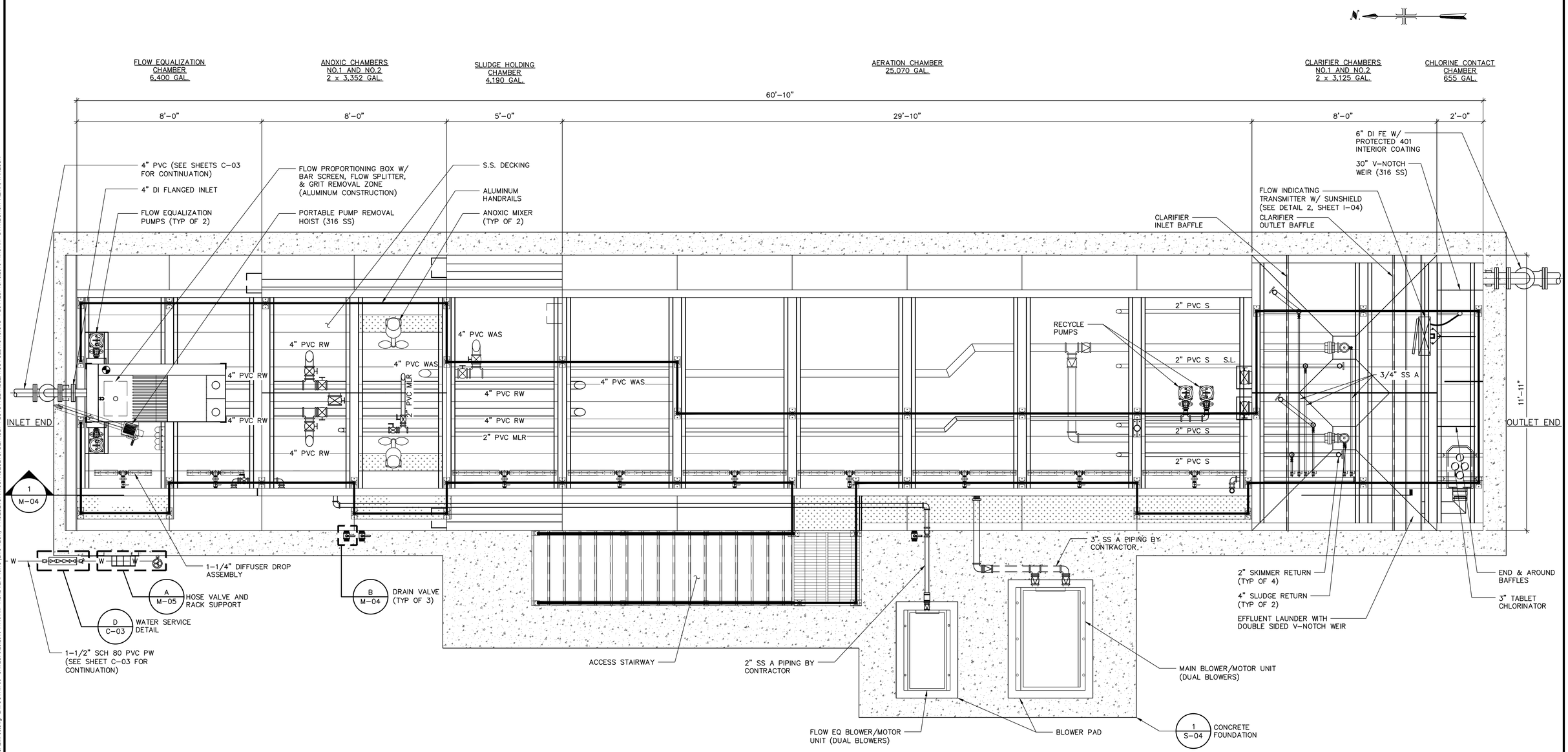
LIFT STATIONS - SECTION

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016
ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

M-02

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CAD\ACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\04-MECHANICAL\M-02.dwg LAYOUT: M-02 SAVED: 8/23/2016 8:41 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE:NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:18 AM BY: NEGRON-VIEIRA, VANESSA

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CADD\ACAD\PROJ\67704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\04-MECHANICAL\M-03.dwg LAYOUT: M-03 SAVED: 8/23/2016 11:16 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:18 AM BY: NEGRON-VIEIRA, VANESSA



PLAN

NOTES:

1. SLIGHT CHANGES TO PIPING, DIFFUSERS, SIZING, AND GENERAL ARRANGEMENT MAY BE REQUIRED DEPENDING ON PACKAGED WWTP MANUFACTURER. CONTRACTOR IS REQUIRED TO MAKE ALL NECESSARY CHANGES AT NO ADDITIONAL COST TO OWNER.
2. TANK MANUFACTURER SHALL PROVIDE PIPE AND CONDUIT SUPPORTS. SEE S-05 FOR DETAILS.
3. PORTABLE HOIST TO HAVE MOUNTING BRACKET FOR USE IN REMOVAL OF RECYCLE PUMPS.

SCALE: 1/2" = 1'-0"

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Professional Engineer's Name: SEAN K. CHAPARRO, P.E.
Professional Engineer's No.: 75865

State	Date Signed	Project Mgr.
		SKC
Designed by	Drawn by	Checked by
JAR	KAK	DAO

SEAN K. CHAPARRO
P.E. NO. 75865

ORIGINAL SIGNED AND SEALED SHEET ON FILE

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FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

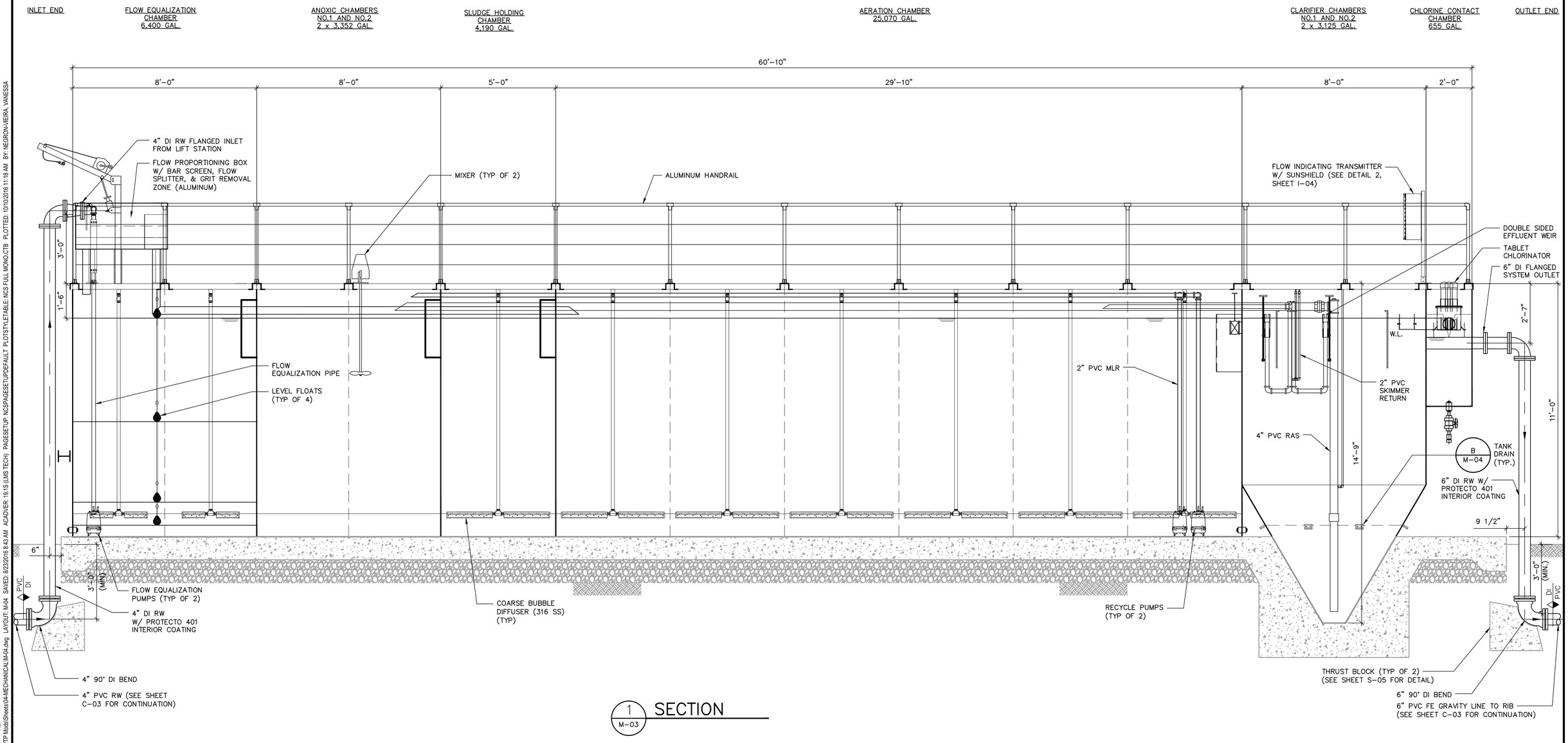
WASTEWATER TREATMENT PLANT - PLAN

ARCADIS Project No.
06704010.0000

Date
OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
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TEL. 813.903.3125

M-03



1 / M-03 SECTION

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
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SCALE: 1/2" = 1'-0"

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Professional Engineer's No.: 75865

State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
JAR	KAK	DAO

SEAN K. CHAPARRO
P.E. NO. 75865

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FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

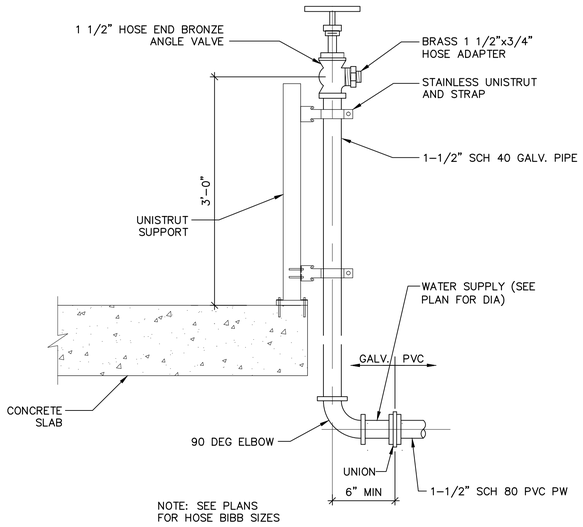
WASTEWATER TREATMENT PLANT - SECTION

ARCADIS Project No.
06704010.0000

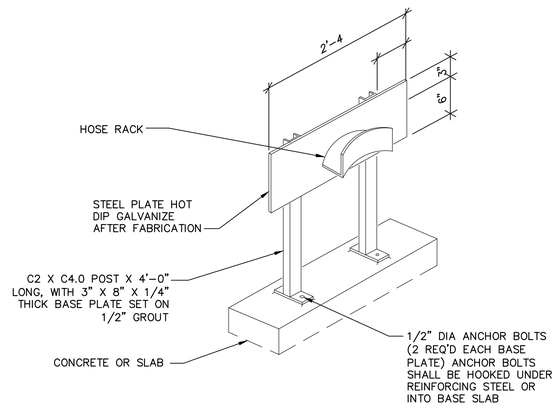
Date
OCTOBER 2016

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M-04



HOSE VALVE DETAIL

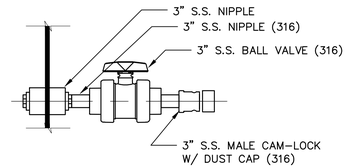


HOSE RACK SUPPORT DETAIL

GENERAL NOTES:

1. HOSE RACK SHALL BE OF ALL WELDED CONSTRUCTION. MATERIAL SHALL BE MINIMUM OF 3/16 INCH THICK STEEL.
2. UTILITY STATIONS FASTENERS AND MOUNTING HARDWARE SHALL BE TYPE 316 STAINLESS STEEL.

A / M-03 HOSE VALVE & RACK SUPPORT DETAIL



B / M-02 TANK DRAIN DETAIL

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State: FL | Date Signed: | Project Mgr.: SKC
Designed by: JAR | Drawn by: KAK | Checked by: DAO

SEAN K. CHAPARRO
P.E. NO. 75865

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

MECHANICAL DETAILS

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

M-05

DIAGRAMS:

S [S] [S] — POWER ON–OFF SNAP SWITCH, 1PH, 120V AC, 20A
S2–DENOTES, 2 POLE, 240 VOLTS, 20A

[MS] — 20A TWO OR THREE POLE MANUAL STARTER,

PUSH–BUTTON STATION

PUSH–BUTTON STATION WITH LOCK–OUT FEATURE

SELECTOR SWITCH

INDICATING LIGHT

[CS] — CONTROL STATION

[H O A] — HAND–OFF–AUTO SELECTOR SWITCH CONTROL STATION

[VCS] — CONTROL STATION FURNISHED BY EQUIPMENT VENDOR

(A) (AS) — AMMETER – AMMETER SWITCH

(V) (VS) — VOLTMETER – VOLTMETER SWITCH

[F] 60/40 — DISCONNECT SWITCH – 480V 3POLE UNFUSED OR FUSED
F DENOTES FUSING, ONLY WHERE INDICATED.
FIRST NUMBER DENOTES SWITCH AMP RATING.
SECOND NUMBER DENOTES FUSE SIZE WHEN PROVIDED.

[VFD–B] — VARIABLE FREQUENCY DRIVE – VFD
–B WHEN INDICATED DENOTES WITH STARTING AND FULL SPEED BYPASS

[CS] — CONTROL STATION

[JB] — JUNCTION BOX; SIZE AS REQUIRED BY N.E.C.

[T] — TERMINAL BOX; SIZE AS REQUIRED BY N.E.C.
AND TO ACCOMODATE ALL TERMINATIONS ON TERMINAL BLOCKS. TERMINATIONS TO INCLUDE SPARE WIRING.

[PB] — PULL BOX; SIZE AS REQUIRED BY N.E.C.

(M) (5) — ELECTRIC MOTOR (NUMBER INDICATES HORSEPOWER).

[MV] — MOTORIZED VALVE WITH CONTROLLER BY VENDOR

[MG] — MOTORIZED GATE WITH CONTROLLER BY VENDOR

[SV] — SOLENOID VALVE

PFD — PFD DENOTES PULL FUSE DISCONNECT TYPE

600/5 / 3 — CURRENT TRANSFORMER, RATIO AND QUANTITY DENOTED

POTENTIAL TRANSFORMER

[S T] 800/600 — FIXED MOUNTED POWER OR MOLDED CASE CIRCUIT BREAKER WITH RMS TYPE SOLID STATE TRIP PROGRAMMER.

(400P) — DENOTES PLUG RATING WHEN LESS THAN SENSOR RATING IS REQUIRED

100 CB 2P (TRIP SIZE) — THERMAL–MAGNETIC CIRCUIT BREAKER
2P WHEN NOTED DENOTES 2 POLE
CIRCUIT BREAKERS ARE 3 POLE UON

7A MCP — AC COMBINATION
FULL VOLTAGE NON–REVERSING STARTER
(CONTINUOUS AMP RATING) MAGNETIC BREAKER
(MOTOR CIRCUIT PROTECTOR)

MAGNETIC MOTOR STARTER

OVERLOAD RELAY

7A MCP, F, R — AC COMBINATION
FULL VOLTAGE REVERSING STARTER

TRANSFORMER– SIZE AS NOTED ON THE DRAWINGS

DISCONNECT SWITCH
WITH FUSING WHERE NOTED

SUBMERSIBLE CABLES
BY VENDOR

[TVSS] — TRANSIENT VOLTAGE SURGE SUPPRESSOR

PLANS:

I–2 GF/SS — DUPLEX CONVENIENCE RECEPTACLE, 2 POLE, 3 WIRE, 120 VOLTS A.C. 20 AMP RECEPTACLE DESIGNATIONS, FIRST NUMBER DENOTES PANEL, SECOND NUMBER DENOTES CIRCUIT NUMBER. GF–DENOTES GROUND FAULT TYPE. SS–DENOTES SURGE SUPPRESSION TYPE WP–DENOTES WEATHERPROOF ENCLOSURE

SINGLE CONVENIENCE RECEPTACLE, 2 POLE, 3 WIRE; 120 VOLTS AC. 20 AMP UNLESS NOTED OTHERWISE ON DRAWINGS.

POWER RECEPTACLE, 2 POLE, 3 WIRE 250 VOLTS A.C. 20 AMP UNLESS NOTED OTHERWISE ON DRAWINGS.

Sa — SINGLE POLE SWITCH – LOWER CASE LETTER DENOTES SWITCHING.

S_2 — TWO POLE SWITCH

S_3 — THREE–WAY SWITCH

S_4 — FOUR–WAY SWITCH

INDICATES NEW EQUIPMENT/EXPOSED CONDUIT

INDICATES EXISTING EQUIPMENT/CONDUIT

INDICATES CONCEALED OR UNDERGROUND EQUIPMENT/CONDUIT

CONDUIT TURN DOWN

CONDUIT TURN UP

CONDUIT CAPPED

LP1–2 / JB / 10 — LETTERS AND NUMBERS INDICATE PANEL AND CIRCUIT NUMBER (LP1–2). CROSS LINES INDICATE NUMBER OF CONDUCTORS. HALF HASH MARKS INDICATES NEUTRAL. NUMBER (10) DENOTES WIRE SIZE WHEN NOT #12 AWG. CONTINUE CONDUIT AND WIRE RUN FROM BOX TO DEVICE IN ROOM OR AREA AS NOTED BY BRANCH CIRCUIT NUMBER. #10 AWG WIRING SHALL BE USED FOR RUNS BETWEEN PANEL AND FIRST LIGHTING FIXTURE OR RECEPTACLE EXCEEDING 50 FEET, UNLESS OTHERWISE NOTED ON DRAWING.

INDICATES GROUND CONDUCTOR

C12 — INDICATES HOMERUN AND CONDUIT TAG

EMH — ELECTRICAL MANHOLE

EHH — ELECTRICAL HANDHOLE

TMH — TELEPHONE MANHOLE

THH — TELEPHONE HANDHOLE

[PC] — PHOTOCELL

FLUORESCENT LIGHTING FIXTURE – SURFACE OR PENDANT MOUNTED. FIRST NUMERAL DENOTES LIGHTING PANEL (HW–LP), SECOND NUMBER DENOTES BRANCH CIRCUIT NUMBER. LOWER CASE LETTER DENOTES SWITCHED CIRCUIT.

LED WALL MOUNTED LIGHTING FIXTURE.

FLUORESCENT LIGHTING FIXTURE – SURFACE OR PENDANT MOUNTED. FIRST NUMERAL DENOTES LIGHTING PANEL (HW–LP), SECOND NUMBER DENOTES BRANCH CIRCUIT NUMBER. LOWER CASE LETTER DENOTES SWITCHED CIRCUIT.

FLUORESCENT LIGHTING FIXTURE WITH BATTERY PACK – SURFACE OR PENDANT MOUNTED.

WALL MOUNTED LIGHTING FIXTURE.

POLE OR STANCHION MOUNTED LIGHTING FIXTURE.

TWO (2) POLE OR STANCHION MOUNTED LIGHTING FIXTURES

GF — POLE MOUNTED FIXTURE WITH GF RECEPTACLE

LED SELF CONTAINED DC EMERGENCY LIGHTING UNIT. LETTER DENOTES FIXTURE TYPE.

LED SELF CONTAINED DC EMERGENCY LIGHTING UNIT. LETTER DENOTES FIXTURE TYPE.

D / 150 / 10'–0" AFF — FIXTURE DESIGNATION SYMBOL. SEE LIGHTING FIXTURE SCHEDULE FOR DESCRIPTION AND TYPE. ALL FIXTURES SHOWN IN A ROOM WITH THIS SYMBOL SHALL BE OF TYPE INDICATED BY LETTER; NUMBER IN SYMBOL INDICATES LAMP WATTAGE AND NUMBER OF LAMPS WHERE MORE THAN ONE (UNLESS OTHERWISE NOTED). NUMBER BELOW SYMBOL INDICATES MOUNTING HEIGHT ABOVE FINISHED FLOOR OR AS NOTED.

M 1–24 / UH 1–24 OR 1–24 — MOTOR, UNIT HEATER–NUMERAL DENOTES LIGHTING PANEL AND BRANCH CIRCUIT NUMBER. MOTOR SYMBOL SHOWN DASHED DENOTES EQUIPMENT LOCATED ON ROOF.

(T) — THERMOSTAT

GROUND ROD

GROUND TEST POINT

GROUND GRID CABLE CONNECTION

GROUND

#4/0 GROUND CABLE BURIED 2'–6" BELOW GRADE, UNLESS NOTED OTHERWISE

INSTRUMENTS:

PS 123 — INSTRUMENT DEVICE: LETTERS IDENTIFY DEVICE FUNCTION, NUMBERS WHERE INDICATED DENOTE LOOP NUMBER

(PC) — PRESSURE CONTROLLER

(PS) — PRESSURE SWITCH (PSH DENOTES PRESSURE SWITCH HIGH AND PSL DENOTES PRESSURE LOW)

ABBREVIATIONS:

A	AMPERES
AC	ALTERNATING CURRENT
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AL	ALUMINUM
ATS	AUTOMATIC TRANSFER SWITCH
AWG	AMERICAN WIRE GAUGE
BKR	BREAKER
BLDG	BUILDING
C, CND	CONDUIT
CB	CIRCUIT BREAKER
CBV	CABLE BY VENDOR, INSTALLED BY CONTRACTOR
CKT	CIRCUIT
CNTRL	CONTROL
CP	CONTROL PANEL
CPT	CONTROL POWER TRANSFORMER
CS	CONTROL STATION
CT	CURRENT TRANSFORMER
DB	DECIBEL
DC	DIRECT CURRENT
DN	DOWN
DISC	DISCONNECT
DPDT	DOUBLE POLE DOUBLE THROW
DS	DISCONNECT SWITCH
EC	EMPTY CONDUIT
EHH	ELECTRICAL HANDHOLE
EL, ELEV	ELEVATION
EMH	ELECTRICAL MANHOLE
EMT	ELECTRICAL METALLIC TUBING
EP	EXPLOSION PROOF
EXIST	EXISTING
FDR	FEEDER
FIXT	FIXTURE
FT	FEET OR FOOT
FVNR	FULL VOLTAGE NON–REVERSING
GALV	GALVANIZED
GEC	GROUNDING ELECTRODE CONDUCTOR
G, GND	GROUND
GFI	GROUND FAULT INTERRUPTOR
HH	HAND HOLE
HOA	HAND/OFF/AUTO
HZ	HERTZ
JB	JUNCTION BOX, CONDUIT, FITTING AS REQUIRED BY NEC, UNLESS OTHERWISE NOTED
KAIC	THOUSAND AMPERES INTERRUPTING CURRENT
KCMIL	THOUSAND CIRCULAR MILS
KVA	THOUSAND VOLT AMPERES
KW	KILOWATTS
LA	LIGHTNING ARRESTOR
LCP	LOCAL CONTROL PANEL
LS	LEVEL SWITCH
LTG	LIGHTING
M	MOTOR
MCC	MOTOR CONTROL CENTER
MCP	MOTOR CIRCUIT PROTECTOR
MFR	MANUFACTURER
MIN	MINIMUM
MTG	MOUNTING
MTS	MANUAL TRANSFER SWITCH
NA	NON–AUTOMATIC
N/A	NOT APPLICABLE
NCTC	NORMALLY CLOSED, TIME CLOSE
NCTO	NORMALLY OPEN, TIME OPEN
NEC	NATIONAL ELECTRIC CODE
NIC	NOT IN CONTRACT
NTS	NOT TO SCALE
OFCI	OWNER FURNISHED, CONTRACTOR INSTALLED
OL	OVERLOAD RELAY
PB	PUSH BUTTON
P/B	PULL BOX
PFC	POWER FACTOR CORRECTION CAPACITORS
PFD	PULL FUSE DISCONNECT
PLC	PROGRAMMABLE LOGIC CONTROLLER
PNL	PANEL
PT	POTENTIAL TRANSFORMER
PVC	POLYVINYL CHLORIDE
RECEP	RECEPTACLE
RGS	RIGID GALVANIZED STEEL
SP	SPARE
SPD	SURGE PROTECTION DEVICE
SST	STAINLESS STEEL
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
TEW	THERMOCOUPLE EXTENSION WIRE
TYP	TYPICAL
UG	UNDERGROUND
UON	UNLESS OTHERWISE NOTED
UPS	UNINTERRUPTIBLE POWER SUPPLY
V	VOLTS
VAC	VOLTS ALTERNATING CURRENT
VFD	VARIABLE FREQUENCY DRIVE
WP	WEATHERPROOF
XFMR	TRANSFORMER

GENERAL NOTES:

1. THE SYMBOLS AND ABBREVIATIONS LIST ON THIS SHEET IS A COMPREHENSIVE STANDARD GUIDE INTENDED FOR GENERAL USE ON ALL PROJECTS. THEREFORE NOT ALL THE SYMBOLS AND ABBREVIATIONS CONTAINED IN THIS LIST ARE NECESSARILY USED ON THIS PARTICULAR PROJECT AND SHOULD BE USED FOR CLARIFICATION ONLY.
2. THE CONTRACTOR SHALL READ AND UNDERSTAND THE ENTIRE SET OF CONSTRUCTION DOCUMENTS. THIS INCLUDES BUT IS NOT LIMITED TO THE PLANS AND SPECIFICATIONS FOR ALL DISCIPLINES. THIS WILL ENSURE THAT HE UNDERSTANDS THE FULL SCOPE OF WORK AND IS ABLE TO CONVEY THE REQUIRED MATERIALS AND METHODS OF INSTALLATION TO THE HIS ESTIMATORS, SUPPLIERS AND INSTALLERS.
3. THE CONTRACTOR SHALL VISIT THE SITE AND FAMILIARIZE HIMSELF WITH THE EXISTING CONDITIONS.
4. PROVIDE MEANS TO FURNISH AND INSTALL.
5. COORDINATE ANY AND ALL WORK WITH OTHER TRADES PRIOR TO INSTALLATION IN ORDER TO AVOID CONFLICTS DURING CONSTRUCTION.
6. THESE DRAWINGS ARE DIAGRAMMATIC IN NATURE. DO NOT SCALE FROM THESE DRAWINGS.
7. WHERE JOB CONDITIONS REQUIRE CHANGES FROM THE CONTRACT DOCUMENTS THAT DO NOT CHANGE THE SCOPE OF INSTALLATION OR NATURE OF THE WORK REQUIRED, THE CONTRACTOR SHALL MAKE SUCH CHANGES WITHOUT ANY ADDITIONAL COST TO THE OWNER. NO OTHER CHANGES MAY BE MADE WITHOUT WRITTEN CONSENT FROM THE ENGINEER AND OWNER.
8. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF THE ENFORCED EDITION OF THE NATIONAL ELECTRIC CODE, NATIONAL ELECTRIC SAFETY CODE, LIFE SAFETY CODE, FLORIDA BUILDING CODE AND ALL LOCAL AND STATE CODES AND REGULATIONS. THE CONTRACTOR SHALL OBTAIN AND PAY FOR ALL PERMITS AND INSPECTIONS REQUIRED BY THE AUTHORITY HAVING JURISDICTION.
9. MOUNTING HEIGHTS INDICATED ARE TO THE CENTER OF THE DEVICE U.O.N.

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CAD\DACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\05-ELECTRICAL\E-01.dwg LAYOUT: E-01 SAVED: 7/20/2016 5:43 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:18 AM BY: NEGRON-VIEIRA, VANESSA

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Professional Engineer's Name: KEFF S. KURELLA, P.E.
Professional Engineer's No.: 63077
State: FL | Date Signed: | Project Mgr.: SKC
Designed by: EB | Drawn by: EB | Checked by: KSK

KEFF SCOTT KURELLA
P.E. NO. 63077

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

ELECTRICAL NOTES, LEGEND, & ABBREVIATIONS

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016
ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
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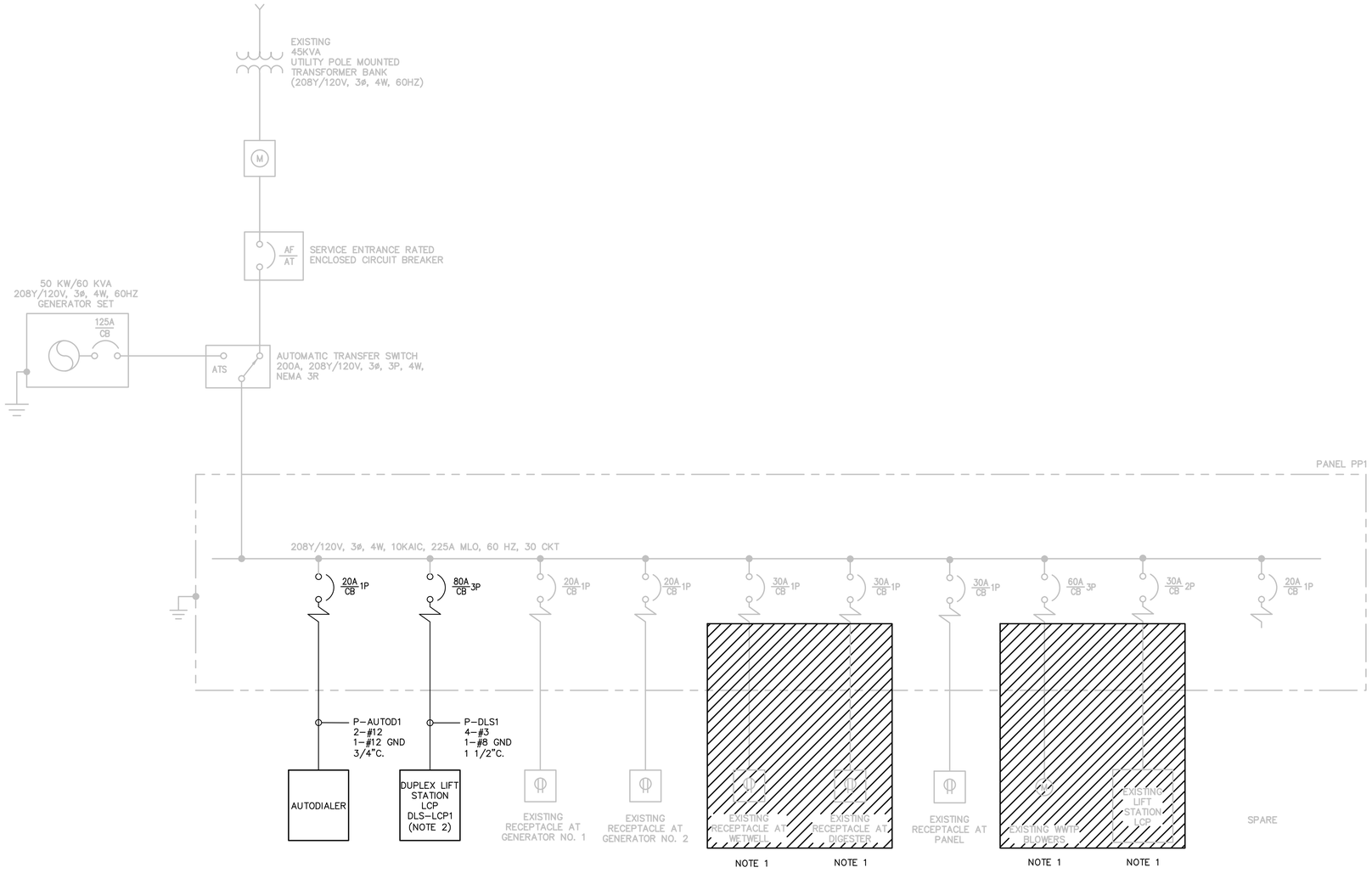
E-01

DUPLEX LIFT STATION LCP (DLS–LCP1) LOAD CALC				
EQUIPMENT	(D) DUTY OR (S) STANDBY	HP/KVA	CONNECTED LOAD (A)	RUNNING LOAD (A)
LIFT STATION PUMP NO. 1	D	10 HP/11.10 KVA	30.80	30.80
LIFT STATION PUMP NO. 2	D	10 HP/11.10 KVA	30.80	30.80
CONTROL POWER	D	0.5 KVA	1.40	1.40
SUBTOTAL			63.00	63.00
25% OF LARGEST MOTOR				7.70
LOAD PER NEC 430.24				70.70

EXISTING PANEL PP–1 LOAD CALC				
EQUIPMENT	CONNECTED LOAD (KVA)	CONNECTED LOAD (A)	DESIGN LOAD (KVA)	DESIGN LOAD (A)
AUTODIALER	0.50	4.20	0.50	4.20
DLS–LCP1	22.70	63.00	22.70	63.00
RECEPTACLES	0.54	4.50	0.54	4.50
TOTAL	23.74	71.70	23.74	71.70

NOTES:

1. CIRCUIT BREAKERS FEEDING EXISTING LOADS THAT ARE DEMOLISHED DURING CONSTRUCTION SHALL BE MARKED AS "SPARE".
2. LOCAL CONTROL PANEL(S) PROVIDED BY THE PACKAGED LIFT STATION VENDOR. CONNECTIONS FROM EACH CONTROL PANEL TO EQUIPMENT SHALL BE PROVIDED BY THE CONTRACTOR. REFER TO SHEET E–06 FOR MORE INFORMATION ON QUANTITY AND SIZES. COORDINATE ALL FINAL CONNECTIONS PRIOR TO ROUGH–IN.
3. REFER TO SPECIFICATION SECTION 26 00 05 ELECTRICAL WORK FOR ALL GENERAL INSTALLATION REQUIREMENTS.



LIFT STATION #1 – ONE–LINE DIAGRAM

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CADD\ACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\05-ELECTRICAL\E-02.dwg LAYOUT: E-02 SAVED: 7/20/2016 5:43 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:18 AM BY: NEGRON-VIERA, VANESSA

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USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

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Professional Engineer's Name: KEFF S. KURELLA, P.E.
Professional Engineer's No.: 63077
State: FL | Date Signed: | Project Mgr.: SKC
Designed by: EB | Drawn by: EB | Checked by: KSK

KEFF SCOTT KURELLA
P.E. NO. 63077

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

LIFT STATION NO. 1 - ONE-LINE DIAGRAM

ARCADIS Project No.
06704010.0000

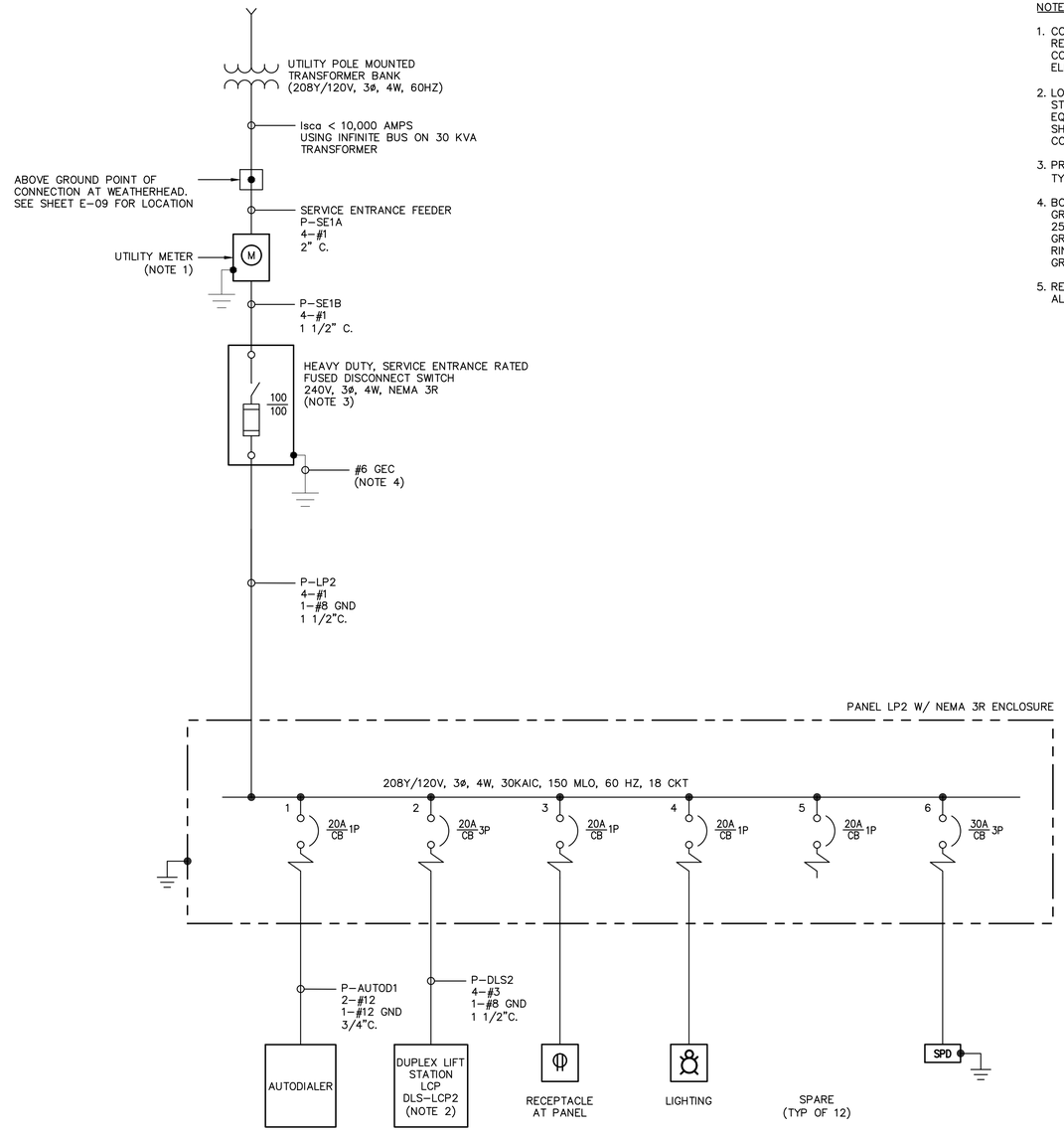
Date
OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

E-02

DUPLEX LIFT STATION LCP (DLS–LCP2) LOAD CALC				
EQUIPMENT	(D) DUTY OR (S) STANDBY	HP/KVA	CONNECTED LOAD (A)	RUNNING LOAD (A)
LIFT STATION PUMP NO. 1	D	10 HP/11.10 KVA	30.80	30.80
LIFT STATION PUMP NO. 2	D	10 HP/11.10 KVA	30.80	30.80
CONTROL POWER	D	0.5 KVA	1.40	1.40
SUBTOTAL			63.00	63.00
25% OF LARGEST MOTOR				7.70
LOAD PER NEC 430.24				70.70

PANEL LP–2 LOAD CALC				
EQUIPMENT	CONNECTED LOAD (KVA)	CONNECTED LOAD (A)	DESIGN LOAD (KVA)	DESIGN LOAD (A)
AUTODIALER	0.50	4.20	0.50	4.20
DLS–LCP2	22.70	63.00	22.70	63.00
RECEPTACLE	0.18	1.50	0.18	1.50
LIGHTING	0.20	1.67	0.20	1.67
TOTAL	23.38	68.70	23.38	68.70



NOTES:

1. CONTRACTOR TO COORDINATE AND PROVIDE METER SOCKET PER THE REQUIREMENTS OF THE LOCAL UTILITY, CLAY ELECTRIC. PROVIDE CONNECTION FROM THE METER ENCLOSURE TO THE GROUNDING ELECTRODE SYSTEM.
2. LOCAL CONTROL PANEL(S) PROVIDED BY THE PACKAGED LIFT STATION VENDOR. CONNECTIONS FROM EACH CONTROL PANEL TO EQUIPMENT SHALL BE PROVIDED BY THE CONTRACTOR. REFER TO SHEET E–06 FOR MORE INFORMATION ON QUANTITY AND SIZES. COORDINATE ALL FINAL CONNECTIONS PRIOR TO ROUGH–IN.
3. PROVIDE 600V, DUAL ELEMENT, TIME DELAY, 200 KAIC, CLASS RK5 TYPE FUSES (SIZE AS SHOWN).
4. BOND THE GROUNDING ELECTRODE CONDUCTOR TO AN ACCEPTABLE GROUNDING ELECTRODE SYSTEM IN ACCORDANCE WITH NEC SECTION 250. THIS MAY INCLUDE A CONCRETE–ENCASED ELECTRODE OR A GROUND ROD. THIS SYSTEM SHALL BE CONNECTED TO THE GROUND RING AS SHOWN ON SHEET E–09. PROVIDE A SUPPLEMENTAL GROUND ROD IF THE RESISTANCE TO EARTH EXCEEDS 5 OHMS.
5. REFER TO SPECIFICATION SECTION 26 00 05 ELECTRICAL WORK FOR ALL GENERAL INSTALLATION REQUIREMENTS.

LIFT STATION #2 – ONE–LINE DIAGRAM

CITY: DW/GROUP: DB: LD: PIC: PM: TM: LVRON=*OFF=*REF*
G:\CAD\ACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\05-ELECTRICAL\E-03.dwg LAYOUT: E-03 SAVED: 7/20/2016 5:42 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:18 AM BY: NEGRON-VIERA, VANESSA

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Professional Engineer's Name: KEFF S. KURELLA, P.E.
Professional Engineer's No.: 63077
State: FL | Date Signed: | Project Mgr.: SKC
Designed by: EB | Drawn by: EB | Checked by: KSK

KEFF SCOTT KURELLA
P.E. NO. 63077

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

LIFT STATION NO. 2 - ONE-LINE DIAGRAM

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

E-03

CONTROL PANEL FE–LCP LOAD CALC

EQUIPMENT	(D) DUTY OR (S) STANDBY	HP/KVA	CONNECTED LOAD (A)	RUNNING LOAD (A)
FLOW EQUALIZATION BLOWER NO. 1	D	3 HP/3.99 KVA	4.80	4.80
FLOW EQUALIZATION BLOWER NO. 2	D	3 HP/3.99 KVA	4.80	4.80
FLOW EQUALIZATION PUMP NO. 1	D	0.5 HP/0.91 KVA	1.10	1.10
FLOW EQUALIZATION PUMP NO. 2	D	0.5 HP/0.91 KVA	1.10	1.10
CONTROL POWER XFMR	D	0.5 KVA	1.04	1.04
SUBTOTAL			12.84	12.84
25% OF LARGEST MOTOR				1.20
LOAD PER NEC 430.24				14.04

CONTROL PANEL AM–LCP LOAD CALC

EQUIPMENT	(D) DUTY OR (S) STANDBY	HP/KVA	CONNECTED LOAD (A)	RUNNING LOAD (A)
ANOXIC MIXER NO. 1	D	0.5 HP/0.91 KVA	1.10	1.10
ANOXIC MIXER NO. 2	D	0.5 HP/0.91 KVA	1.10	1.10
CONTROL POWER XFMR	D	0.5 KVA	1.04	1.04
SUBTOTAL			3.24	3.24
25% OF LARGEST MOTOR				0.28
LOAD PER NEC 430.24				3.52

CONTROL PANEL RP–LCP LOAD CALC

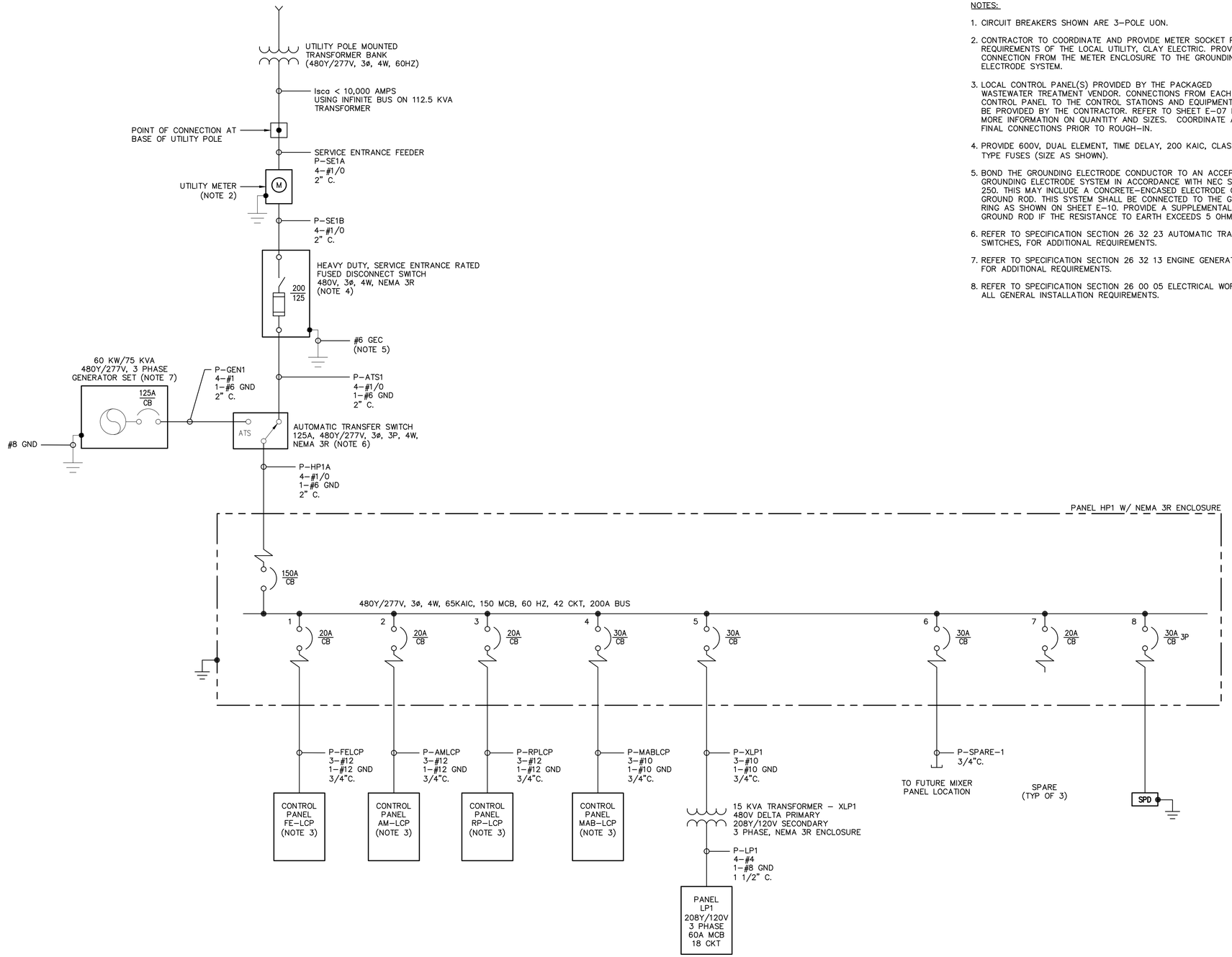
EQUIPMENT	(D) DUTY OR (S) STANDBY	HP/KVA	CONNECTED LOAD (A)	RUNNING LOAD (A)
RECYCLE PUMP NO. 1	D	0.75 HP/1.33 KVA	1.60	1.60
RECYCLE PUMP NO. 2	D	0.75 HP/1.33 KVA	1.60	1.60
CONTROL POWER XFMR	D	0.5 KVA	1.04	1.04
SUBTOTAL			4.24	4.24
25% OF LARGEST MOTOR				0.40
LOAD PER NEC 430.24				4.64

CONTROL PANEL MAB–LCP LOAD CALC

EQUIPMENT	(D) DUTY OR (S) STANDBY	HP/KVA	CONNECTED LOAD (A)	RUNNING LOAD (A)
MAIN AIR BLOWER NO. 1	D	7.5 HP/9.15 KVA	11.00	11.00
MAIN AIR BLOWER NO. 2	S	7.5 HP/9.15 KVA	11.00	0.00
120V XFMR	D	0.5 KVA	1.04	1.04
SUBTOTAL			23.04	12.04
25% OF LARGEST MOTOR				2.75
LOAD PER NEC 430.24				14.79

PANEL HP–1 (SERVICE) LOAD CALC

EQUIPMENT	CONNECTED LOAD (KVA)	CONNECTED LOAD (A)	DESIGN LOAD (KVA)	DESIGN LOAD (A)
CONTROL PANEL FE–LCP	10.70	12.84	10.70	12.84
CONTROL PANEL AM–LCP	2.70	3.24	2.70	3.24
CONTROL PANEL RP–LCP	3.50	4.24	3.50	4.24
CONTROL PANEL MAB–LCP	19.20	23.04	10.01	12.04
FUTURE MXR PANEL	19.20	23.04	10.01	12.04
120/208V XFMR (LP1)	15.00	18.00	15.00	18.00
SUBTOTAL	70.30	84.40	51.92	62.40
75% SPARE CAPACITY			38.94	
TOTAL			90.86	109.34
150A SERVICE IS ADEQUATE				



NOTES:

1. CIRCUIT BREAKERS SHOWN ARE 3–POLE UON.
2. CONTRACTOR TO COORDINATE AND PROVIDE METER SOCKET PER THE REQUIREMENTS OF THE LOCAL UTILITY, CLAY ELECTRIC. PROVIDE CONNECTION FROM THE METER ENCLOSURE TO THE GROUNDING ELECTRODE SYSTEM.
3. LOCAL CONTROL PANEL(S) PROVIDED BY THE PACKAGED WASTEWATER TREATMENT VENDOR. CONNECTIONS FROM EACH CONTROL PANEL TO THE CONTROL STATIONS AND EQUIPMENT SHALL BE PROVIDED BY THE CONTRACTOR. REFER TO SHEET E–07 FOR MORE INFORMATION ON QUANTITY AND SIZES. COORDINATE ALL FINAL CONNECTIONS PRIOR TO ROUGH–IN.
4. PROVIDE 600V, DUAL ELEMENT, TIME DELAY, 200 KAIC, CLASS RK5 TYPE FUSES (SIZE AS SHOWN).
5. BOND THE GROUNDING ELECTRODE CONDUCTOR TO AN ACCEPTABLE GROUNDING ELECTRODE SYSTEM IN ACCORDANCE WITH NEC SECTION 250. THIS MAY INCLUDE A CONCRETE–ENCASED ELECTRODE OR A GROUND ROD. THIS SYSTEM SHALL BE CONNECTED TO THE GROUND RING AS SHOWN ON SHEET E–10. PROVIDE A SUPPLEMENTAL GROUND ROD IF THE RESISTANCE TO EARTH EXCEEDS 5 OHMS.
6. REFER TO SPECIFICATION SECTION 26 32 23 AUTOMATIC TRANSFER SWITCHES, FOR ADDITIONAL REQUIREMENTS.
7. REFER TO SPECIFICATION SECTION 26 32 13 ENGINE GENERATORS, FOR ADDITIONAL REQUIREMENTS.
8. REFER TO SPECIFICATION SECTION 26 00 05 ELECTRICAL WORK FOR ALL GENERAL INSTALLATION REQUIREMENTS.

WASTEWATER TREATMENT PLANT – ONE–LINE DIAGRAM

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CADD\ACAD\PROJS\704 Columbia County FL\010 - Ellisville WWTP Mod\Sheets\05-ELECTRICAL\E-04.dwg LAYOUT: E-04 SAVED: 7/20/2016 5:42 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUP.DWG PAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/19/2016 11:18 AM BY: NEGRON-VIERA, VANESSA

No.	Date	Revisions	By	Ckd

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Professional Engineer's Name: KEFF S. KURELLA, P.E.
Professional Engineer's No.: 63077
State: FL | Date Signed: | Project Mgr.: SKC
Designed by: EB | Drawn by: EB | Checked by: KSK

KEFF SCOTT KURELLA
P.E. NO. 63077

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

WASTEWATER TREATMENT PLANT - ONE-LINE DIAGRAM

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

E-04

NEW POWER DISTRIBUTION PANEL AT NEW WASTEWATER TREATMENT PLANT
REFER TO SHEET E-10 FOR LOCATION

CKT NO.	TRIP AMPS	DESCRIPTION OF LOAD	LOAD KVA	AMPS	POLES	KVA PER PHASE A	KVA PER PHASE B	KVA PER PHASE C	POLES	AMPS	LOAD KVA	DESCRIPTION OF LOAD	TRIP AMPS	CKT NO.
1	20	RECEPTACLE	0.2	1.7	1	0.4			1	1.7	0.2	LIGHTING	20	2
3	20	FE/FIQR	0.1	0.8	1		0.1		1			SPARE	20	4
5	20	GENERATOR BATTERY CHARGER	0.5	4.2	1			0.5	1			SPARE	20	6
7	20	GENERATOR BLOCK HEATER	1	8.3	1	1.0			1			SPARE	20	8
9	20	AUTODIALER	0.5	4.2	1		0.5		1			SPARE	20	10
11		<SPACE>			1			0.0	1			SPARE	20	12
13	20	SPARE			1	0.0			1			SPARE	20	14
15	20	SPARE			1		0.0		1			SPARE	20	16
17	20	SPARE			1			0.0	1			SPARE	20	18

PANEL **LP1**
LOCATION Exterior WWTP Service
BUILDING N/A
NOTES:

TOTAL KVA	1.4	0.6	0.5
GRAND CONNECTED TOTAL KVA		2.5	

SERVICE CHARACTERISTICS
VOLTS: 208Y/120
PHASE: 3
WIRE: 4
10k MIN AIC SYMM, FULLY RATED ASSEMBLY

_____ A MLO
60 A MCB

NEW POWER DISTRIBUTION PANEL AT NEW DUPLEX LIFT STATION 2
REFER TO SHEET E-09 FOR LOCATION

CKT NO.	TRIP AMPS	DESCRIPTION OF LOAD	LOAD KVA	AMPS	POLES	KVA PER PHASE A	KVA PER PHASE B	KVA PER PHASE C	POLES	AMPS	LOAD KVA	DESCRIPTION OF LOAD	TRIP AMPS	CKT NO.
1	20	AUTODIALER	0.5	4.2	1	8.1			3	63.0	22.7	DUPLEX LIFT STATION LCP DLS-LCP2	80	2
3	20	RECEPTACLE	0.18	1.5	1		7.7							
5	20	LIGHTING	0.2	1.7	1			7.8						
7	20	SPARE			1	0.0			1			SPARE	20	8
9	20	SPARE			1		0.0		1			SPARE	20	10
11	20	SPARE			1			0.0	1			SPARE	20	12
13	20	SPARE			1	0.0			1			SPARE	20	14
15	20	SPARE			1		0.0		1			SPARE	20	16
17	20	SPARE			1			0.0	1			SPARE	20	18

PANEL **LP2**
LOCATION Exterior WWTP Service
BUILDING N/A
NOTES:

TOTAL KVA	8.1	7.7	7.8
GRAND CONNECTED TOTAL KVA		23.6	

SERVICE CHARACTERISTICS
VOLTS: 208Y/120
PHASE: 3
WIRE: 4
10k MIN AIC SYMM, FULLY RATED ASSEMBLY

150 A MLO
_____ A MCB

EXISTING POWER DISTRIBUTION PANEL AT EXISTING WASTEWATER TREATMENT PLANT
REFER TO SHEET E-10 FOR LOCATION

CKT NO.	TRIP AMPS	DESCRIPTION OF LOAD	LOAD KVA	AMPS	POLES	KVA PER PHASE A	KVA PER PHASE B	KVA PER PHASE C	POLES	AMPS	LOAD KVA	DESCRIPTION OF LOAD	TRIP AMPS	CKT NO.
1	20	AUTODIALER	0.5	4.2	1	8.1			3	63.0	22.70	DUPLEX LIFT STATION LCP DLS-LCP1 **	80	2
3		<SPACE>			1		7.6							
5		<SPACE>			1			7.6						
7		<SPACE>			1	0.0			1			<SPACE>		8
9		<SPACE>			1		0.0		1			<SPACE>		10
11		<SPACE>			1			0.0	1			<SPACE>		12
13		<SPACE>			1	0.0			1			<SPACE>		14
15		<SPACE>			1		0.0		1			<SPACE>		16
17		<SPACE>			1			0.0	1			<SPACE>		18
19		<SPACE>			1	0.2			1	1.5	0.18	RECEPTACLE AT GENERATOR NO. 1	20	20
21	20	SPARE			1		0.2		1	1.5	0.18	RECEPTACLE AT GENERATOR NO. 2	20	22
NOTE 1 → 23	20	RECEPTACLE AT WETWELL	0.18	1.5	1			0.4	1	1.5	0.18	RECEPTACLE AT DIGESTER	20	24 → NOTE 1
25	20	RECEPTACLE AT PANEL	0.18	1.5	1	0.2			3			EXISTING WWTP BLOWERS	60	26 → NOTE 1
NOTE 1 → 27	30	EXISTING LIFT STATION LCP	4	19.2	2		2.0							
								2.0						

PANEL **PP1**
LOCATION NEAR GENERATOR
BUILDING N/A
NOTES: EXISTING PANEL
** INDICATES NEW LOAD

TOTAL KVA	8.4	9.7	9.9
GRAND CONNECTED TOTAL KVA		28.1	

SERVICE CHARACTERISTICS
VOLTS: 208Y/120
PHASE: 3
WIRE: 4
10k MIN AIC SYMM, FULLY RATED ASSEMBLY

225 A MLO
_____ A MCB

NOTES:

1. EXISTING LOADS THAT ARE DEMOLISHED DURING CONSTRUCTION SHALL BE MARKED AS "SPARE".

NEW POWER DISTRIBUTION PANEL AT NEW WASTEWATER TREATMENT PLANT
REFER TO SHEET E-10 FOR LOCATION

CKT NO.	TRIP AMPS	DESCRIPTION OF LOAD	LOAD KVA	AMPS	POLES	KVA PER PHASE A	KVA PER PHASE B	KVA PER PHASE C	POLES	AMPS	LOAD KVA	DESCRIPTION OF LOAD	TRIP AMPS	CKT NO.
1	20	CONTROL PANEL	3.27	12.4	3	4.2			3	3.8	0.89	CONTROL PANEL	20	2
		(FE-LCP)	3.52				4.7				1.14	(RP-LCP)		
			3.52					4.7			1.14			
7	20	CONTROL PANEL	0.61	2.8	3	3.7			3	11.6	3.05	CONTROL PANEL	30	8
		(AM-LCP)	0.86				4.2				3.30	(MAB-LCP)		
			0.86					4.2			3.30			
13	30	SPACE FOR FUTURE MXR PANEL	3.05	11.6	3	8.1			3	18.0	15	XLP1	30	14
			3.30				8.3					(LP-1 PANEL XFMR)		
			3.30					8.3						
19	20	SPARE			3	0.0			3			SPARE	30	20
							0.0							
								0.0						
25		SPACE			3	0.0			3			SPARE	30	26
							0.0							
								0.0						
31		SPACE			3	0.0			3			SPACE		32
							0.0							
								0.0						
37		SPACE			3	0.0			3			SPACE		38
							0.0							
								0.0						

PANEL **HP1**
LOCATION Exterior WWTP Service
BUILDING N/A
NOTES:

TOTAL KVA	15.9	17.1	17.1
GRAND CONNECTED TOTAL KVA		50.1	

SERVICE CHARACTERISTICS
VOLTS: 480Y/277
PHASE: 3
WIRE: 4
65k MIN AIC SYMM, FULLY RATED ASSEMBLY

_____ A MLO
150 A MCB

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CADD\ACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\05-ELECTRICAL\E-05.dwg LAYOUT: E-05 SAVED: 7/20/2016 5:41 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:18 AM BY: NEGRON-VIEIRA, VANESSA

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Professional Engineer's No.: 63077
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KEFF SCOTT KURELLA
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ELLISVILLE WASTEWATER TREATMENT PLANT

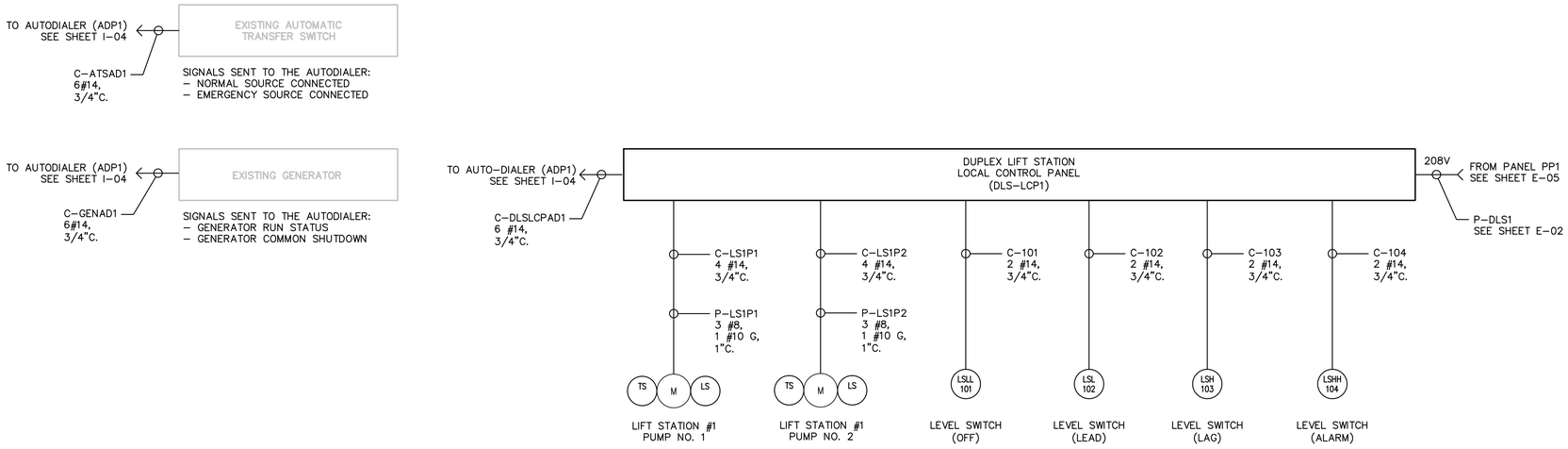
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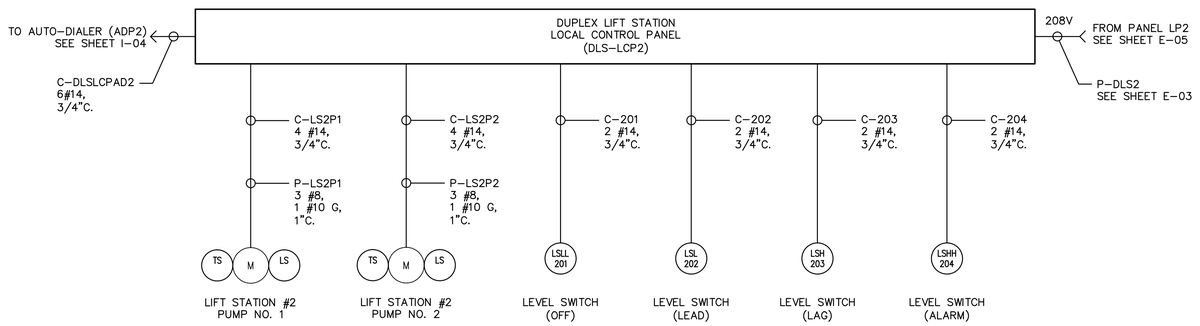
ARCADIS Project No.
06704010.0000

Date
OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

E-05





CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CAD\ACAD\PROJ\06704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\05-ELECTRICAL\E-06.dwg LAYOUT: E-06 SAVED: 7/20/2016 5:40 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUP.DWG PAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:19 AM BY: NEGRON-VIERA, VANESSA

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Professional Engineer's Name		
KEFF S. KURELLA, P.E.		
Professional Engineer's No.		
63077		
State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
EB	EB	KSK

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COLUMBIA COUNTY, FLORIDA

ELLISVILLE WASTEWATER TREATMENT PLANT

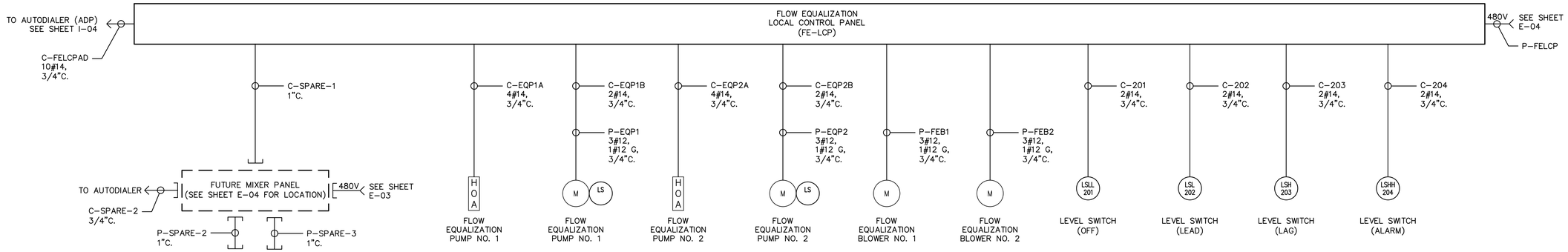
LIFT STATIONS - INTERCONNECT DIAGRAMS

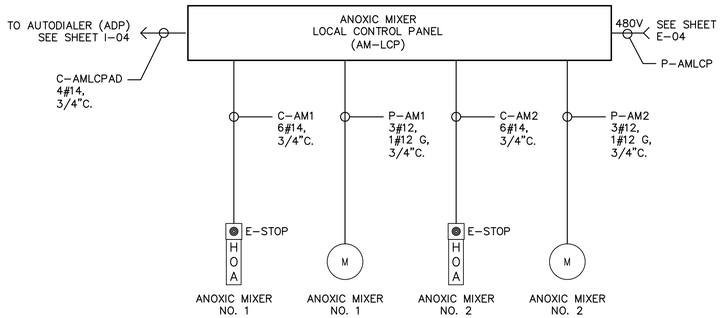
ARCADIS Project No.
06704010.0000

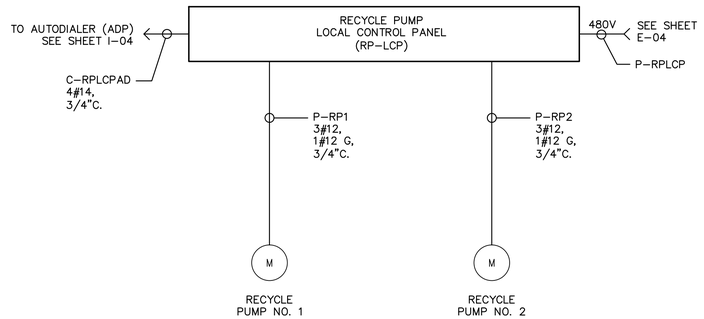
Date
OCTOBER 2016

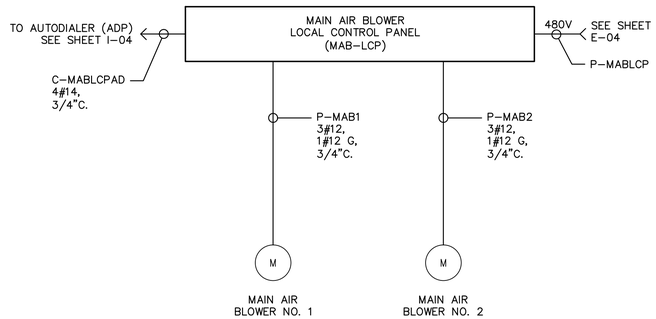
ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

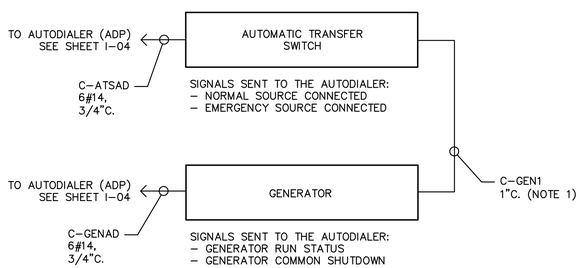
E-06

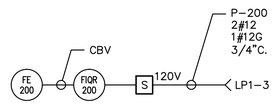












NOTES:

1. PROVIDE CONTROL WIRING BETWEEN THE GENERATOR AND THE AUTOMATIC TRANSFER SWITCH AS REQUIRED BY THE MANUFACTURER FOR COMPLETE AND FUNCTIONAL OPERATION.

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CADD\ACAD\PROJ\67104 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\05-ELECTRICAL\E-07.dwg LAYOUT: E-07 SAVED: 7/20/2016 5:40 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:19 AM BY: NEGRON-VIEIRA, VANESSA

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

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Professional Engineer's Name: KEFF S. KURELLA, P.E.
Professional Engineer's No.: 63077
State: FL | Date Signed: | Project Mgr.: SKC
Designed by: EB | Drawn by: EB | Checked by: KSK

KEFF SCOTT KURELLA
P.E. NO. 63077

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

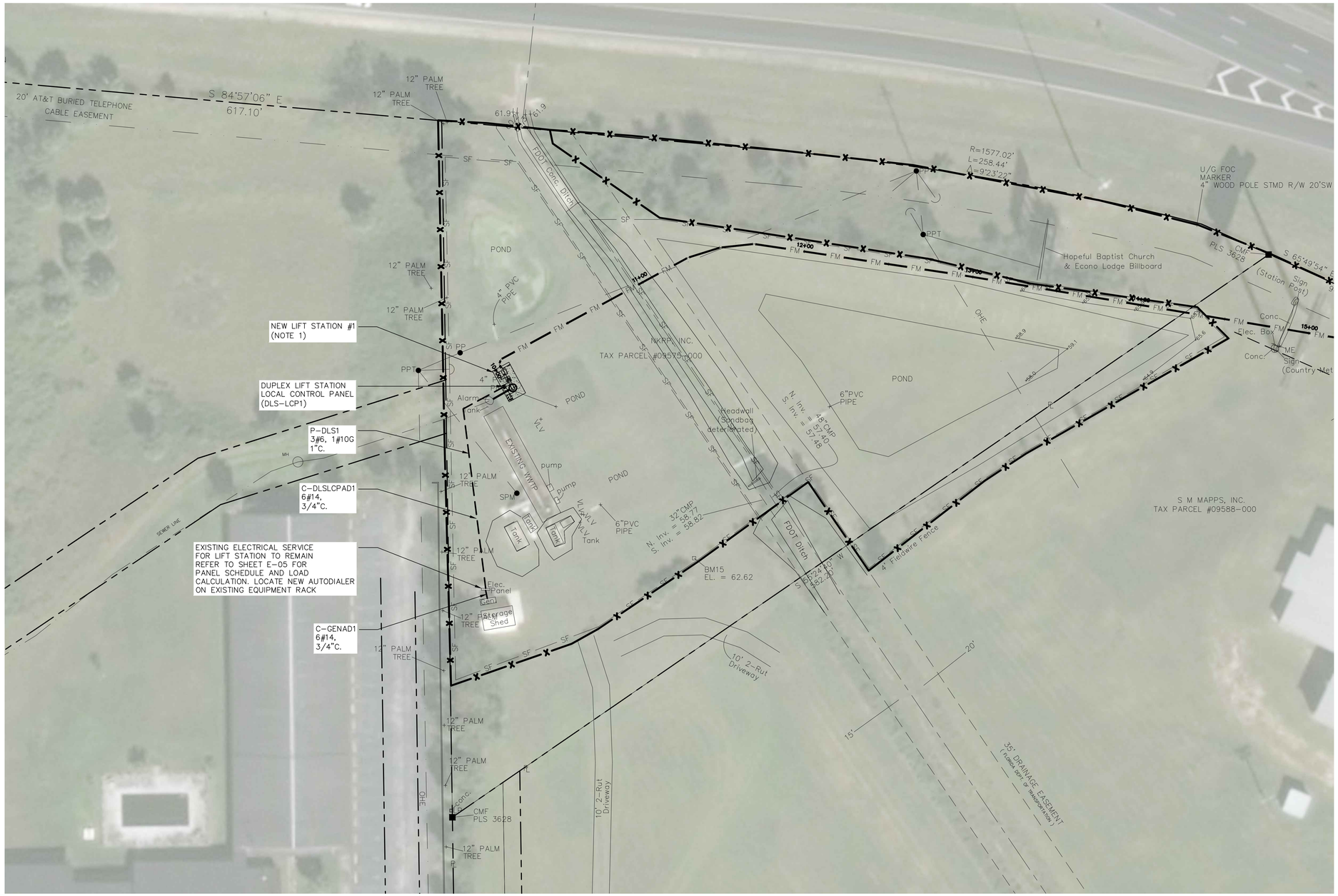
COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

WASTEWATER TREATMENT PLANT - INTERCONNECT DIAGRAM

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

E-07



NOTES:

1. NEW LIFT STATION WITH LOCAL CONTROL PANEL, DLS-LCP, TO REPLACE EXISTING. REFER TO SHEETS E-02 AND E-06 FOR ALL REQUIRED CONNECTIONS FROM THE LOCAL CONTROL PANEL TO THE LIFT STATION PUMPS AND FLOATS. REFER TO SHEETS M-01 AND I-02 FOR MORE INFORMATION.
2. THE EXISTING LIFT STATION AND WASTE WATER TREATMENT PLANT SHALL REMAIN IN OPERATION DURING CONSTRUCTION. COORDINATE WITH THE OWNER AND ALL OTHER TRADES FOR DEMOLITION.
3. TELEPHONE CONNECTION FOR THE NEW AUTODIALER SHALL BE BY THE OWNER.
4. PROVIDE EQUIPMENT RACK PER DETAIL ON SHEET E-12 TO MOUNT THE ELECTRICAL SERVICE EQUIPMENT.
5. REFER TO SHEET E-11 FOR THE EXTENTS OF THE CLASS 1, DIVISION 2 AREA CLASSIFICATION.

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CADD\ACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\05-ELECTRICAL\E-08.dwg LAYOUT: E-08 SAVED: 7/20/2016 5:40 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:19 AM BY: NEGRON-VIEIRA, VANESSA

0 30' 60'

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Professional Engineer's Name: KEFF S. KURELLA, P.E.
Professional Engineer's No.: 63077

State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
EB	EB	KSK

KEFF SCOTT KURELLA
P.E. NO. 63077

ORIGINAL SIGNED AND SEALED SHEET ON FILE

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FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

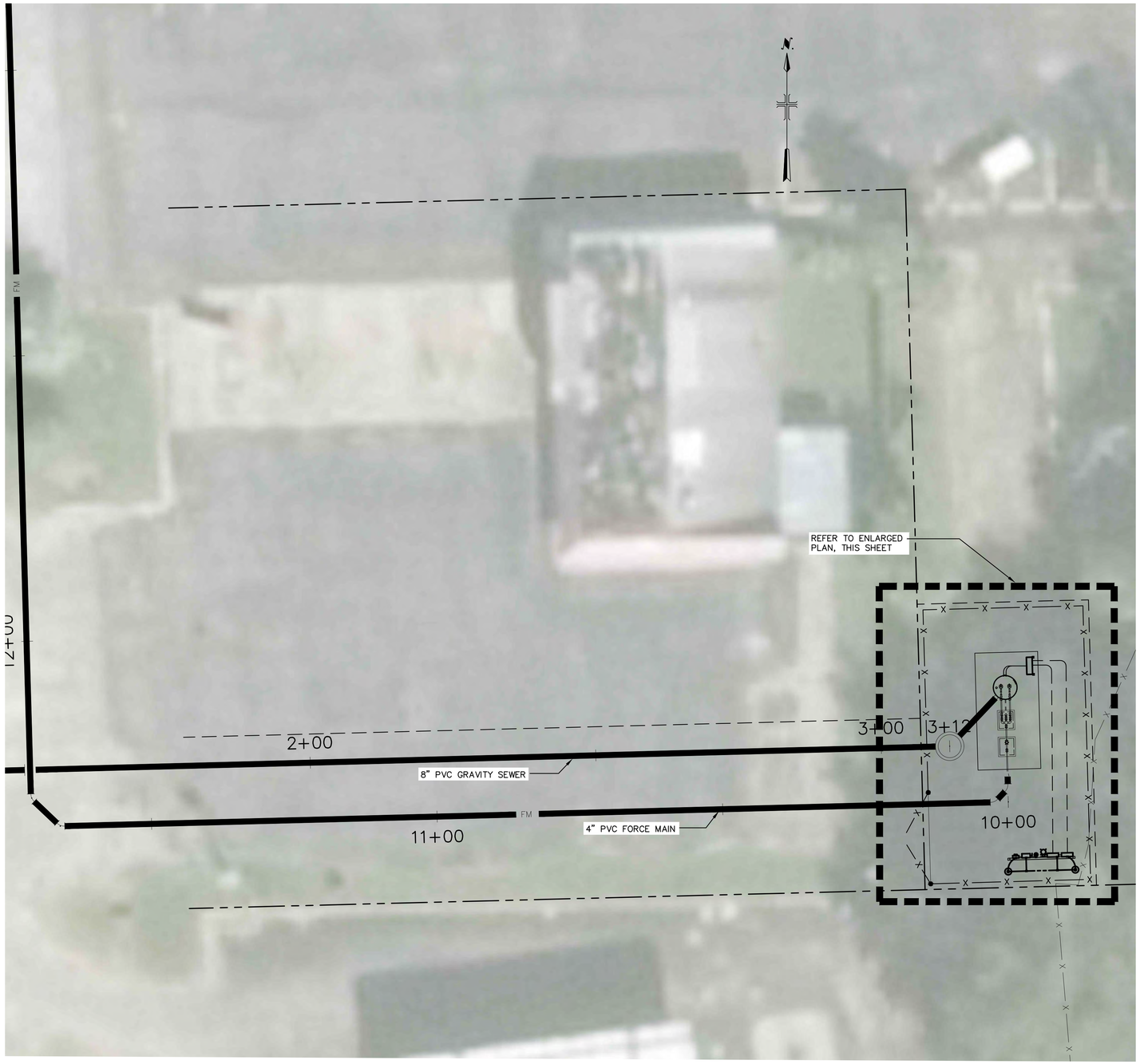
LIFT STATION NO. 1 - ELECTRICAL SITE PLAN

ARCADIS Project No.
06704010.0000

Date
OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

E-08

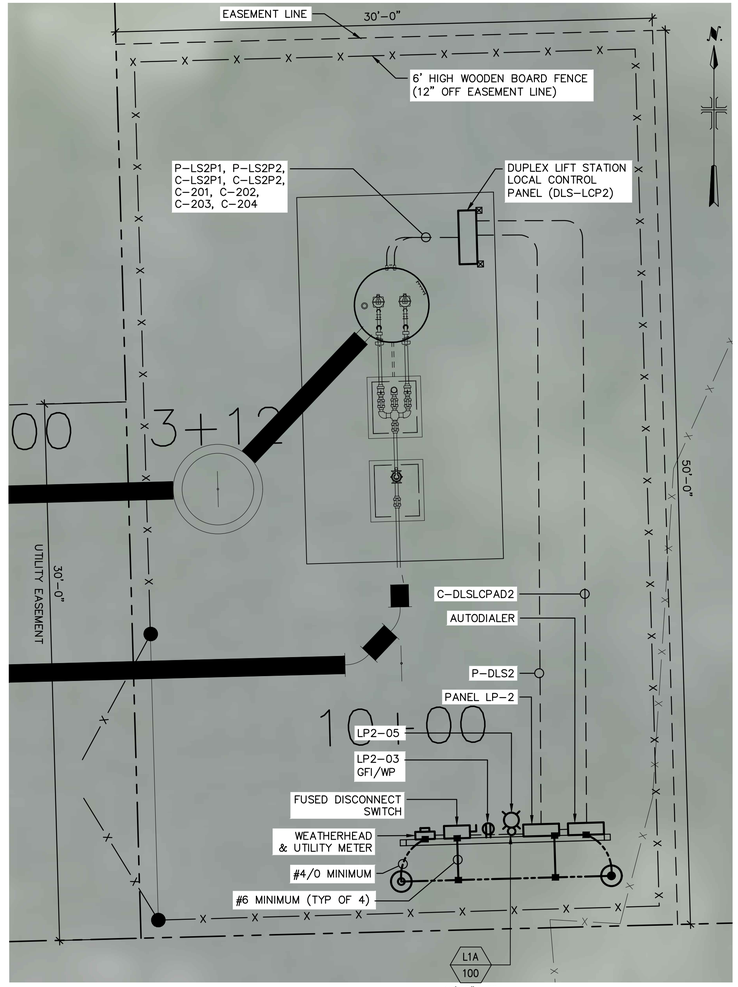


SITE PLAN

SCALE: 1" = 10'

NOTES:

1. NEW LIFT STATION WITH LOCAL CONTROL PANEL, DLS–LCP2. REFER TO SHEETS E–02 AND E–06 FOR ALL REQUIRED CONNECTIONS FROM THE LOCAL CONTROL PANEL TO THE LIFT STATION PUMPS AND FLOATS. REFER TO SHEETS M–01 AND I–02 FOR MORE INFORMATION.
2. THE EXISTING WASTE WATER TREATMENT PLANT SHALL REMAIN IN OPERATION DURING CONSTRUCTION. COORDINATE WITH THE OWNER AND ALL OTHER TRADES FOR DEMOLITION.
3. TELEPHONE CONNECTION FOR THE NEW AUTODIALER SHALL BE BY THE OWNER.
4. CONNECT THE LIGHTING HOMERUN CIRCUIT THROUGH A 120V, WATERPROOF SNAP SWITCH AS DEFINED PER SPECIFICATION 26 00 05.
5. PROVIDE EQUIPMENT RACK PER DETAIL ON SHEET E–12 TO MOUNT THE ELECTRICAL SERVICE EQUIPMENT.
6. COORDINATE EXACT CONNECTION POINT WITH THE LOCAL UTILITY PRIOR TO START OF WORK.
7. REFER TO SHEET E–11 FOR THE EXTENTS OF THE CLASS 1, DIVISION 2 AREA CLASSIFICATION.



ENLARGED PLAN

SCALE: 3" = 1'

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CAD\ACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\05-ELECTRICAL\E-09.dwg LAYOUT: E-09 SAVED: 10/6/2016 6:36 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:19 AM BY: NEGRON-VIERRA, VANESSA

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No.	Date	Revisions	By	Ckd

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Professional Engineer's Name: KEFF S. KURELLA, P.E.
Professional Engineer's No.: 63077

State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
EB	EB	KSK

KEFF SCOTT KURELLA
P.E. NO. 63077

ORIGINAL SIGNED AND SEALED SHEET ON FILE

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ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

LIFT STATION NO. 2 - ELECTRICAL SITE PLAN

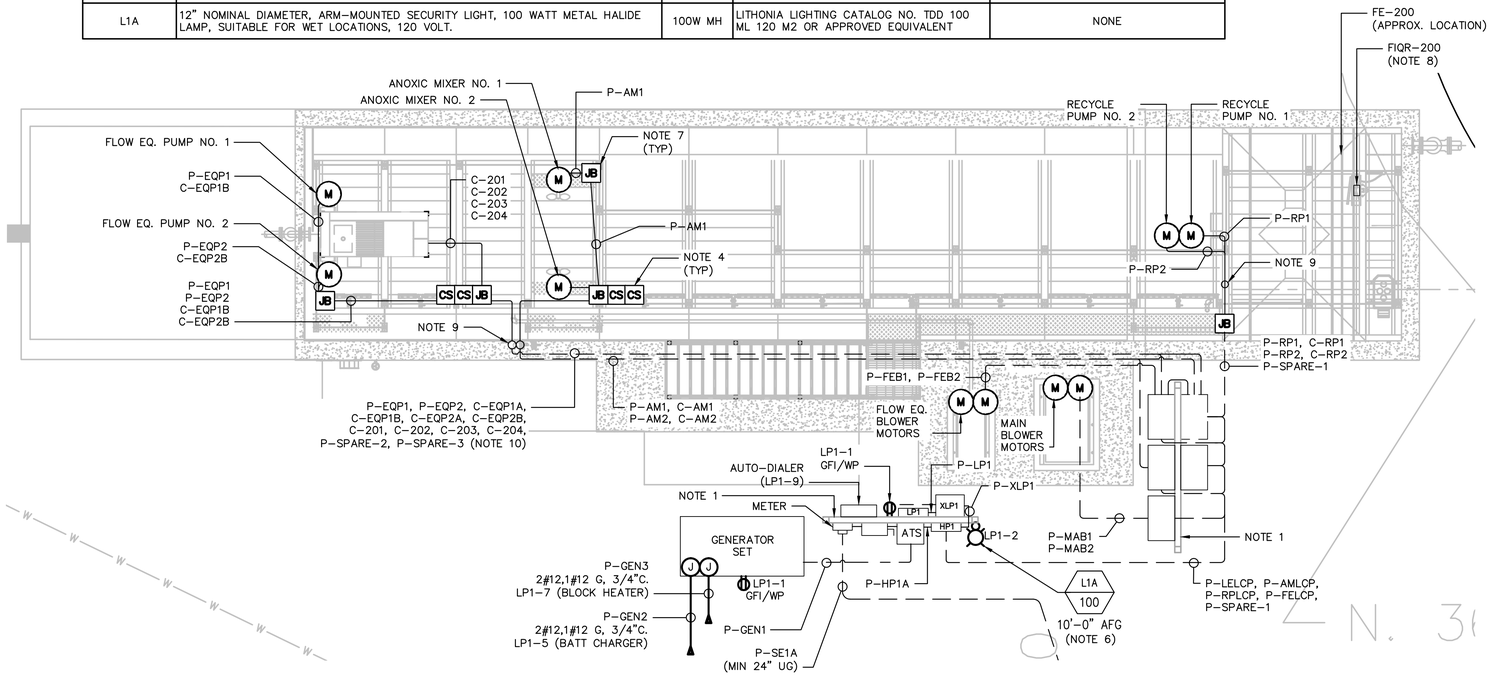
ARCADIS Project No.
06704010.0000

Date
OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

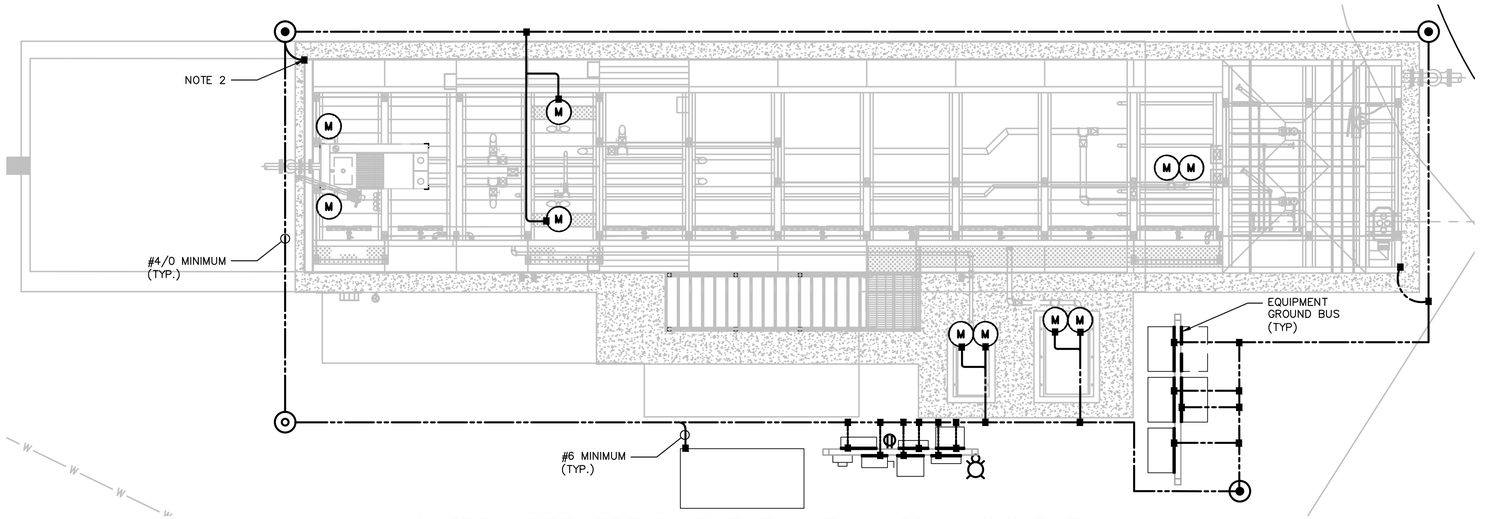
E-09

LIGHTING FIXTURE SCHEDULE				
FIXTURE LETTER	FIXTURE DESCRIPTION	BULB TYPE	MANUFACTURER MODEL NO.	REMARKS
L1A	12" NOMINAL DIAMETER, ARM-MOUNTED SECURITY LIGHT, 100 WATT METAL HALIDE LAMP, SUITABLE FOR WET LOCATIONS, 120 VOLT.	100W MH	LITHONIA LIGHTING CATALOG NO. TDD 100 ML 120 M2 OR APPROVED EQUIVALENT	NONE



WASTEWATER TREATMENT PLANT – ELECTRICAL PLAN

0 2' 4' 8'

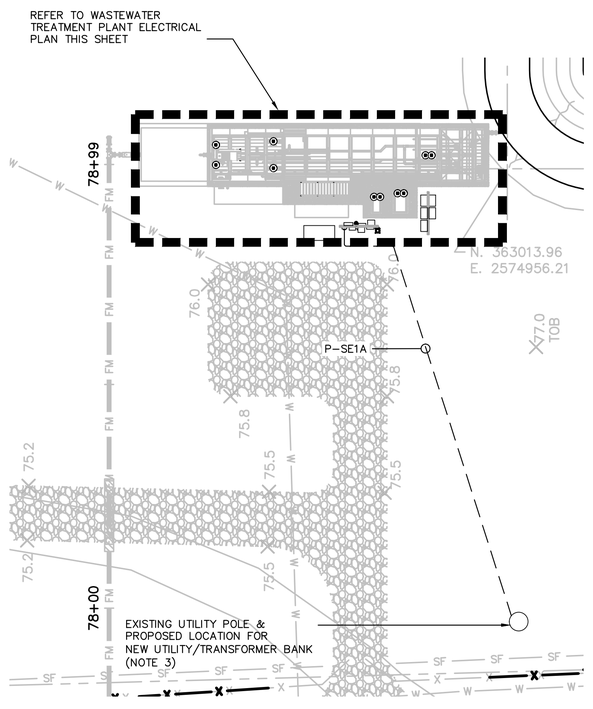


WASTEWATER TREATMENT PLANT – GROUNDING PLAN

0 2' 4' 8'

NOTES:

1. PROVIDE EQUIPMENT RACK PER DETAIL ON SHEET E-12 TO MOUNT THE ELECTRICAL SERVICE EQUIPMENT.
2. COORDINATE WITH THE SUPPLIER/INSTALLER OF THE PACKAGED WASTE WATER TREATMENT PLANT FOR OPTIMAL LOCATION OF ALL GROUNDING CONNECTIONS PRIOR TO INSTALLATION.
3. COORDINATE EXACT CONNECTION POINT WITH THE LOCAL UTILITY PRIOR TO START OF WORK.
4. REFER TO SHEET I-03 FOR EXACT CONFIGURATION OF EACH CONTROL STATION. TYPICAL FOR ALL UON.
5. REFER TO SHEET E-11 FOR THE EXTENTS OF THE CLASS 1, DIVISION 2 AREA CLASSIFICATION.
6. CONNECT THE LIGHTING HOMERUN CIRCUIT THROUGH A 120V, WATERPROOF SNAP SWITCH AS DEFINED PER SPECIFICATION 26 00 05.
7. PROVIDE A MINIMUM 18"x18"x12" DEEP, NEMA 4X JUNCTION BOX. MOUNT HEIGHT SHALL BE A MINIMUM 30" FROM THE PLATFORM LEVEL OF THE WASTE WATER TREATMENT PLANT TO THE BOTTOM OF THE JUNCTION BOX.
8. PROPOSED LOCATION OF FLOW ELEMENT TOTALIZER AT THE TOP OF THE PACKAGED WASTEWATER TREATMENT PLANT MOUNTED TO THE HAND RAIL STRUCTURE. COORDINATE EXACT LOCATION WITH THE OWNER PRIOR TO ROUGH-IN. COORDINATE ALL REQUIREMENTS FOR MAXIMUM WIRING DISTANCE FROM THE TOTALIZER TO THE FLOW ELEMENT. SEE SHEET I-04 FOR DETAILS.
9. THE PACKAGED WASTE WATER TREATMENT PLANT SUPPLIER WILL PROVIDE UNISTRUT BRACING IN ORDER TO SUPPORT VERTICAL SECTIONS OF CONDUIT. REFER TO SHEET S-04 FOR MORE INFORMATION.
10. PROVIDE QTY TWO (2) SPARE 1"C. (P-SPARE-2, P-SPARE-3) FROM FUTURE MIXER PANEL LOCATION TO STUB UP TO WESTSIDE OF NEW WWTP.



WASTEWATER TREATMENT PLANT – SITE PLAN

0 8' 16' 32'

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF* G:\CADD\ACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\05-ELECTRICAL\E-10.dwg LAYOUT: E-10 SAVED: 7/20/2016 5:33 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:19 AM BY: NEGRON-VIEIRA, VANESSA

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No.	Date	Revisions	By	Ckd

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Professional Engineer's Name: KEFF S. KURELLA, P.E.
Professional Engineer's No.: 63077
State: FL | Date Signed | Project Mgr.: SKC
Designed by: EB | Drawn by: EB | Checked by: KSK

KEFF SCOTT KURELLA
P.E. NO. 63077

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

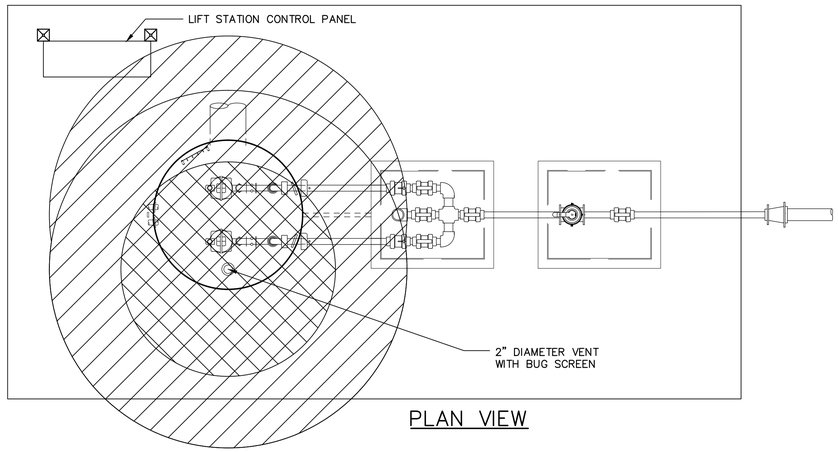
COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

WASTEWATER TREATMENT PLANT - ELECTRICAL SITE PLAN

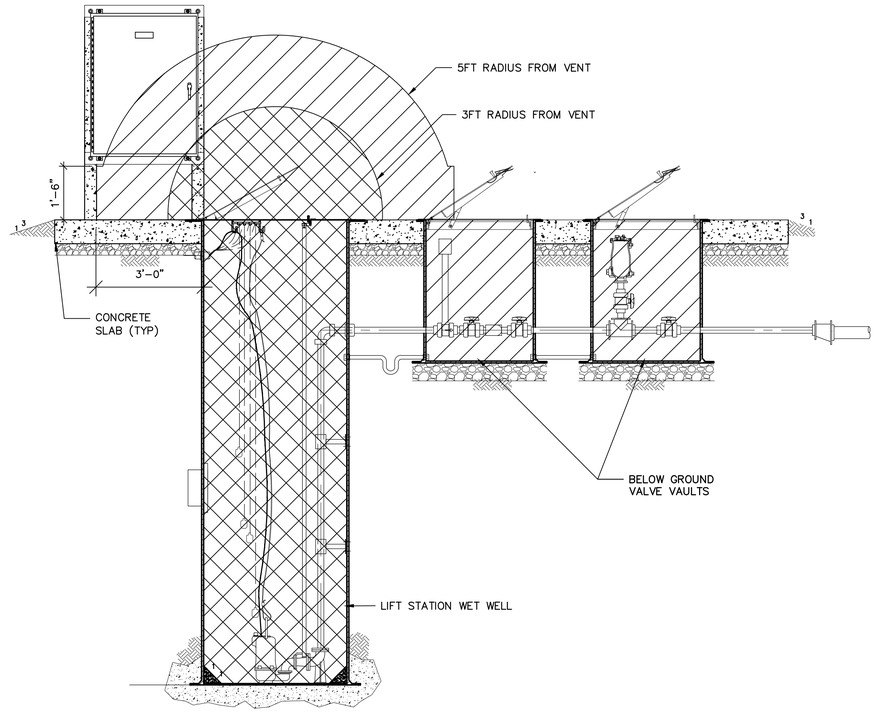
ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016

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3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

E-10



PLAN VIEW



LS AREA CLASSIFICATION PLAN (TYP.)

0 1' 2' 4'

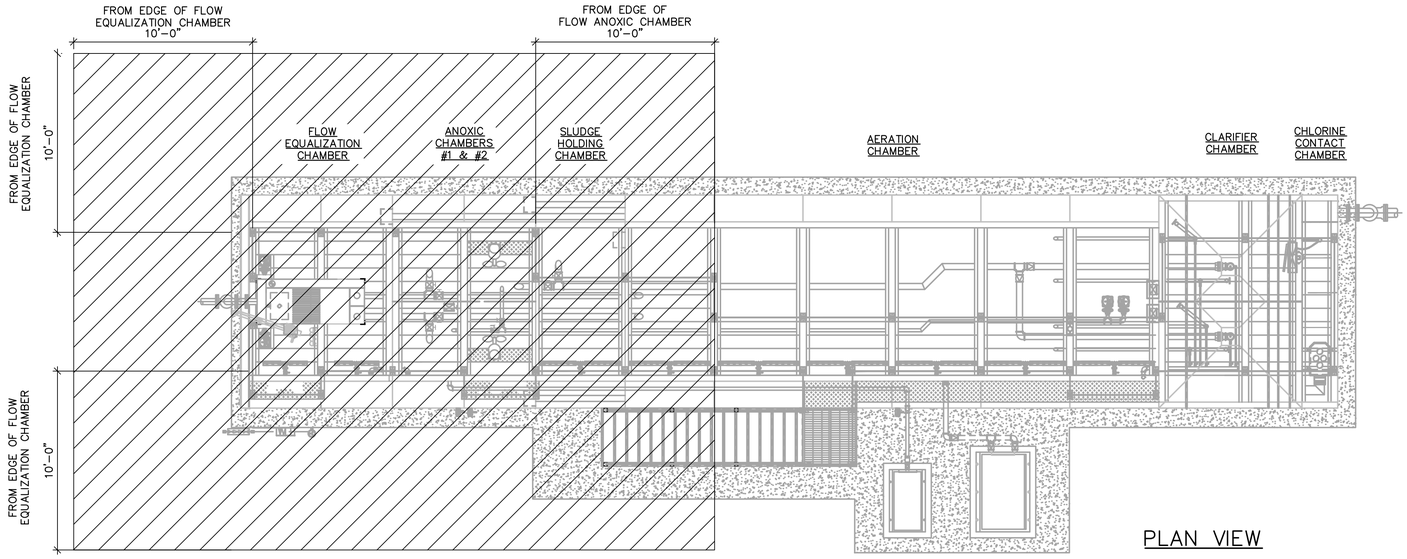
LEGEND:

CLASS 1, DIVISION 1 AREA

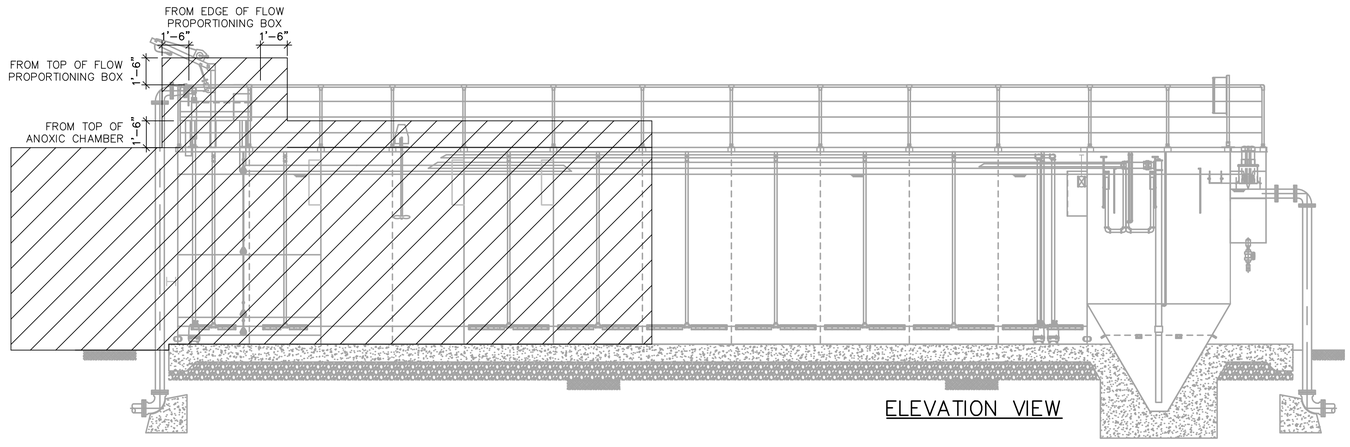
CLASS 1, DIVISION 2 AREA

NOTES:

1. THIS DRAWING IS CONTINGENT UPON THE BASIS OF DESIGN FOR THE PACKAGED WASTEWATER TREATMENT PLANT. THE AREA CLASSIFICATION SHALL BE MODIFIED AS NECESSARY FOR ANY MANUFACTURER OTHER THAN THE BASIS OF DESIGN.



PLAN VIEW



ELEVATION VIEW

WWTP AREA CLASSIFICATION PLAN

0 2' 4' 8'

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR ON=* OFF=*REF*
G:\CADD\ACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\05-ELECTRICAL\E-11.dwg LAYOUT: E-11 SAVED: 10/6/2016 6:55 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:19 AM BY: NEGRON-VIEIRA, VANESSA

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Professional Engineer's Name		
KEFF S. KURELLA, P.E.		
Professional Engineer's No.		
63077		
State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
EB	EB	KSK

KEFF SCOTT KURELLA
P.E. NO. 63077

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COLUMBIA COUNTY, FLORIDA

ELLISVILLE WASTEWATER TREATMENT PLANT

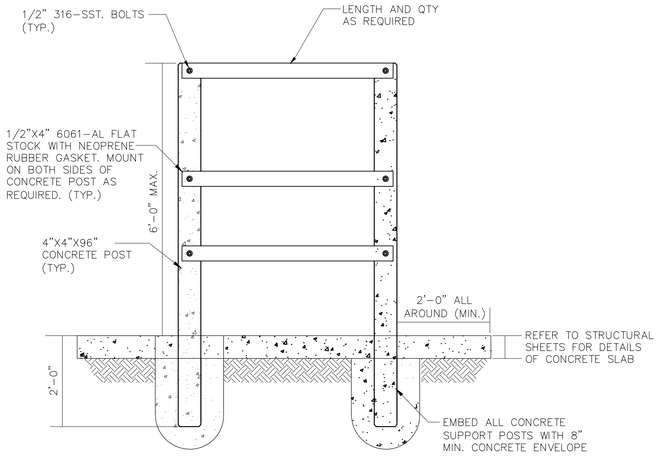
AREA CLASSIFICATION PLANS

ARCADIS Project No.
06704010.0000

Date
OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

E-11



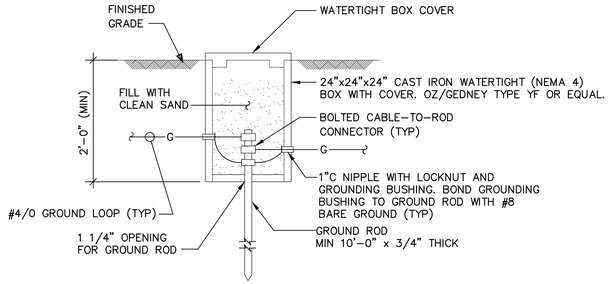
A EQUIPMENT RACK ON SLAB DETAIL

SCALE: NO SCALE

TYPE OF CONNECTION	BOLTED OR COMPRESSION		WELDED
	BURNDY CAT#	T&B CAT#	CADWELL CAT#
CABLE TO LUG (LUG, CABLE)	YA	54000 SERIES	LA
CABLE TO ROD (ROD, CABLE)	–	53000 SERIES	GT
ROD, CABLE	GAR	–	GR
CABLE TO CABLE (CABLE)	GX	53000 SERIES	TV OR TA
CABLE TO PIPE (CABLE, PIPE OR CONDUIT)	–	–	HA OR VS
	GAR OR GD	3900 SERIES	–
CABLE TO FLAT SURFACE (CABLE)	GB	–	HA OR HS
BRAID TO PIPE	GG	–	–

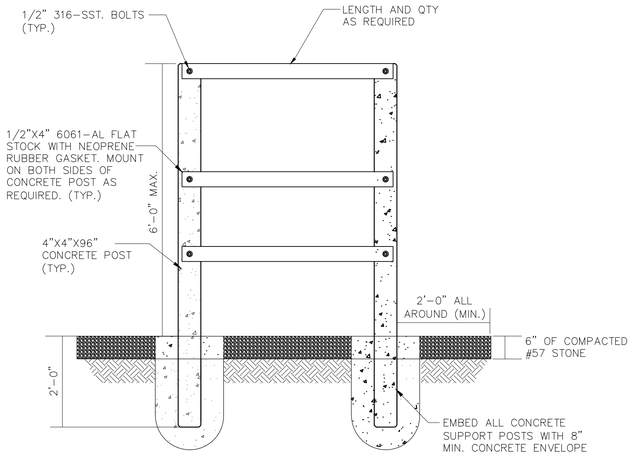
C GROUNDING CONNECTIONS

SCALE: NO SCALE



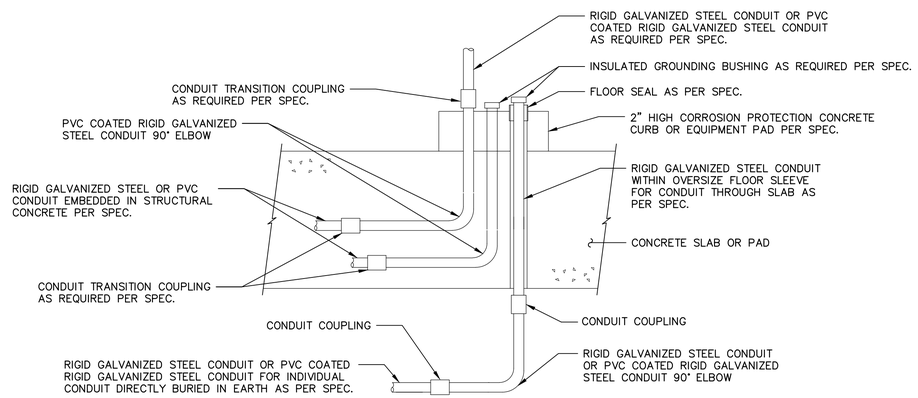
D EXTERIOR GROUND TEST POINT

SCALE: NO SCALE



B EQUIPMENT RACK ON GRADE DETAIL

SCALE: NO SCALE



E TYPICAL EMBEDDED CONDUIT DETAIL AND CONDUIT CORROSION PROTECTION DETAIL

SCALE: NO SCALE

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR ON:*OFF*REF*
G:\CADD\ACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\05-ELECTRICAL\E-12.dwg LAYOUT: E-12 SAVED: 7/20/2016 5:32 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUP.DEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:19 AM BY: NEGRON-VIEIRA, VANESSA

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Professional Engineer's No.: 63077
State: FL | Date Signed: | Project Mgr.: SKC
Designed by: EB | Drawn by: EB | Checked by: KSK

KEFF SCOTT KURELLA
P.E. NO. 63077

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

ELECTRICAL DETAILS

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016
ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

E-12

INSTRUMENT IDENTIFICATION LEGEND

	FIRST LETTER		SUCCEEDING LETTERS		
	MEASURED OR INITIATING VARIABLE,	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER FLAME		NOT USED	NOT USED	NOT USED
C	CONDUCTIVITY (ELECTRICAL)			CONTROL	CLOSED
D	DENSITY (MASS) OR SPECIFIC GRAVITY	DIFFERENTIAL			
E	VOLTAGE (EMF)		PRIMARY ELEMENT		
F	FLOW RATE	RATIO (FRACTION)			
G	INTRUSION		GLASS GAGE (UNCALIBRATED)		
H	HAND (MANUALLY INITIATED)				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME OR TIME SCHEDULE			CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOISTURE OR HUMIDITY				MIDDLE OR INTER-MEDIATE
N	SEQUENCE, STRATEGY		NOT USED	NOT USED	NOT USED
O	NOT USED		ORIFICE (RESTRICTION)		OPEN
P	PRESSURE OR VACUUM		POINT (TEST CONNECTION)	PULSE	
Q	QUANTITY	INTEGRATE OR TOTALIZE			
R	RADIOACTIVITY		RECORD OR PRINT		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION			VALVE, DAMPER OR LOUVER	
W	WEIGHT OR FORCE		WELL		
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT STATUS	Y AXIS		RELAY OR COMPUTE	
Z	POSITION			DRIVE, ACTUATE OR UNCLASSIFIED FINAL CONTROL ELEMENT	

BASE INSTRUMENTATION SYMBOLS

(FIT #) INSTRUMENT FIELD MOUNTED
SEE THIS SHEET FOR DETAILS OF INSTRUMENT TAGGING SYSTEM.
FULL TAG NUMBER SHOULD BE INCLUDED ON INSTRUMENT INDEX. POWER SUPPLY REQUIRED LOCALLY WHERE SHOWN.

(FIR #) INSTRUMENT PANEL FACE MOUNTED

(FY # X Y) INSTRUMENT RELAY MOUNTED IN REAR OF PANEL (BROKEN LINE). ACTIVATES AND DEACTIVATES CONTROL AND/OR ALARM SWITCHES AT PRESET VALUE. EQUIPMENT NUMBER (Y) ONLY WHEN NECESSARY. SEE BELOW FOR FUNCTIONS (X).

- △ DIFFERENCE
- > HIGH SELECTOR
- < LOW SELECTOR
- P/I PNEUMATIC/CURRENT CONVERTER
- I/I CURRENT/CURRENT CONVERTER (REPEATER)
- Σ SUMMATION
- AV AVERAGE
- % RATIO

(FR # AR # DO) FR & AR ARE TWO FUNCTIONS AS PART OF ONE UNIIT. (CIRCLES TOUCH)

SYMBOLS FOR ANALYTICAL DEVICES:
- CH_4–METHANE
- Cl_2–CHLORINE
- DO–DISSOLVED OXYGEN
- H_2S–HYDROGEN SULFIDE
- H_3PO_4 –PHOSPHORIC ACID
- H_2SO_4 –SULFURIC ACID
- MeOH–METHANOL
- NaHOCL–SODIUM HYPOCHLORITE
- $Na_2S_2O_5$ –SODIUM METHA–BISULFITE
- O_2–OXYGEN
- ORP –OXYDATION REDUCTION POTENTIAL
- pH–HYDROGEN ION CONCENTRATION

△▽ DISCRETE INPUT/OUTPUT

▲▼ ANALOG INPUT/OUTPUT

▲▽ DIGITAL COMMUNICATION INPUT/OUTPUT–ETHERNET (E), MODBUS (M), HART (H) OR DEVICENET (D)

IAS INSTRUMENT AIR SUPPLY

120V 120V AC POWER SUPPLY

480V 480V AC POWER SUPPLY

24V 24V DC POWER SUPPLY

PROGRAMMABLE LOGIC CONTROLLER (PLC) CONTROL BLOCK

(## #) POINT FOR SHARED VIDEO DISPLAY (FUNCTIONS IN PLC)

(## #) AS ABOVE WITH LIMITED ACCESS

(# ◇) INTERLOCK
– INTERLOCK CONTROL STRATEGY

(FIT #) THERMAL MASS METER

(FE #) MAGMETER

(FIT #) VENTURI

(FE #) ORIFICE PLATE

(FE #) ROTAMETER

(FE #) ANNUBAR FLOW METER

FLUME

(LE #) ULTRASONIC OR RADAR ELEMENT

(HSS #) SAFETY PULL CORD

(ZS #) BELT ALIGNMENT SWITCH

INSTRUMENT TAGGING SYSTEM

HF–IPS–FIT– 0234
- FACILITY CODE
- BUILDING CODE
- INSTRUMENT IDENTIFICATION
- LOOP NUMBER

(SEE DRAWING SET G FOR LIST OF FACILITY CODES)

VALVE SYMBOLS

- GATE VALVE
- GLOBE VALVE
- PLUG VALVE
- DIAPHRAGM VALVE
- BALL VALVE
- PINCH VALVE
- NEEDLE VALVE
- CHECK VALVE
- 3–WAY VALVE
- RELIEF VALVE
- PRESSURE SELF REGULATING VALVE
- BACK PRESSURE SELF REGULATING VALVE

PIPING SYMBOLS

- Y STRAINER
- VENT
- DIAPHRAGM SEAL WITH ISOLATION VALVE
- INLINE SEAL WITH ISOLATION VALVE
- PULSATION DAMPENER
- FLEXIBLE HOSE
- QUICK–CONNECT
- CALIBRATION COLUMN
- EYE WASH/EMERGENCY SHOWER
- UNION
- BACKFLOW PREVENTOR
- SINGLE BASKET STRAINER
- (SW) SEAL WATER
- DRAIN
- REDUCER

EQUIPMENT SYMBOLS

- CENTRIFUGAL PUMP
- METERING PUMP
- SUBMERSIBLE PUMP
- VERTICAL TURBINE PUMP
- PROGRESSIVE CAVITY PUMP
- PERISTALTIC PUMP
- POSITIVE DISPLACEMENT PUMP
- DIAPHRAGM PUMP
- GRINDER/MACERATOR
- BLOWER, CENTRIFUGAL
- BLOWER POSITIVE DISPLACEMENT
- CENTRIFUGAL FAN
- AXIAL/MIXED FLOW PUMP
- CHLORINE INJECTOR/JET PUMP
- WEIR
- (M) MOTOR
- GRIT SCREW
- MANUAL SCREEN
- (VFD) VARIABLE FREQUENCY DRIVE
- (MCC) MOTOR CONTROL CENTER

PANEL DEVICE SYMBOLS

(HS L/O/R) HAND SWITCH (MANUAL SELECTOR)
FUNCTION SUBSCRIPT (LOCATION MAY VARY)

(PB ESTOP) PUSHBUTTON
FUNCTION SUBSCRIPT (LOCATION MAY VARY)

FUNCTION SUBSCRIPTS FOR HAND SWITCH AND PUSHBUTTON CONTROLS:

ESTOP	E–STOP
F/O/R	FORWARD–OFF–REVERSE
F/O/JR	FORWARD–OFF–JOG REVERSE
H/O/A	HAND–OFF–AUTO
H/O/R	HAND–OFF–REMOTE
H/O/SBY	HAND–OFF–STANDBY
L/O/R	LOCAL–OFF–REMOTE
M/A	MANUAL–AUTO
M/O/A	MANUAL–OFF–AUTO
O/C	OPEN–CLOSE
O/O	ON–OFF
O/S/C	OPEN–STOP–CLOSE
RS	RESET
R/L	REMOTE–LOCAL
R/O	RUN–OFF
SC	SPEED CONTROL POTENTIOMETER
SCR	SILICON CRYSTAL RECTIFIER
S/S	START–STOP
S/SLO	START–STOP WITH LOCKOUT

(IL G) INDICATING LIGHT UNIT
G–GREEN (OFF,STOP,CLOSED)
R–RED (RUN,START,OPEN)
W–WHITE (POWER ON)
A–AMBER (ALARM CONDITION)
F–FLASHES ON ELECTRIC OR MECHANICAL MALFUNCTION

(1) INTERLOCK
1 = NOTE NUMBER

ELECTRONIC HORN

(W) STROBE LIGHT
A – AMBER
W – WHITE
R – RED
B – BLUE

INTERCONNECTING LINES WITH DOT INDICATE ROUTING OF THE SAME SIGNAL.

INTERCONNECTING LINES WITHOUT DOT INDICATE ROUTING OF MORE THAN ONE SIGNAL

GENERAL NOTES

1. COORDINATE WORK WITH OTHER DRAWINGS AND DISCIPLINES.
2. THE SYMBOLS SHOWN ON THIS SHEET ARE STANDARD DESIGNATIONS. NOT ALL SYMBOLS ARE APPLICABLE TO THE INCLUDED DIAGRAMS AND INSTRUMENT TAGGING SYSTEM.
3. NOT ALL PIPING, FITTINGS, AND TANK DETAILS ARE SHOWN. REFER TO PROCESS DRAWINGS FOR ACTUAL DETAILS.
4. INSTRUMENT IDENTIFICATION AND LOOP NUMBERS APPEAR WITH INSTRUMENT SYMBOL.
5. TAG NUMBER DOES NOT CHANGE IF SIGNAL IS BROUGHT TO ANOTHER CONTRACT AREA.
6. FINAL ALPHA CHARACTER IN TAG (E.G. FI–101A) INDICATES DUPLICATE DEVICE EXISTS. FI–101B MAY BE IN A A PANEL.

LINE TYPES

- SOFTWARE LINK, SYSTEM FUNCTION CONNECTION OR COMMUNICATION LINK
- MODBUS COMMUNICATION
- ETHERNET COMMUNICATION
- DEVICENET COMMUNICATION
- MAIN PROCESS LINE
- AUXILIARY SYSTEMS
- EQUIPMENT PACKAGE LIMIT
- ELECTRIC (ELECTRONIC) SIGNAL
- PNEUMATIC SIGNAL
- CAPILLARY LINE
- HYDRAULIC SIGNAL
- SONIC SIGNAL
- HEAT TRACED AND INSULATED
- TELEPHONE LINK
- EXISTING

DRAWING CONTINUATION LEGEND

PROCESS LINES (ON/OFF PAGE):

PROCESS MEDIUM
CONN | AREA OR EQUIPMENT DRAWING I–XXX

UTILITY LINES (ON/OFF PAGE):

REMARKS 1
CONN | UTILITY DRAWING NUMBER
REMARKS 2

INSTRUMENT SIGNAL LINES (ON/OFF PAGE):

SIGNAL NAME
CONN | DRAWING NUMBER

PROCESS LINE
NOT WITHIN THE BOUNDARY OF THIS SET OF DRAWINGS

PROCESS MEDIUM
PROCESS EQUIPMENT

INSTRUMENT SIGNAL LINE
NOT WITHIN THE BOUNDARY OF THIS SET OF DRAWINGS

SIGNAL NAME

CONN: CONNECTION NUMBER

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*OFF=*REF*
G:\CADD\ACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\06-INSTRUMENTATION\I-01.dwg LAYOUT: I-01 SAVED: 7/20/2016 5:48 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:20 AM BY: NEGRON-VIEIRA, VANESSA

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING. USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

THIS DRAWING IS THE PROPERTY OF THE ARCADIS ENTITY IDENTIFIED IN THE TITLE BLOCK AND MAY NOT BE REPRODUCED OR ALTERED IN WHOLE OR IN PART WITHOUT THE EXPRESS WRITTEN PERMISSION OF SAME.

Professional Engineer's Name: KEFF S. KURELLA, P.E.
Professional Engineer's No.: 63077

State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
EB	KAK	KSK

KEFF SCOTT KURELLA
P.E. NO. 63077

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS
ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

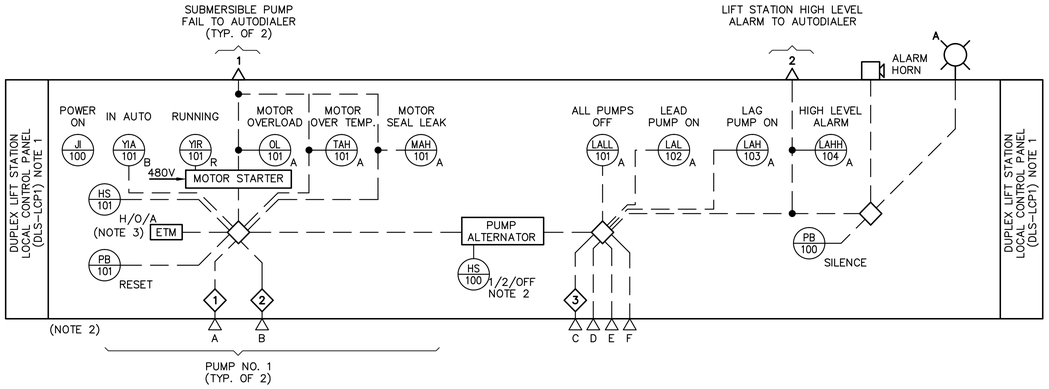
INSTRUMENTATION SYMBOLS & LEGEND

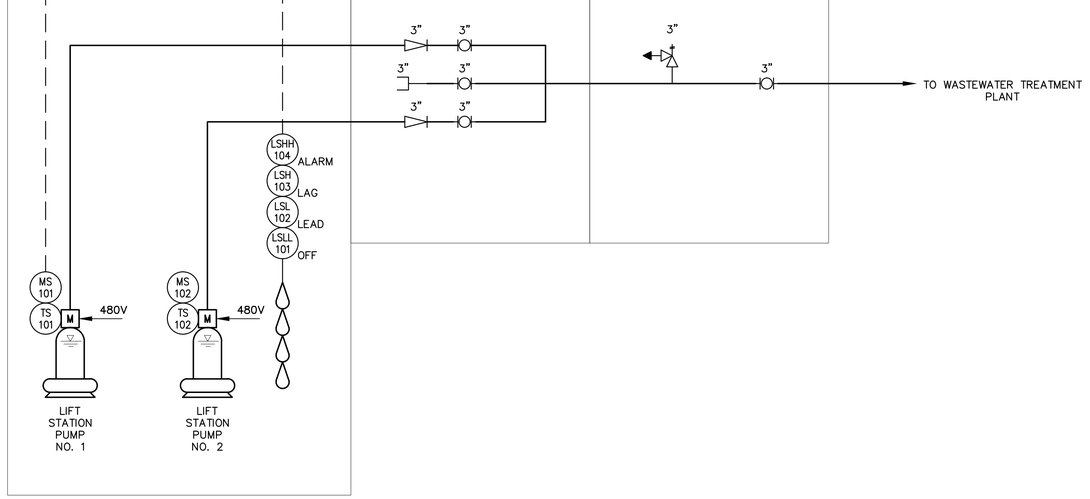
ARCADIS Project No.
06704010.0000

Date
OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

I-01





GENERAL NOTES:

1. THIS DRAWING SHALL APPLY TO BOTH LIFT STATION NO. 1 AND LIFT STATION NO. 2. EQUIPMENT LOOP NUMBER SHALL CHANGE FROM 1XX SERIES TO 2XX SERIES FOR LIFT STATION NO. 2.
2. PROVIDE AN ALTERNATOR WITH A MANUAL SELECTOR SWITCH TO ALLOW MANUAL SELECTION OF THE LEAD PUMP. ALTERNATOR SHALL BE MODEL 261 SERIES ALTERNATING RELAY AS PROVIDED BY TIME MARK CORPORATION, OR EQUAL.
3. DUPLEX LIFT STATION LOCAL CONTROL PANEL, (DLS-LCP), SHALL INCLUDE STARTERS, ALTERNATORS, INDICATING LIGHTS, SWITCHES, ETC. FOR (QTY OF 2) SUBMERSIBLE PUMPS.
4. ELAPSED TIME METER SHOULD BE VIEWABLE EITHER FROM EXTERIOR DOOR OR PANEL DEADFRONT.

INTERLOCK NOTES:

1. HIGH TEMPERATURE ALARM INTERLOCK (HARD-WIRED) SHALL SHUT DOWN RESPECTIVE LIFT STATION PUMP. AND REQUIRE RESET BEFORE IT CAN BE STARTED AGAIN.
2. SEAL LEAK ALARM INTERLOCK (HARD-WIRED) SHALL SHUT DOWN RESPECTIVE LIFT STATION PUMP. AND REQUIRE RESET BEFORE IT CAN BE STARTED AGAIN.
3. LOW LEVEL FLOAT INTERLOCK (HARD-WIRED) SHALL SHUT DOWN ALL PUMPS.

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G:\CAD\DAGAD\PROJ\06704 Columbia County FL\010 - Ellisville WWTP Mods\Sheets\06-INSTRUMENTATION\I-02.dwg LAYOUT: I-02 SAVED: 7/28/2016 5:48 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/19/2016 11:20 AM BY: NEGRON-VIEIRA, VANESSA

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Professional Engineer's Name: KEFF S. KURELLA, P.E.
Professional Engineer's No.: 63077

State	Date Signed	Project Mgr.
FL		SKC
Designed by: EB	Drawn by: KAK	Checked by: KSK

KEFF SCOTT KURELLA
P.E. NO. 63077

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

LIFT STATION - PROCESS & INSTRUMENTATION DIAGRAM

ARCADIS Project No.: 06704010.0000
Date: OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
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I-02

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FLOW EQ PUMP FAIL TO AUTODIALER (TYP. OF 2)

FLOW EQ HIGH LEVEL ALARM TO AUTODIALER

FLOW EQ BLOWER FAIL TO AUTODIALER (TYP. OF 2)

ANOXIC MIXER FAIL TO AUTODIALER (TYP. OF 2)

RECYCLE PUMP FAIL TO AUTODIALER (TYP. OF 2)

MAIN AIR BLOWER FAIL TO AUTODIALER (TYP. OF 2)

FLOW EQUALIZATION CONTROL PANEL LOCAL CONTROL PANEL (FE-LCP)

POWER ON (JI) W

IN AUTO (YIA) B

RUNNING (YIR) R

MOTOR OVERLOAD (OL) A

MOTOR SEAL LEAK (MAH) A

480V MOTOR STARTER

PB START

PB STOP

PB RESET

ETM

PUMP ALTERNATOR

HS 1/2/OFF (NOTE 1)

ALL PUMPS/FANS OFF (LALL) A

LEAD PUMP ON (LAL) A

LAG PUMP ON (LAH) A

HIGH LEVEL ALARM (LAHH) A

BLOWER ALTERNATOR

HS H/O/A

ANOXIC MIXER LOCAL CONTROL PANEL (AM-LCP)

RECYCLE PUMP LOCAL CONTROL PANEL (RP-LCP)

PUMP ALTERNATOR W/ TIMER

MAIN AIR BLOWER LOCAL CONTROL PANEL (MAB-LCP)

BLOWER ALTERNATOR W/ TIMER

ETM NOTE 6 (TYP.)

(NOTE 2)

(NOTE 3)

(NOTE 4)

(NOTE 5)

A B C D E F G H I J K

FLOW EQ PUMP NO. 1 (TYP. OF 2)

FLOW EQUALIZATION BLOWER NO. 1 (TYP. OF 2)

ANOXIC MIXER NO. 1 (TYP. OF 2)

RECYCLE PUMP NO. 1 (TYP. OF 2)

MAIN AIR BLOWER NO. 1 (TYP. OF 2)

FLOW EQ PUMP LOCAL CONTROL STATION (TYP. OF 2)

ANOXIC MIXER LOCAL CONTROL STATION (TYP. OF 2)

ESTOP

FLOW EQ PUMP NO. 1 (TYP. OF 2)

FLOW EQUALIZATION CHAMBER 8,000 GAL

LSHH 304 ALARM

LSH 303 LAG

LSL 302 LEAD

LSLL 301 OFF

RWOF

INFLUENT

RW (6" DI)

RW (4" PVC)

EOF (4" PVC)

FLOW EQUALIZATION PUMPS 1 & 2

AIR DIFFUSER

PI 301

A (2" SS)

FLOW EQUALIZATION AIR BLOWER NO. 1

FLOW EQUALIZATION AIR BLOWER NO. 1

SLUDGE HOLDING CHAMBER

RW (4" PVC)

EOF (4" PVC)

RECYCLE PUMP NO. 1 (TYP. OF 2)

MLR (2" PVC)

ANOXIC MIXER NO. 2

ANOXIC CHAMBER NO. 2

NC

NC

ANOXIC CHAMBER NO. 1

ANOXIC MIXER NO. 1

RECYCLE PUMPS 1 & 2

AERATION CHAMBER

WAS (4" PVC)

RAS (4" PVC)

RAS (4" PVC)

DECANT AIR LIFT PUMP W/ TELESCOPING VALVE

AIR DIFFUSER

A (3/4" SS)

A (3" SS)

PI 302

A (3" SS)

MAIN AIR BLOWER NO. 1

MAIN AIR BLOWER NO. 2

AIR LIFT PUMP (TYP)

ML (6" PVC)

RAS (4" PVC)

S (2" PVC)

S (2" PVC)

RAS (4" PVC)

ML (6" PVC)

CLARIFIER CHAMBER NO. 1

CLARIFIER CHAMBER NO. 2

AIR DIFFUSER

A (2" SS)

A (3/4" SS)

EFFLUENT LAUNDERER WITH DOUBLE SIDE V-NOTCH WEIR

FE (6" PVC)

CHLORINE CONTACT CHAMBER

FIQR 300 120V

FE 300

FE (6" DI)

EFFLUENT

V-NOTCH WEIR STAFF GAUGE

CHLORINE FEED

GENERAL NOTES:

1. PROVIDE AN ALTERNATOR WITH A MANUAL SELECTOR SWITCH TO ALLOW MANUAL SELECTION OF THE LEAD PUMP. ALTERNATOR SHALL BE MODEL 261 SERIES ALTERNATING RELAY AS PROVIDED BY TIME MARK CORPORATION, OR EQUAL.
2. FLOW EQUALIZATION LOCAL CONTROL PANEL, (FELCP), SHALL INCLUDE STARTERS, ALTERNATORS, TIMERS (WHERE INDICATED), INDICATING LIGHTS, SWITCHES, ETC. FOR (QTY OF 2) FLOW EQUALIZATION PUMPS AND (QTY OF 2) FLOW EQUALIZATION BLOWERS.
3. ANOXIC MIXER LOCAL CONTROL PANEL, (AMLCP), SHALL INCLUDE STARTERS, INDICATING LIGHTS, SWITCHES, ETC. FOR (QTY OF 2) ANOXIC MIXERS.
4. RECYCLE PUMP LOCAL CONTROL PANEL, (RPLCP), SHALL INCLUDE STARTERS, ALTERNATORS, TIMERS (WHERE INDICATED), INDICATING LIGHTS, SWITCHES, ETC. FOR (QTY OF 2) FLOW EQUALIZATION PUMPS AND (QTY OF 2) FLOW EQUALIZATION BLOWERS.
5. MAIN AIR BLOWER LOCAL CONTROL PANEL, (MABLCP), SHALL INCLUDE STARTERS, ALTERNATORS, TIMERS, INDICATING LIGHTS, SWITCHES, ETC. FOR (QTY OF 2) MAIN AIR BLOWERS.
6. (NOTE 3 FROM I-02)

INTERLOCK NOTES:

1. SEAL LEAK ALARM INTERLOCK (HARD-WIRED) SHALL SHUT DOWN RESPECTIVE SUBMERSIBLE PUMP AND REQUIRE RESET BEFORE IT CAN BE STARTED AGAIN.
2. LOW LEVEL FLOAT INTERLOCK (HARD-WIRED) SHALL SHUT DOWN ALL RESPECTIVE PUMPS AND FANS.

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

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Professional Engineer's Name: KEFF S. KURELLA, P.E.

Professional Engineer's No.: 63077

State	Date Signed	Project Mgr.
FL		SKC
Designed by	Drawn by	Checked by
EB	KAK	KSK

KEFF SCOTT KURELLA
P.E. NO. 63077

ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA

ELLISVILLE WASTEWATER TREATMENT PLANT

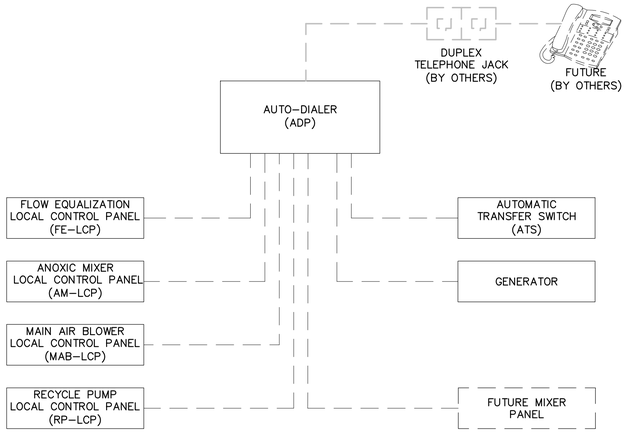
WASTEWATER TREATMENT PLANT - PROCESS & INSTRUMENTATION DIAGRAM

ARCADIS Project No. 06704010.0000

Date OCTOBER 2016

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I-03

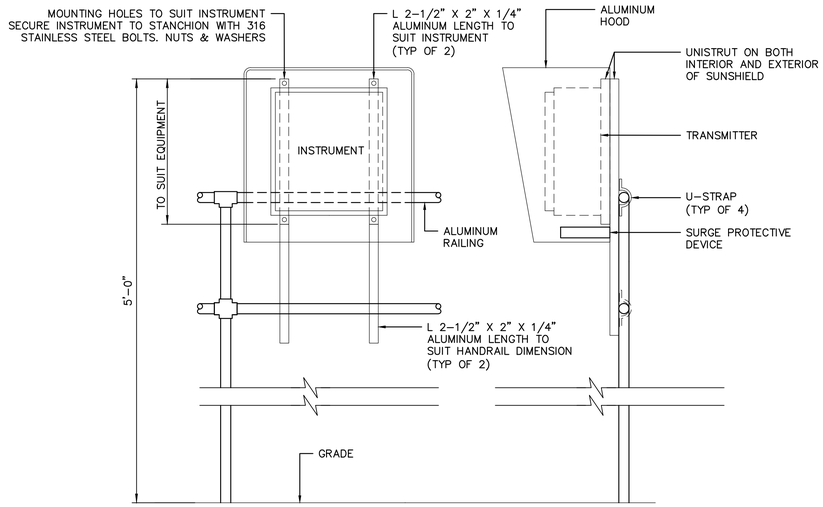


A WWTP AUTO–DIALER NETWORK DIAGRAM

SCALE: NO SCALE

NOTES:

1. REFER TO ELECTRICAL DRAWINGS FOR CONDUIT AND WIRING REQUIREMENTS.
2. REFER TO SPECIFICATION SECTION 40 60 05 FOR AUTO DIALER INPUT/OUTPUT LIST.
3. PHONE LINE BY OWNER.



B RAILING MOUNTING STAND FOR INSTRUMENTS

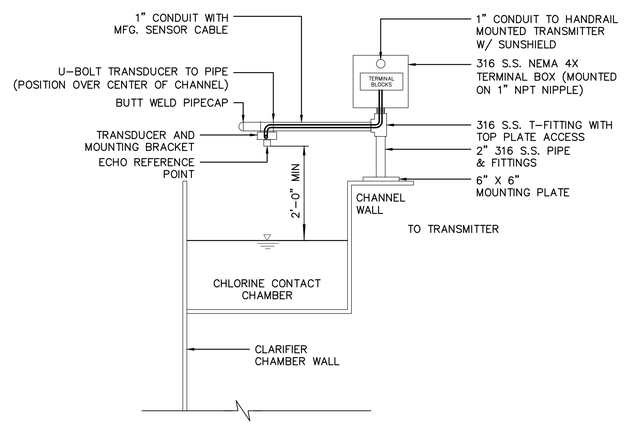
SCALE: NO SCALE

(ALL RAILING MOUNTED PANELS/TRANSMITTERS)

1
I–04

NOTES:

1. SUN SHIELD SHALL BE AS PER DIV 40 SPECIFICATIONS.
2. ALL EXPOSED EDGES TO BE GROUND SMOOTH AND BURR FREE.



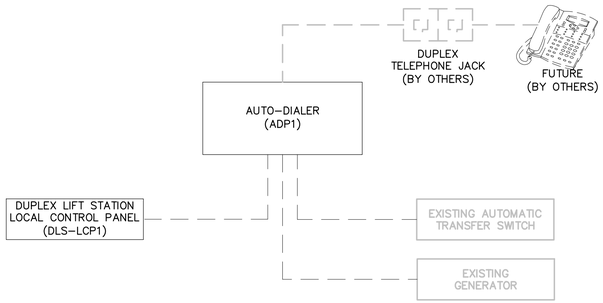
C OPEN CHANNEL FLOW METER MOUNTING DETAIL

SCALE: NO SCALE

2
I–04

NOTES:

1. ALL EXPOSED EDGES TO BE GROUND SMOOTH AND BURR FREE.

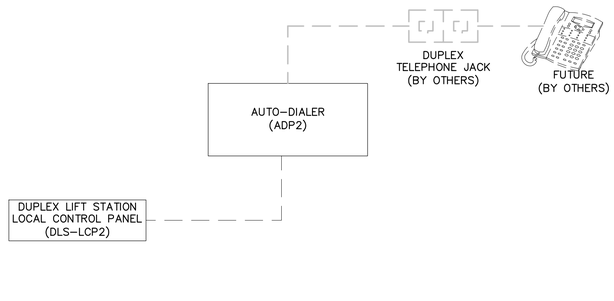


D DUPLEX LIFT STATION #1 – AUTO–DIALER NETWORK DIAGRAM

SCALE: NO SCALE

NOTES:

1. REFER TO ELECTRICAL DRAWINGS FOR CONDUIT AND WIRING REQUIREMENTS.
2. REFER TO SPECIFICATION SECTION 40 60 05 FOR AUTO DIALER INPUT/OUTPUT LIST.
3. PHONE LINE BY OWNER.



E DUPLEX LIFT STATION #2 – AUTO–DIALER NETWORK DIAGRAM

SCALE: NO SCALE

NOTES:

1. REFER TO ELECTRICAL DRAWINGS FOR CONDUIT AND WIRING REQUIREMENTS.
2. REFER TO SPECIFICATION SECTION 40 60 05 FOR AUTO DIALER INPUT/OUTPUT LIST.
3. PHONE LINE BY OWNER.

0 4" 8" 16"

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

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Professional Engineer's Name: KEFF S. KURELLA, P.E.		
Professional Engineer's No.: 63077		
State: FL	Date Signed:	Project Mgr.:
Designed by: EB	Drawn by: KK	Checked by: KSK

KEFF SCOTT KURELLA
P.E. NO. 63077

ORIGINAL SIGNED AND SEALED SHEET ON FILE

ARCADIS

ARCADIS U.S., INC.
FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER 7917

COLUMBIA COUNTY, FLORIDA
ELLISVILLE WASTEWATER TREATMENT PLANT

NETWORK DIAGRAM & INSTALLATION DETAILS

ARCADIS Project No.
06704010.0000

Date
OCTOBER 2016

ARCADIS
3109 W. DR. MARTIN LUTHER KING JR. BLVD., SUITE 350
TAMPA, FLORIDA 33607
TEL. 813.903.3125

I-04

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CADD\ACAD\PROJ\6704 Columbia County FL\010 - Ellisville WWTP Models\Sheets\06-INSTRUMENTATION\I04.dwg LAYOUT: I-04 SAVED: 7/20/2016 5:46 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: NCSPAGESETUPDEFAULT PLOTSTYLETABLE: NCS FULL MONO.CTB PLOTTED: 10/10/2016 11:20 AM BY: NEGRON-VIEIRA, VANESSA