

ATTACHMENT G
LAKE AOPKA NORTH SHORE PHASE 4 PUMP STATION
TECHNICAL SPECIFICATIONS

**100% TECHNICAL
SPECIFICATIONS FOR**

**LAKE APOPKA NORTH SHORE PHASE 4 PUMP STATION
IFB No. 34718**

Prepared for:



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REISS ENGINEERING

PLANNING | DESIGN | CONSTRUCTION

St. Johns River Water Management District Lake Apopka North Shore Phase 4 Pump Station

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**SECTION 01000
GENERAL REQUIREMENTS**

PART 1 - GENERAL

1.01 SCOPE AND INTENT

A. Description of Project:

The project consists of the construction of a canal transfer pumping station and earthen berm located approximately 1.3 miles north of Lake Apopka near the intersection of Laughlin Road and McDonald/Fudge Road, Apopka, Florida 32703.

B. Work Included:

1. The Contractor shall furnish all supervision, labor, materials, power, light, heat, fuel, water, tools, appliances, equipment, supplies, and means of construction necessary for proper performance and completion the work. The Contractor shall obtain and pay for all required permits. The Contractor shall perform and complete the work in the manner best calculated to promote rapid construction consistent with safety of life and property and to the satisfaction of the District (St. Johns River Water Management District), and in strict accordance with the Contract Documents. The Contractor shall clean up the Work and maintain it during and after construction, until accepted, and shall do all work and pay all costs incidental thereto. The Contractor shall repair or restore all structures and property that may be damaged or disturbed during performance of the Work.
2. The cost of incidental work described in these General Requirements, for which there are no specific Contract Items, shall be considered as part of the general cost of doing the Work and shall be included in the prices for the various Contract Items. No additional payment will be made therefore.
3. The Contractor shall provide and maintain such modern materials, tools, and equipment as may be necessary, in the opinion of the District and Engineer, to perform in a satisfactory and acceptable manner all the work required by this Contract. Only equipment of established reputation and proven efficiency shall be used. The Contractor shall be solely responsible for the adequacy of his workmanship, materials and equipment, prior approval of the District or Engineer notwithstanding.

C. Public Utility Installations and Structures:

1. Public utility installations and structures shall be understood to include all poles, tracks, pipes, wires, conduits, vaults, manholes and all other appurtenances and facilities pertaining thereto whether owned or controlled by

the District, other governmental bodies or privately owned by individuals, firms or corporations, used to serve the public with transportation, traffic control, gas, electricity, telephone, sewerage, drainage, water or other public or private property which may be affected by the Work shall be deemed included hereunder.

2. The Contract Documents contain data relative to existing public utility installations and structures above and below the ground surface. These data are not guaranteed as to their completeness or accuracy and it is the responsibility of the Contractor to make its own investigations to inform itself fully of the character, condition and extent of all such installations and structures as may be encountered and as may affect the construction operations.
3. The Contractor shall protect all public utility installations and structures from damage during the work. Access across any buried public utility installation or structure shall be made only in such locations and by means approved by the District and Engineer. The Contractor shall so arrange its operations as to avoid any damage to these facilities. All required protective devices and construction shall be provided by the Contractor at his expense. All existing public utilities damaged by the Contractor which are shown on the Drawings or have been located in the field by the utility shall be repaired by the Contractor, at its expense, as directed by the District. No separate payment shall be made for such protection or repairs to public utility installations or structures.
4. Public utility installations or structures owned or controlled by the District or other governmental body which are shown on the Drawings to be removed, relocated, replaced or rebuilt by the Contractor shall be considered as a part of the general cost of doing the work and shall be included in the prices bid for the various contract items. No separate payment shall be made therefore.
5. Where public utility installations or structures owned or controlled by the District or other governmental body are encountered during the course of the work, and are not indicated on the Drawings or in the Technical Specifications "Specifications", and when, in the opinion of the Engineer, removal, relocation, replacement or rebuilding is necessary to complete the work under this Contract, such work shall be accomplished by the utility having jurisdiction, or such work may be ordered, in writing by the District, for the Contractor to accomplish. If such work is accomplished by the utility having jurisdiction it will be carried out expeditiously and the Contractor shall give full cooperation to permit the utility to complete the removal, relocation, replacement or rebuilding as required. If such work is accomplished by the Contractor, it will be paid for as extra work as provided in the Agreement.
6. The Contractor shall, at all times in performance of the work, employ approved methods and exercise reasonable care and skill so as to avoid unnecessary delay, injury, damage or destruction of public utility installations and structures; and shall, at all times in the performance of the work, avoid

unnecessary interference with, or interruption of, public utility services, and shall cooperate fully with the District thereof to that end.

7. The Contractor shall give written notice to District, other governmental utility departments and other owners of public utilities of the location of his proposed construction operations, at least forty-eight hours in advance of breaking ground in any area or on any unit of the work.
8. The maintenance, repair, removal, relocation or rebuilding of public utility installations and structures, when accomplished by the Contractor as herein provided, shall be done by methods approved by the owners of such utilities.

1.02 DRAWINGS AND PROJECT MANUAL

- A. Drawings: When obtaining data and information from the Drawings, figures shall be used in preference to scaled dimensions, and large scale drawings in preference to small scale drawings.
- B. Copies Furnished to Contractor:
 1. After the payment and performance bond and insurance have been submitted and approved by the District, and the Contract has been executed by both parties, the District will furnish the Contractor one (1) complete set of drawings (22-inch by 34-inch).
 2. The Contractor shall furnish each of the subcontractors, manufacturers, and material suppliers such copies of the Contract Documents as may be required for their work. All copies of the Contract Documents shall be printed from the reproducible sets furnished to the Contractor. All costs of reproduction and printing shall be borne by the Contractor.
- C. Supplementary Drawings:
 1. When, in the opinion of the District and Engineer, it becomes necessary to explain more fully the work to be done or to illustrate the work further or to show any changes which may be required, drawings known as Supplementary Drawings, with Specifications pertaining thereto, will be prepared by the ENGINEER and the Contractor will be furnished one (1) complete set of drawings (22-inch by 34-inch).
 2. The Supplementary Drawings shall be binding upon the Contractor with the same force as the Drawings. Where such Supplementary Drawings require either less or more than the estimated quantities of work, credit to the District or compensation therefore to the Contractor shall be subject to the terms of the Agreement.
- D. Contractor to Check Drawings and Data:
 1. The Contractor shall verify all dimensions, quantities and details shown on the Drawings, Supplementary Drawings, schedules, Specifications or other data

received from the District and Engineer, and shall notify the District of all errors, omissions, conflicts, and discrepancies found therein. Failure to discover or correct errors, conflicts or discrepancies shall not relieve the Contractor of full responsibility for unsatisfactory work, faulty construction or improper operation resulting there from nor from rectifying such conditions at the Contractor's own expense. The Contractor will not be allowed to take advantage of any errors or omissions, as full instructions will be furnished by the Engineer, should such errors or omissions be discovered.

2. All schedules are given for the convenience of the Engineer and the Contractor and are not guaranteed to be complete. The Contractor shall assume all responsibility for the making of estimates of the size, kind, and quality of materials and equipment included in work to be done under the Contract.
- E. Technical Specifications: The Specifications consist of three parts: General, Products and Execution. The General Section contains General Requirements which govern the Work. Products and Execution modify and supplement these by detailed requirements for the Work and shall always govern whenever there appears to be a conflict.
- F. Intent:
1. All Work called for in the Specifications applicable to this Contract, but not shown on the Drawings in their present form, or vice versa, shall be of like effect as if shown or mentioned in both. Work not specified in either the Drawings or in the Specifications, but involved in carrying out their intent or in the complete and proper execution of the work, is required and shall be performed by the Contractor as though it were specifically delineated or described.
 2. The apparent silence of the Specifications as to any detail, or the apparent omission from them of a detailed description concerning any work to be done and materials to be furnished, shall be regarded as meaning that only the best general practice is to prevail and that only material and workmanship of the best quality is to be used, and interpretation of these Specifications shall be made upon that basis.

1.03 MATERIALS AND EQUIPMENT

- A. Manufacturer:
1. The names of proposed manufacturers, material suppliers, and dealers who are to furnish materials, fixtures, equipment, appliances or other fittings shall be submitted to the Engineer for approval, as early as possible, to afford proper investigation and checking. Such approval must be obtained before Shop Drawings will be checked. No manufacturer will be approved for any materials to be furnished under this Contract unless he shall be of good reputa-

tion and have manufactured products of ample capacity. The manufacturer shall, upon the request of the Engineer, be required to submit evidence that he has manufactured a similar product to the one specified and that it has been previously used for a like purpose for a sufficient length of time to demonstrate its satisfactory performance.

2. All transactions with the manufacturers or subcontractors shall be through the Contractor, unless the Contractor shall request, in writing to the Engineer, that the manufacturer or subcontractor deal directly with the Engineer. Any such transactions shall not in any way release the Contractor from his full responsibility under this Contract.
3. Any two or more pieces of material or equipment of the same kind, type or classification, and being used for identical types of service, shall be made by the same manufacturer.

B. Delivery and Storage:

1. The Contractor shall deliver and store materials to the site in ample quantities to ensure the most speedy and uninterrupted progress of the work so as to complete the work within the allotted time. However, the Contractor shall not store materials on site for more than thirty days before installation.
2. The Contractor shall also coordinate deliveries in order to avoid delay in, or impediment of, the progress of the work of any related Contractor.
3. All materials and equipment shall be properly stored on site in accordance with these Specifications and the manufacturer's recommendations.

C. Service of Manufacturer's engineer:

1. The Contract prices for equipment shall include the cost of furnishing a competent and experienced engineer or superintendent who shall represent the manufacturer and shall assist the Contractor, when required, to install, adjust, test and place in operation, the equipment in conformity with the Contract Documents.
2. After the equipment is placed in permanent operation by the District, such engineer or superintendent shall make all adjustments and tests required by the Engineer to prove that such equipment is in proper and satisfactory operating condition and shall instruct such personnel as may be designated by the District in the proper operation and maintenance of such equipment.

1.04 INSPECTION AND TESTING

A. General:

1. Inspection and testing of materials will be provided by the Contractor and witnessed by the District unless otherwise specified.
 - a. Pressure Testing of New Piping

b. Pump Testing

2. The testing personnel shall make the necessary inspections and tests, and the reports thereof shall be in such form as will facilitate checking to determine compliance with the Contract Documents. Five copies of the reports shall be submitted and authoritative certification thereof must be furnished to the District as a prerequisite for the acceptance of any material or equipment.
3. If, in the making of any test of any material or equipment, it is ascertained by the Engineer that the material or equipment does not comply with the Contract Documents, the Contractor will be notified thereof by the District and the Contractor will be directed to refrain from delivering said material or equipment, or to remove it promptly from the site or from the work and replace it with acceptable material, without cost to the District.
4. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the District normally takes over the operation thereof.

B. Costs:

1. Inspection and testing of materials furnished under this Contract will be provided by the Contractor, unless otherwise specified.
2. The cost of shop and field tests of equipment and certain other tests specifically called for in the Contract Documents shall be borne by the Contractor and such costs shall be deemed to be included in the Contract price.
3. Materials and equipment submitted by the Contractor as the equivalent to those specifically named in the Contract may be tested by the District for compliance. The Contractor shall reimburse the District for the expenditures incurred in making such tests of materials and equipment which are rejected for non-compliance.

C. Inspection of Materials:

1. The Contractor shall give notice in writing to the District, sufficiently in advance of his intention to commence the manufacture or preparation of materials especially manufactured or prepared for use in or as part of the permanent construction. Such notice shall contain a request for inspection, the date of commencement and the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice, the District will arrange to have a representative present at such times during the manufacture as may be necessary to inspect the materials or he will notify the Contractor that the inspection will be made at a point other than the point of manufacture.

2. The Contractor must comply with these provisions before shipping any material. Such inspection shall not release the Contractor from the responsibility for furnishing materials meeting the requirements of the Contract Documents.
- D. Certificate of Manufacture:
1. When inspection is waived or when the District so requires, the Contractor shall furnish to the Engineer authoritative evidence in the form of Certificate of Manufacture that the materials to be used in the work have been manufactured and tested in conformity with the Contract Documents.
 2. These certificates shall be notarized and shall include copies of the results of physical tests and chemical analyses, where necessary, that have been made directly on the product or on similar products of the manufacturer.
- E. Shop Tests:
1. Testing for pressure, duty, capacity, rating, efficiency, performance, function or special requirements which are specified shall be tested in the shop of the maker in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents.
 2. No such equipment or materials shall be shipped to the work site until the District notifies the Contractor, in writing, that the results of such tests are acceptable.
 3. Five copies of the manufacturer's actual test data and interpreted results thereof, accompanied by a certificate of authenticity sworn to be a responsible official of the manufacturing company and/or independent laboratory, shall be forwarded to the District and Engineer for approval.
 4. The cost of shop tests and of furnishing manufacturer's preliminary and shop test data of operating equipment shall be borne by the Contractor.
- F. Final Field Tests:
1. Upon completion of the work and prior to final payment, all equipment and piping installed under this Contract shall be subjected to acceptance tests as specified or required to provide compliance with the Contract Documents.
 2. The Contractor shall furnish labor, fuel, energy, water and all other materials, equipment and instruments necessary for all acceptance tests, at no additional cost to the District. The Contractor and furnishing Manufacturer shall assist in the final field tests as applicable.
- G. Final Inspection: During such final inspections, the Work shall be clean and functional.

1.05 ACCIDENT PREVENTION

- A. Precautions shall be exercised at all times for the protection of person and property. The safety provisions of applicable laws, building and construction codes shall be observed.
- B. The Contractor shall comply with the U.S. Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596), and under Hours and Safety Standards Act Section 107. Hours and Safety Standards Act (PL 91-54), except where state and local safety standards exceed the federal requirements and except where state safety standards have been approved by the Secretary of Labor in accordance with provisions of the Occupational Safety and Health Act, shall be complied with.
- C. First Aid: The Contractor shall keep upon the site, at each location where work is in progress, a completely equipped first aid kit and shall provide ready access thereto at all times when men are employed on the work.

1.06 LINES AND GRADES

- A. Grade:
 - 1. All work under this Contract shall be constructed in accordance with the lines and grades shown on the Drawings, or as given by the Engineer. The full responsibility for keeping alignment and grade shall rest upon the Contractor.
 - 2. Bench marks and base line controlling points shall be established prior to beginning work. Reference marks for lines and grades as the work progresses will be located to cause as little inconvenience to the prosecution of the work as possible. The Contractor shall so place excavation and other materials as to cause no inconvenience in the use of the reference marks provided. The Contractor shall remove any obstructions placed by the Contractor contrary to this provision.
- B. Surveys:
 - 1. The Contractor shall furnish and maintain, at the Contractor's expense, stakes and other such materials.
 - 2. The Contractor shall check such reference marks by such means as he may deem necessary and, before using them, shall call the Engineer's attention to any inaccuracies.
 - 3. The Contractor shall, at the Contractor's expense, establish all working or construction lines and grades as required from the reference marks set by the District, and shall be solely responsible for the accuracy thereof.
- C. Safeguarding Marks:

1. The Contractor shall safeguard all points, stakes, grade marks, monuments and bench marks made or established on the work, bear the cost of reestablishing them if disturbed, and bear the entire expense of rectifying work improperly installed due to not maintaining or protecting or to removing without authorization such established points, stakes and marks.
2. The Contractor shall safeguard all existing and known property corners, monuments and marks adjacent to but not related to the work and, if required, shall bear the cost of reestablishing them if disturbed or destroyed.

1.07 ADJACENT STRUCTURES AND LANDSCAPING

A. Responsibility:

1. The Contractor shall also be entirely responsible and liable for all damage or injury as a result of the Contractor's operations to all other adjacent public and private property, structures of any kind and appurtenances thereto met with during the progress of the work.
2. The cost of protection, replacement in their original locations and conditions or payment of damages for injuries to such adjacent public and private property and structures affected by the work, whether or not shown on the Drawings, and the removal, relocation and reconstruction of such items called for on the Drawings or specified shall be included in the various Contract Items and no separate payments will be made therefore.
3. Contractor is expressly advised that the protection of buildings, structures, tanks, pipelines, etc. and related work adjacent and in the vicinity of his operations, wherever they may be, is solely the Contractor's responsibility.
4. Conditional inspection of buildings or structures in the immediate vicinity of the project which may reasonably be expected to be affected by the Work shall be performed by and be the responsibility of the Contractor.
5. Contractor shall, before starting operations, make an examination of the adjacent structures, buildings, facilities, etc., and record by notes, measurements, photographs, etc., conditions which might be aggravated by open excavation and construction. Repairs or replacement of all conditions disturbed by the construction shall be made to the satisfaction of the District. Copies of surveys, photographs, reports, etc., shall be given to the District.
6. Prior to the beginning of any excavations the Contractor shall advise the District of all structures on which he intends to perform work or which performance of the project work will affect.

- B. Protection of Trees: All trees and shrubs shall be adequately protected by the Contractor with boxes and otherwise and in accordance with ordinances governing the protection of trees. Excavated materials shall be placed so as not to injure such trees or shrubs. Trees or shrubs destroyed by negligence of the Contractor or his

employees shall be replaced by him with new stock of similar size and age, at its proper season and at the sole expense of the Contractor.

- C. Lawn Areas: Lawn areas shall be left in as good condition as before the starting of the work. Where sod is to be removed, it shall be carefully removed, and later replaced, or the area where sod has been removed shall be restored with new sod.

1.08 PROTECTION OF WORK AND PUBLIC

A. Barricades, Guards and Safety Provisions:

1. The Contractor shall be solely responsible for adhering to the rules and regulations of OSHA and appropriate authorities regarding safety provisions. To protect persons from injury and to avoid property damage, adequate barricades, construction signs, lights and guards as required shall be placed and maintained by the Contractor at his expense during the progress of the Work and until it is safe for traffic to use the roads and streets. Material piles, equipment and pipe which may serve as obstructions for traffic shall be enclosed by fences or barricades and shall be protected by proper lights when the visibility is poor.
2. Signage and barricades shall be in accordance with applicable FDOT manuals.
3. During construction, pedestrian corridors shall be maintained in a safe, passable, and stabilized manner. Measures utilized shall include, but not be limited to, boardwalks or stabilized pathways. The Contractor shall be solely responsible for coordination with School Board Transportation Safety Manager for potential construction impacts to schoolyards and crossings. Closure of any sidewalks and/or school crossings near schools shall require coordination with the School Board Transportation Safety Manager and written authorization from Utilities if construction is conducted when school is in session.
4. Contractor shall notify the District 72 hours prior to any construction activity that will block Laughlin Road (Wildlife Drive) or Fudge Road.
5. Laughlin Road (Wildlife Drive) is open to public access on Fridays, Saturdays, Sundays, and during Federal holidays. Contractor shall take caution at all times and ensure the safety of the public.
6. The Contractor shall coordinate any traffic conflicts with other contractors or District.

B. Noise:

1. The Contractor shall eliminate noise to as great an extent as practicable at all times. Air compressing equipment shall be equipped with silencers and the exhaust of all gasoline motors or other power equipment shall be provided with mufflers. The Contractor shall construct sound barriers as necessary to eliminate noise.

2. In the vicinity of hospitals and schools, special care shall be used to avoid noise or other nuisances. The Contractor shall strictly observe all local regulations and ordinances covering noise control.
 3. Except in the event of an emergency, all work shall be done pursuant to Section 51 of the Contract entitled WORK SCHEDULE.
- C. Access to Public Services: Neither the materials excavated nor the materials or equipment used in the construction of the work shall be so placed as to prevent free access to all fire hydrants, valves, manholes or other public services.
- D. Dust Prevention: The Contractor shall prevent dust nuisance from his operations or from traffic by keeping the roads and/or construction areas sprinkled with water at all times.

1.09 CUTTING AND PATCHING

- A. The Contractor shall do all cutting, fitting or patching of his portion of the work that may be required to make the several parts thereof join and coordinate in a manner satisfactory to the Engineer and in accordance with the Drawings and Specifications.
- B. The work must be done by competent workmen skilled in the trade required by the restoration.

1.10 CLEANING

- A. During Construction:
1. During construction of the work, the Contractor shall, at all times, keep the site of the work and adjacent premises as free from material, debris and rubbish as is practicable and shall remove the same from any portion of the site if, in the opinion of the District and Engineer, such material, debris, or rubbish constitutes a nuisance or is objectionable.
 2. The Contractor shall remove from the site all of his surplus materials and temporary structures when no further need therefore develops. Contractor shall be responsible and liable for all spillage and incur all associated costs including, but not limited to, costs related to repair and maintenance resulting from damages thereof, and fines that may be levied as a result of citations given by State or local regulatory agencies.
- B. Final Cleaning:
1. At the conclusion of the Work, all erection plant, tools, temporary structures and materials belonging to the Contractor shall be promptly taken away, and he shall remove and promptly dispose of all water, dirt, rubbish or any other foreign substances in a legal manner.

1.11 MISCELLANEOUS

A. Protection Against Siltation and Bank Erosion:

1. The Contractor shall arrange his operations and construct erosion control devices to minimize siltation and bank erosion on construction sites and on existing or proposed water course and drainage channels.
2. The Contractor, at his own expense, shall remove any siltation deposits and correct any erosion problems as directed by the District which results from his construction operations.

B. Protection of Wetland Areas:

1. The Contractor shall properly dispose of all surplus material, including soil, in accordance with local, state and federal regulations.
2. Under no circumstances shall surplus material be disposed of in wetland areas as defined by the Florida Department of Environmental Protection or the wetland areas under construction under this project.

C. Existing Facilities: The Work shall be so conducted to maintain existing traffic lanes in operation, except where shown in the Drawings.

D. Use of Chemicals: All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfection, polymer, reactant, or of other classification, must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with instructions.

E. Cooperation With Other Contractors and Forces:

1. During progress of work under this Contract, it may be necessary for other contractors and persons employed by the District to work in or about the project.
2. The District reserves the right to put such other contractors to work and to afford such access to the Site of the Work to be performed hereunder at such times as the District deems proper.
3. The Contractor shall not impede or interfere with the work of such other contractors engaged in or about the Work and shall so arrange and conduct his work that such other contractors may complete their work at the earliest date possible.

F. Construction shall be conducted and shall result in construction of the improvements of this project in full accordance with the conditions of the permits granted for the project.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01010
SUMMARY OF PROJECT

PART 1 - GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. This Contract is for the construction of the Lake Apopka North Shore Pump Station, Bid Number 34718 for the St. Johns River Water Management District (District). The Work consists of furnishing all labor, equipment, and materials for the construction of the facilities consisting of, but not limited to, the following:
1. Construction of a canal transfer pump station with two (2) 50 HP angled line shaft, axial flow pumps, 30” welded steel piping, fittings, valves, pump supports and pilings, platform structure and pilings, concrete sump and sheet piling, and all associated electrical, controls, and instrumentation to complete fully operating canal transfer pumps station as shown on the Drawings and specified in the Specifications.
 2. Site work construction and improvements in the vicinity of the new canal transfer pump station consisting of site grading, installation of pre-engineering canopy, construction of concrete pad and unpaved roadway, installation of chain link fencing, installation of shoreline erosion protection including engineered turf and rip rap, installation of sodding, and modification to existing drainage culverts as shown on the Drawings and specified in the Specifications.
 3. Construction of an earthen berm across the drainage canal and installation of 48” corrugated aluminum alloy cross drain culvert with motor operated slide gate as shown on the Drawings and specified in the Specifications.

1.02 CONTRACTOR’S USE OF PREMISES

- A. The Contractor shall assume full responsibility for the protection and safekeeping of products and materials at the job site. If additional storage or work areas are required, they shall be obtained by the Contractor at no additional cost to the District.

1.03 PROJECT SEQUENCE

- A. The Contractor shall establish his work sequence based on the use of crews to facilitate completion of construction and testing within the specified Contract Time.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

**SECTION 01025
MEASUREMENT AND PAYMENT**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall receive and accept the compensation provided in the Cost Schedule and the Contract Documents as full payment for furnishing all materials, labor, tools and equipment, for performing all operations necessary to complete the Work under the Contract, and also in full payment for all loss or damages arising from the nature of the Work, or from any discrepancy between the actual quantities of work and quantities herein estimated by the Engineer or from the action of the elements of from any unforeseen difficulties which may be encountered during the prosecution of the Work until the final acceptance by the District.
- B. The prices stated in the proposal include all costs and expenses for taxes, labor, equipment, materials, commissions, transportation charges and expenses, patent fees and royalties, labor for handling materials during inspection, together with any and all other costs and expenses for performing and completing the Work as shown on the Drawings and specified herein.
- C. The Contractor's attention is again called to the fact that the quotations for the various items of work are intended to establish a total price for completing the Work in its entirety.

1.02 PAYMENT

- A. Payments will be made pursuant to Section 6 of the Contract entitled Payment of Invoices.

1.03 PAYMENT OF BID ITEMS

- A. No separate payment will be made for the following Work and its cost shall be included in appropriate Payment Items
 - 1. Maintenance and replacement of plantings and sodding.
 - 2. Record drawings.
 - 3. Construction photographs and videotape recordings.
 - 4. Field office(s) and storage facilities.
 - 5. Clean up.
 - 6. Testing.
 - 7. Appurtenant work.
 - 8. Contractor fees associated with the performance of the Work.
- B. The following will clarify the Work included for bid items in the Itemized Cost Schedule:
 - 1. Mobilization (Bid Item No. 1)

- a. This item shall be for the preparatory work and operations in mobilizing for beginning work on the Project. Examples of work under this item include:
 - i. Securing required permits.
 - ii. The mobilization of field offices, buildings, safety equipment, first aid supplies, sanitary and other facilities, as required.
 - iii. Preparation of an initial construction schedule.
 - iv. Provision of preconstruction photographs and video documentation.
 - b. The Contractor is responsible for securing a site for storage of materials and equipment and all other construction needs and providing security for this site and its contents.
2. Performance and Payment Bond (Bid Item No. 2)
- a. The Performance and Payment Bond will be made at the Contract lump sum price for the item. Such price and payment shall be full compensation for provision and execution of the Performance and Payment Bond. The Performance and Payment Bond shall be invoiced with the first payment application.
3. General Conditions (Bid Item No. 3)
- a. Measurement of various items for General Conditions will not be made for payment and all items shall be included in the lump sum price. Such price and payment shall be full compensation for the general requirements are defined in Division 1 of the Specifications. Examples of work under this item include:
 - i. The provision of and maintenance of field offices, buildings, safety equipment, first aid supplies, sanitary and other facilities, as required.
 - ii. Installation of temporary erosion and sedimentation control facilities
 - iii. Site security facilities
 - iv. Providing shop drawings, schedules, samples, testing, operating and maintenance manuals, and record documents
 - v. Surveying and field engineering
 - b. The General Conditions shall include costs for addressing Division 1 requirements such as shop drawings, schedules, samples, testing, surveying, field engineering, record documents, operating and maintenance manual, and similar items.
4. Angled Lineshaft Axial Flow Pumps (Bid Item No. 4)
- a. The quantity for payment shall be the actual number of angled lineshaft axial flow pumps with associated appurtenances satisfactorily furnished, installed, tested and incorporated into the canal transfer pump station.
 - b. Measurement for this item shall be for furnishing all labor, materials and equipment to furnish, install, and test the angled lineshaft axial flow pumps at the canal transfer pump station complete with motors, belts

and pulleys, pump mounting, discharge piping and fittings, and flap gate valves, and all incidental and related work to complete this item as shown on the Drawings and detailed in the Specifications.

5. Canal Transfer Pump Station (Bid Item No. 5)
 - a. Measurement for this item shall be for furnishing all labor, materials and equipment necessary to construct the canal transfer pump station including the pump station platform and pilings, pump supports and pilings, sheet piling, engineered turf, fencing, fill and grading, unpaved road surface, concrete pads and sumps, pump station control panel, electrical, instrumentation and controls, and other appurtenances as shown on the drawings and detailed in the Specifications.
6. Earthen Berm, Culvert, and Slide Gate (Bid Item No. 6)
 - a. Measurement for this item shall be for furnishing all labor, materials and equipment necessary to construct an earthen berm across the drainage canal, install a cross-drain culvert with precast concrete drainage structure and remote operated slide gate, and other appurtenances as shown on the Drawings and detailed in the Specifications.
7. Demobilization and Cleanup (Bid Item No. 7)
 - a. Measurement of various items for Demobilization and Cleanup shall be for cleanup of the construction site and storage areas, demobilizing equipment, materials, and facilities, and ending work on the Project.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

**SECTION 01041
PROJECT COORDINATION**

PART 1 - GENERAL

1.01 PIPE LOCATIONS

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

1.02 OPEN EXCAVATIONS

- A. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights, and other means to prevent accidents to persons, and damage to property. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by workmen.

1.03 TEST PITS

- A. Test pits for the purpose of locating underground pipelines or structures in advance of the construction shall be excavated, backfilled, and compacted by the Contractor. Test pits shall be backfilled immediately after their purpose has been satisfied and maintained in a manner satisfactory to the District and Engineer. The costs for such test pits shall be borne by the Contractor.

1.04 CARE AND PROTECTION OF PROPERTY

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

1.05 COOPERATION WITHIN THIS CONTRACT

- A. The Contractor shall, prior to interrupting a utility service (water, sewer, etc.) for the purpose of making cut-ins to the existing lines or for any other purposes, contact the

District and make arrangements for the interruption which will be satisfactory to the District.

- B. Laughlin Road is open to public access on Fridays, Saturdays, Sundays, and during Federal holidays. Contractor shall take caution at all times and ensure the safety of the public.
- C. Contractor shall notify the District 72 hours prior to any construction activity that will block Laughlin Road or Fudge Road.

1.06 UTILITY NOTIFICATION AND COORDINATION

- A. Provide for the coordination of the Work with the required work of public agencies and utilities. Contact Sunshine State One Call of Florida prior to any work in areas of existing utilities. Notify applicable utilities prior to commencing Work, if damage occurs, or if conflicts or emergencies arise during Work.
- B. Contractor is responsible for addressing conflicts with existing piping on site.

1.07 PROJECT MILESTONES

- A. General: Include the Milestones specified herein as a part of the Progress Schedule required under Section 01310, Construction Progress Schedule, Construction Progress Documentation, and the Agreement.
- B. Project Milestones: Generally described in the Agreement Form. Following is a detailed description of each:

1. Substantial Completion

- a. The work may not be considered substantially complete unless the punch list items that remain, as identified by the District, can be completed within thirty (30) days. All painting, finishes, fencing, cleanup, final grading, grassing and landscape planting shall have been completed and ready for inspection before substantial completion is given. After (or concurrent with) the Demonstration Tests, with any minor deficiencies noted, the Contractor wishing to consider the Work substantially complete, shall have work completed as follows and submit to the District:
 - i. A written notice that the Work is substantially complete.
 - ii. A list of items to be completed or corrected and explanations thereof.
 - iii. All Operations and Maintenance manuals have been submitted and approved in accordance with the contract documents.

- iv. Project Record Documents are complete and have been submitted and reviewed in accordance with the Contract documents.
 - v. All areas to be used and occupied are safe, operable in automatic and complete.
 - vi. All deficiencies noted on inspection reports or non-conformances are corrected or the correction plan is approved.
 - b. Within a reasonable time after receipt of such notice, the District will make an inspection, if necessary, to determine the status of completion.
 - c. Should District determine that the Work is not substantially complete:
 - i. The District and Engineer will promptly notify Contractor in writing, giving the reasons therefore.
 - ii. Contractor shall remedy the deficiencies in the Work and send a second written notice of substantial completion to District and Engineer.
 - iii. District and Engineer will reinspect the Work.
 - d. When District finds that the Work is substantially complete, they will:
 - i. Prepare a tentative Certificate of Substantial Completion, with a tentative list of items to be completed or corrected before final inspection.
 - ii. After consideration of any objections made by the District as provided in the General Conditions of the Contract, the Engineer will execute the Certificate of Substantial Completion with a revised list of items to be completed or corrected.
2. Final Completion
- a. When Contractor considers the Work is complete with all minor deficiencies completed or corrected, he shall submit written certification that:
 - i. Contract Document requirements have been met.
 - ii. Work has been inspected for compliance with Contract Documents.
 - iii. Work has been completed in accordance with Contract Documents.
 - iv. Equipment and systems have been tested in the presence of the District's representative and are operational.
 - v. All minor deficiencies have been corrected or completed and the Work is ready for final inspection.
 - vi. Project record documents are complete and submitted.

- vii. Transfer of all spares and expendables has been made to the District with a full accounting of the quantities and amounts due.
- b. District will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.
- c. Should District consider that the Work is incomplete or defective:
 - i. District and Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.
 - ii. Contractor shall take immediate steps to remedy the stated deficiencies, and send a second written certification to District that the Work is complete.
 - iii. District will reinspect the Work.
- d. When the District and Engineer find that the Work is acceptable under the Contract Documents, the District shall request the Contractor to make closeout submittals.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

3.01 COORDINATION OF WORK

- A. Coordinate the Work of all trades so that each will have sufficient space and time within which to work properly and efficiently.
- B. Changes in the intended design of the Project as a result of improperly coordinated construction Work will not be tolerated. Delays in the Work caused by rejections of installed materials due to improper coordination, and as otherwise specified, will not be considered valid justification for extensions of Contract Time.

3.02 CUTTING, FITTING, AND PATCHING

- A. Cut, fit, adjust, or patch Work and work of others, including excavation and backfill as required, to make Work complete.
- B. Restore existing work, surfaces that are to remain in completed work including concrete-embedded piping, conduit, and other utilities as specified and as shown.
- C. Make restorations with new materials and appropriate methods as specified for new Work of similar nature; if not specified, use recommended practice of manufacturer or appropriate trade association.

END OF SECTION

SECTION 01070
ABBREVIATIONS AND SYMBOLS

PART 1 - GENERAL

1.01 STANDARDS AND ABBREVIATIONS

- A. Referenced Standards: Any reference to published specifications or standards of any organization or association shall comply with the requirements of the specification or standard which is current on the date of Advertisement for Bids. In case of a conflict between the referenced specifications or standards, the one having the more stringent requirements shall govern.

In case of conflict between the referenced specifications or standards and the Contract Documents, the Contract Documents shall govern.

- B. Abbreviations:

AAA	American Arbitration Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway & Transportation Officials
ABA	American Bar Association
ABMA	American Boiler Manufacturers Association
ABPA	Acoustical and Board Products Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies
AFBMA	Anti-Friction Bearing Manufacturers Association
AGA	American Gas Association
AGC	Associated General Contractors of America
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AIA	American Insurance Association
AIEE	American Institute of Electrical Engineers (Now IEEE)
AIMA	Acoustical and Insulating Materials Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Condition Association
ANSI	American National Standards Institute
APA	American Plywood Association

API	American Petroleum Institute
APWA	American Public Works Association
ARI	American Refrigeration Institute
ASA	American Standards Association (Now ANSI)
ASAHC	American Society of Architectural Hardware Consultants
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASSCBC	American Standard Safety Code for Building Construction
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers Association
AWPB	American Wood Preservers Bureau
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America (formerly SCPI)
CDA	Copper Development Association
CFS	Cubic Feet Per Second
CMAA	Crane Manufacturers Association of America
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
District	St. Johns River Water Management District
DOT Spec	Standard Specification for Road and Bridge Construction Florida Department of Transportation, 1982
E/A	Engineer and/or Architect
EDA	Economic Development Association
EEI	Edison Electric Institute
EPA	Environmental Protection Agency
FCI	Fluid Control Institute
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
Fed Spec	Federal Specification
FPS	Feet Per Second
FS	Federal Standards
GPM	Gallons Per Minute
HMI	Hoist Manufacturers Institute
HP	Horsepower
HSBII	Hartford Steam Boiler Inspection and Insurance Co.
ID	Inside Diameter
IEEE	Institute of Electrical and Electronic Engineers
IFI	Industrial Fasteners Institute

IPCEA	Insulated Power Cable Engineers Association
IPS	Iron Pipe Size
MGD	Million Gallons Per Day
MHI	Materials Handling Institute
MMA	Monorail Manufacturers Association
NBFU	National Board of Fire Underwriters
NBHA	National Builders' Hardware Association
NBS	National Bureau of Standards
NCSA	National Crushed Stone Association
NCSPA	National Corrugated Steel Pipe Association
NEC	National Electrical Code
NECA	National Electrical Contractors' Association
NEMA	National Electrical Manufacturers' Association
NFPA	National Fire Protection Association
NLA	National Lime Association
NPC	National Plumbing Code
NPT	National Pipe Threads
NSC	National Safety Council
NSF	National Sanitation Foundation
OD	Outside Diameter
OSHA	U.S. Department of Labor, Occupational Safety and Health Act
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PDF	Portable Document Format
PS	United States Products Standards
PSI	Pounds per Square Inch
PSIA	Pounds per Square Inch Absolute
PSIG	Pounds per Square Inch Gauge
RAS	Return Activated Sludge
RPM	Revolutions Per Minute
SAE	Society of Automotive Engineers
SDI	Steel Decks Institute
SJI	Steel Joists Institute
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SSI	Scaffolding and Shoring Institute
SSPC	Steel Structures Painting Council
SSPC	Structural Steel Painting Council
STA	Station (100 feet)
TDH	Total Dynamic Head
TH	Total Head
UBC	Uniform Building Code
UL	Underwriter's Laboratories, Inc.
USASI or	United States of America Standards Institute

C. Additional abbreviations and symbols are shown on the Drawings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

**SECTION 01200
PROJECT MEETINGS**

PART 1 - GENERAL

1.01 GENERAL

- A. The District will schedule physical arrangements for meetings throughout progress of the Work, prepare meeting agenda with regular participant input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute PDF copies of minutes within 5 days after each meeting to participants and parties affected by meeting decisions.

1.02 PRECONSTRUCTION CONFERENCE

- A. CONTRACTOR shall be prepared to discuss the following subjects, as a minimum:

1. Required schedules.
2. Sequencing of critical path work items.
3. Progress payment procedures.
4. Project changes and clarification procedures.
5. Use of Site, access, office and storage areas, security and temporary facilities.
6. Major product delivery and priorities.
7. Contractor's safety plan and representative.

- B. Attendees will include:

1. District's representatives.
2. Contractor's office representative.
3. Contractor's resident superintendent.
4. Contractor's quality control representative.
5. Subcontractors' representatives whom Contractor may desire or District may request to attend.
6. Others as appropriate.

1.03 PROGRESS MEETINGS

- A. Contractor shall schedule regular progress meetings at the District Field Office located at 25633 County Road 448A, Mt Dora, FL 32757, conducted monthly to

review the Work progress, Progress Schedule, Schedule of Submittals, Application for Payment, contract modifications, and other matters needing discussion and resolution.

B. Attendees will include:

1. District's representative(s), as appropriate.
2. Contractor, Subcontractors, and Suppliers, as appropriate.
3. Engineer's representative(s).
4. Others as appropriate.

1.04 OTHER MEETINGS

A. In accordance with Contract Documents and as may be required by District.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

**SECTION 01300
SUBMITTALS**

PART 1 - GENERAL

1.01 DEFINITIONS

- A. Submittal: Written and graphic information submitted by Contractor that requires Engineer's/District's approval. Submittals may include shop drawings, O&M manuals, samples, material testing results, and pressure test results.

1.02 PROCEDURES

- A. Direct submittals to District at the address identified at the Preconstruction Conference.

- B. Transmittal of Submittal:

- 1. Contractor shall:

- a. Review each submittal and check for compliance with Contract Documents.
- b. Stamp each submittal with approval stamp before submitting to District.
 - i. Stamp to include Project name, Contract number, submittal number, Specification Section number, Contractor's reviewer name, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with Contract Documents.
 - ii. District will not review submittals that do not bear Contractor's approval stamp and will return them without action.

- 2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form in format approved by District.

- 3. Identify each submittal with the following:

- a. Numbering and Tracking System (for shop drawing submittals):
 - i. Sequentially number each submittal per Specification Section (i.e. 11201-001, 11261-002,...).
 - ii. Resubmission of submittal shall have original number with sequential alphabetic suffix (i.e. 11201-001A, ...).
- b. Specification Section and paragraph to which submittal applies.
- c. District's Project title and number, and Engineer's project number.

- d. Date of transmittal.
 - e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.
- 4. Identify and describe each deviation or variation from Contract Documents.
- C. Format:
 - 1. Do not base Shop Drawings on reproductions of Contract Documents.
 - 2. Package submittal information by individual Specification Section. Do not combine different Specification Sections together in submittal package, unless otherwise directed in Specification.
 - 3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
 - 4. Index with labeled tab dividers in orderly manner.
- D. Timeliness: Schedule and submit in accordance Contractor's Schedule of Submittals, and requirements of individual Specification Sections.
- E. Processing Time:
 - 1. Time for review shall commence on District's receipt of submittal.
 - 2. District will act upon Contractor's submittal and transmit response to Contractor not later than 30 days after receipt, unless otherwise specified.
 - 3. Resubmittals will be subject to same review time.
 - 4. No adjustment of Contract Times or Price will be allowed due to delays in progress of Work caused by rejection and subsequent resubmittals.
- F. Resubmittals: Clearly identify each correction or change made.
- G. Incomplete Submittals:
 - 1. District will return entire submittal for Contractor's revision if preliminary review deems it incomplete.
 - 2. When any of the following are missing, submittal will be deemed incomplete:
 - a. Contractor's review stamp, completed and signed.
 - b. Transmittal of Contractor's Submittal, completed and signed.
 - c. Insufficient number of copies.
- H. Submittals not required by Contract Documents:
 - 1. Will not be reviewed and will be returned stamped "Not Subject to Review."
 - 2. District will keep one copy and return all remaining copies to Contractor.

1.03 SUBMITTALS

A. Action Submittals:

1. Prepare and submit Action Submittals required by individual Specification Sections.
2. Shop Drawings:
 - a. Copies: Four copies for use by District, plus additional copies as required by Contractor.
 - b. Identify and indicate:
 - i. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
 - ii. Equipment and Component Title: Identical to title shown on Drawings.
 - iii. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
 - iv. Project-specific information drawn accurately to scale.
 - c. Manufacturer's standard schematic drawings and diagrams as follows:
 - i. Modify to delete information that is not applicable to the Work.
 - ii. Supplement standard information to provide information specifically applicable to the Work.
 - d. Product Data: Provide as specified in individual Specifications.
 - e. Foreign Manufacturers: When proposed, include following additional information:
 - i. Names and addresses of at least two companies that maintain technical service representatives close to Project. At least one company shall be within 100 miles of the work.
 - ii. Complete list of spare parts and accessories for each piece of equipment.
3. Samples:
 - a. Copies: Three, unless otherwise specified in individual Specifications.
 - b. Preparation: Mount, display, or package Samples in manner specified to facilitate review of quality. Attach label on unexposed side that includes the following:
 - i. Manufacturer name.
 - ii. Model number.
 - iii. Material.
 - iv. Sample source.

- c. Manufacturer's Color Chart: Units or sections of units showing full range of colors, textures, and patterns available.
 - d. Full-size Samples:
 - i. Size as indicated in individual Specification Section.
 - ii. Prepared from same materials to be used for the Work.
 - iii. Cured and finished in manner specified.
 - iv. Physically identical with product proposed for use.
4. Action Submittal Dispositions: District will review, mark, and stamp as appropriate, and distribute marked-up copies as noted:
- a. No Exceptions Taken:
 - i. Contractor may incorporate product(s) or implement Work covered by submittal.
 - ii. Distribution:
 - I.* Two (2) copies to District.
 - II.* Two (2) copies to Engineer.
 - III.* Remaining copies returned to Contractor appropriately annotated.
 - b. Note Comments:
 - i. Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with District's notations.
 - ii. Distribution:
 - I.* Two (2) copies to District.
 - II.* Two (2) copies to Engineer.
 - III.* Remaining copies returned to Contractor appropriately annotated.
 - c. Resubmit:
 - i. Contractor may not incorporate product(s) or implement Work covered by submittal.
 - ii. Distribution:
 - I.* Two (2) copies to District.
 - II.* Two (2) copies to Engineer.
 - III.* Remaining copies returned to Contractor appropriately annotated.
 - d. Rejected:

- i. Contractor may not incorporate product(s) or implement Work covered by submittal. Product is unacceptable. Submit new product.
- ii. Distribution:
 - I.* Two (2) copies to District.
 - II.* Two (2) copies to Engineer.
 - III.* Remaining copies returned to Contractor appropriately annotated.

B. Informational Submittals:

1. General:

- a. Copies: Submit four copies, unless otherwise indicated in individual Specification Section.
- b. Refer to individual Specification Sections for specific submittal requirements.
- c. District and Engineer will review each submittal. If submittal meets conditions of the Contract, District will forward copies to appropriate parties. If District determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, District will retain one copy and return remaining copies with review comments to Contractor, and require that submittal be corrected and resubmitted.

2. Application for Payment: In accordance with Division 00, General Conditions

3. Certificates:

a. General:

- i. Provide notarized statement that includes signature of entity responsible for preparing certification.
- ii. Signed by officer or other individual authorized to sign documents on behalf of that entity.

b. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.

c. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in Sections 02663 Reclaimed Water Transmission/Distribution Mains and in Section 02661 Wastewater Force Mains.

4. Construction Photographs and Video: In accordance with Section 01380, Construction Photographs, and as may otherwise be required in Contract Documents.

5. Contract Closeout Submittals: In accordance with Section 01700, Contract Closeout.
6. Contractor-Design Data:
 - a. Written and graphic information.
 - b. List of assumptions.
 - c. List of performance and design criteria.
 - d. Summary of loads or load diagram, if applicable.
 - e. Calculations.
 - f. List of applicable codes and regulations.
 - g. Name and version of software.
 - h. Information requested in individual Specification Section.
7. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with Specification 02663, Reclaimed Water Transmission/Distribution Mains and Section 02661 Wastewater Force Main.
8. Operation and Maintenance Data: As specified in individual Specification Sections.
9. Schedules:
 - a. Schedule of Submittals: Prepare separately or in combination with Progress Schedule as specified in Section 01300, Construction Progress Schedule
 - i. Show for each, at a minimum, the following:
 - I.* Specification Section number.
 - II.* Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
 - III.* Estimated date of submission to District, including reviewing and processing time.
 - ii. On a monthly basis, submit updated schedule to District if changes have occurred or resubmittals are required.
 - b. Progress Schedules: In accordance with Section 01310, Construction Progress Schedule.
10. Special Guarantee: Supplier's written guarantee as required in individual Specification Sections.
11. Statement of Qualification: Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals.
12. Submittals Required by Laws, Regulations, and Governing Agencies:

- a. Submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
 - b. Transmit to Engineer for District's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.
13. Test and Inspection Reports:
- a. General: Shall contain signature of person responsible for test or report.
 - b. Factory:
 - i. Identification of product and Specification Section, type of inspection or test with referenced standard or code.
 - ii. Date of test, Project title and number, and name and signature of authorized person.
 - iii. Test results.
 - iv. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
 - v. Provide interpretation of test results, when requested by District and Engineer.
 - vi. Other items as identified in Specification 02 73 30, Fusible Polyvinyl Chloride (PVC) Pipe, and Specification 02 66 30, Reclaimed Water Transmission/Distribution Mains.
 - c. Field: As a minimum, include the following:
 - i. Project title and number.
 - ii. Date and time.
 - iii. Record of temperature and weather conditions.
 - iv. Identification of product and Specification Section.
 - v. Type and location of test, Sample, or inspection, including referenced standard or code.
 - vi. Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
 - vii. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
 - viii. Provide interpretation of test results, when requested by District and Engineer.
 - ix. Other items as identified in individual Specification Sections.
14. Onsite Records: Contractor shall have at least one set of complete, approved submittals and shop drawings on the Site at all times when Work is in progress.

15. Testing and Startup Data: As specified in individual Specification Sections.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

**SECTION 01310
CONSTRUCTION PROGRESS SCHEDULES**

PART 1 - GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Preliminary Progress Schedule: Submit with the work plan within time specified in the Agreement.
2. Detailed Progress Schedule:
 - a. Submit initial Detailed Progress Schedule within 30 days following the Effective Date of the Contract or 10 days before submission of the first Application for Payment, whichever shall first occur.
 - b. Submit an Updated Progress Schedule in accordance with Paragraph 1.03 of this Section.
3. Submit with Each Progress Schedule Submission: Contractor's certification that Progress Schedule submission is actual schedule being utilized for execution of the Work.
 - a. Disk file compatible with latest version of Microsoft Project, unless otherwise approved by District.
 - b. Progress Schedule: Five legible copies.
 - c. Narrative Progress Report: Same number of copies as specified for Progress Schedule.
4. Prior to final payment, submit a final Updated Progress Schedule.

1.02 PRELIMINARY PROGRESS SCHEDULE

- A. In addition to basic requirements outlined in the General Conditions, show a detailed schedule, beginning with the Pre-Construction meeting for minimum duration of 90 days, and a summary of balance of Project through Final Completion.
- B. Show activities including, but not limited to the following:
 1. Pre-Construction Meeting.
 2. Permits.
 3. Submittals, with review time. Contractor may use Schedule of Submittals specified in Section 01300: Submittals.
 4. Early procurement activities for long lead equipment and materials.

5. Initial Site work.
 6. Earthwork.
 7. Specified Work sequences and construction constraints.
 8. Contract Milestone and Completion Dates.
 9. District-furnished products delivery dates or ranges of dates.
 10. Major structural, mechanical, equipment, electrical, architectural, and instrumentation and control Work.
 11. System startup summary.
 12. Project close-out summary.
 13. Demobilization summary.
- C. Update Preliminary Progress Schedule monthly as part of progress payment process. Failure to do so may result in the District withholding all or part of the monthly progress payment until the Preliminary Progress Schedule is updated in a manner acceptable to District.
- D. Format: In accordance with Article Progress Schedule—Critical Path Network.

1.03 DETAILED PROGRESS SCHEDULE

- A. In addition to requirements of the Agreement, submit Detailed Progress Schedule beginning with the Pre-construction meeting and continuing through Final Completion.
- B. Show the duration and sequences of activities required for complete performance of the Work reflecting means and methods chosen by Contractor.
- C. When accepted by District, Detailed Progress Schedule will replace Preliminary Progress Schedule and become Baseline Schedule. Subsequent revisions will be considered as Updated Progress Schedules.
- D. Format: In accordance with Article Progress Schedule—Critical Path Network.
- E. Update monthly to reflect actual progress and occurrences to date, including weather delays.

1.04 PROGRESS SCHEDULE-CRITICAL PATH NETWORK

- A. General: Comprehensive computer-generated schedule using CPM, generally as outlined in Associated General Contractors of America (AGC) 580, "Construction Project Planning and Scheduling Guidelines." If a conflict occurs between the AGC publication and this Specification, this Specification shall govern.

B. Contents:

1. Schedule shall begin with the date of Pre-construction meeting and conclude with the date of Final Completion.
2. Identify Work calendar basis using days as a unit of measure.
3. Show complete interdependence and sequence of construction and Project-related activities reasonably required to complete the Work.
4. Identify the Work of separate stages and other logically grouped activities, and clearly identify critical path of activities.
5. Reflect sequences of the Work, restraints, delivery windows, review times, Contract Times and Project Milestones set forth in the Agreement and Section 01041: Project Coordination.
6. Include as applicable, at a minimum:
 - a. Obtaining permits, submittals for early product procurement, and long lead time items.
 - b. Mobilization and other preliminary activities.
 - c. Initial Site work.
 - d. Specified Work sequences, constraints, and Milestones, including Substantial Completion date(s) Subcontract Work.
 - e. Major equipment design, fabrication, factory testing, and delivery dates.
 - f. Site Work.
 - g. Concrete Work.
 - h. Equipment Work.
 - i. Project closeout and cleanup.
 - j. Demobilization.
7. No activity duration, exclusive of those for Submittals review and product fabrication/delivery, shall be less than 1 day or more than 30 days, unless otherwise approved.
8. Activity duration for Submittal review shall not be less than review time specified unless clearly identified and prior written acceptance has been obtained from District.
9. Contractor shall include a mandatory 30 days, minimum float time for utility relocation work. District will not consider Contract Time extensions related to utility coordination matters unless the utility related delays exceed the 30 days float time and extend the critical path of the Project Schedule.

C. Network Graphical Display:

1. Plot or print on paper not greater than 30-inch by 42-inch or smaller than 22-inch by 34-inch, unless otherwise approved.

2. Title Block: Show name of Project, District, date submitted, revision or update number, and the name of the scheduler. Updated schedules shall indicate data date.
 3. Identify horizontally across top of schedule the time frame by year, month, and day.
 4. Identify each activity with a unique number and a brief description of the Work associated with that activity.
 5. Indicate the critical path.
 6. Show, at a minimum, the controlling relationships between activities.
 7. Plot activities on a time-scaled basis, with the length of each activity proportional to the current estimate of the duration.
 8. Plot activities on an early start basis unless otherwise requested by District.
 9. Provide a legend to describe standard and special symbols used.
- D. Schedule Report:
1. On 8-1/2-inch by 11-inch white paper, unless otherwise approved.
 2. List information for each activity in tabular format, including, at a minimum:
 - a. Activity Identification Number.
 - b. Activity Description.
 - c. Original Duration.
 - d. Remaining Duration.
 - e. Early Start Date (Actual start on Updated Progress Schedules).
 - f. Early Finish Date (Actual finish on Updated Progress Schedules).
 - g. Late Start Date.
 - h. Late Finish Date.
 - i. Total Float.
 3. Sort reports, in ascending order, as listed below:
 - a. Activity number sequence with predecessor and successor activity.
 - b. Early-start.
 - c. Total float.

1.05 PROGRESS OF THE WORK

- A. Updated Progress Schedule shall reflect:
1. Progress of Work to within 5 working days prior to submission.
 2. Approved changes in Work scope and activities modified since submission.
 3. Delays in Submittals or resubmittals, deliveries, or Work.
 4. Adjusted or modified sequences of Work.

5. Other identifiable changes.
 6. Revised projections of progress and completion.
 7. Report of changed logic.
- B. Produce detailed sub-schedules during Project, upon request of District, to further define critical portions of the Work such as facility shutdowns.
- C. If Contractor fails to complete activity by its latest scheduled completion date and this Failure is anticipated to extend Contract Times (or Milestones), Contractor shall, within 7 days of such failure, submit a written statement as to how Contractor intends to correct nonperformance and return to acceptable current Progress Schedule. Actions by Contractor to complete the Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.
- D. District may order Contractor to increase plant, equipment, labor force or working hours if Contractor fails to:
1. Complete a Milestone activity by its completion date.
 2. Satisfactorily execute Work as necessary to prevent delay to overall completion of Project, at no additional cost to District.

1.06 NARRATIVE PROGRESS REPORT

- A. Format:
1. Organize same as Progress Schedule.
 2. Identify, on a cover letter, reporting period, date submitted, and name of author of report.
- B. Contents:
1. Number of days worked over the period, work force on hand, construction equipment on hand (including utility vehicles such as pickup trucks, maintenance vehicles, stake trucks).
 2. General progress of Work, including a listing of activities started and completed over the reporting period, mobilization/demobilization of subcontractors, and major milestones achieved.
 3. Contractor's plan for management of Site (for example, lay down and staging areas, construction traffic), utilization of construction equipment, buildup of trade labor, and identification of potential Contract Document changes.
 4. Identification of new activities and sequences as a result of executed Contract Document changes.
 5. Documentation of weather conditions over the reporting period, and any resulting impacts to the work.

6. Description of actual or potential delays, including related causes, and the steps taken or anticipated to mitigate their impact.
7. Changes to activity logic.
8. Changes to the critical path.
9. Identification of, and accompanying reason for, any activities added or deleted since the last report.
10. Steps taken to recover the schedule from Contractor -caused delays.

1.07 SCHEDULE ACCEPTANCE

A. District's acceptance will demonstrate agreement that:

1. Proposed schedule is accepted with respect to:
 - a. Contract Times, including Final Completion and all intermediate Milestones are within the specified times.
 - b. Specified Work sequences and constraints are shown as specified.
 - c. Specified District-furnished Equipment or Material arrival dates, or range of dates, are included.
 - d. Access restrictions are accurately reflected.
 - e. Startup and testing times are as specified.
 - f. Submittal review times are as specified.
 - g. Startup testing duration is as specified and timing is acceptable.
2. In all other respects, District's acceptance of Contractor's schedule indicates that, in District's judgement, schedule represents reasonable plan for constructing Project in accordance with the Contract Documents. District's review will not make any change in Contract requirements. Lack of comment on any aspect of schedule that is not in accordance with the Contract Documents will not thereby indicate acceptance of that change, unless Contractor has explicitly called the nonconformance to District's attention in submittal. Schedule remains Contractor's responsibility and Contractor retains responsibility for performing all activities, for activity durations, and for activity sequences required to construct Project in accordance with the Contract Documents.

B. Unacceptable Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to District as Baseline Progress Schedule, continue review and revision process, during which time Contractor shall update schedule on a monthly basis to reflect actual progress and occurrences to date.

C. Unacceptable Detailed Progress Schedule:

1. Make requested corrections; resubmit within 10 days.

2. Until acceptable to District as Baseline Progress Schedule, continue review and revision process.
- D. Narrative Report: All changes to activity duration and sequences, including addition or deletion of activities subsequent to District's acceptance of Baseline Progress Schedule, shall be delineated in Narrative Report current with proposed Updated Progress Schedule.

1.08 ADJUSTMENT OF CONTRACT TIMES

- A. Reference the Agreement.
- B. Evaluation and reconciliation of Adjustments of Contract Times shall be based on the Updated Progress Schedule at the time of proposed adjustment or claimed delay.
- C. Schedule Contingency:
 1. Contingency, when used in the context of the Progress Schedule, is time between Contractor's proposed Completion Time and Contract Completion Time.
 2. Contingency included in Progress Schedule is a Project resource available to both Contractor and District to meet Contract Milestones and Contract Times. Use of Schedule contingency shall be shared to the proportionate benefit of both parties.
 3. Use of schedule contingency suppression techniques such as preferential sequencing and extended activity times is prohibited.
 4. Pursuant to Contingency sharing provisions of this Specification, no time extensions will be granted, nor will delay damages be paid until a delay occurs which (i) consumes all available contingency time, and (ii) extends Work beyond the Contract Completion date.
- D. Claims Based on Contract Times:
 1. Where District has not yet rendered formal decision on Contractor's Claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in Progress Schedule, Contractor shall reflect an interim adjustment in the Progress Schedule as acceptable to District.
 2. It is understood and agreed that such interim acceptance will not be binding on either Contractor or District, and will be made only for the purpose of continuing to schedule Work until such time as formal decision has been rendered as to an adjustment, if any, of the Contract Times.
 3. Contractor shall revise Progress Schedule prepared thereafter in accordance with District's formal decision.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

**SECTION 01410
PERMITS AND FEES**

PART 1 - GENERAL

- A. The Contractor shall secure and pay for **all** permits and licenses related to his work, including but not limited to, the necessary construction permits, as provided for in the General Conditions except as otherwise provided herein.

- B. Permits by District: The District prior to the advertisement of the project has applied for permits with the following agencies:
 - 1. Florida Department of Environmental Protection
 - 2. U.S. Army Corps of Engineers.

- C. Permits by Contractor:
 - 1. NPDES/SWPPP/Dewatering
 - 2. Building Permit

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01505 MOBILIZATION

PART 1 - GENERAL

1.01 DEFINITION AND SCOPE

- A. Mobilization shall include obtaining all permits, moving all equipment onto the site, and setting up other construction facilities; all as required for the proper performance and completion of the Work. Mobilization shall include, but not be limited to the following:
1. Transporting tools, equipment, personnel and materials to the work site; construction offices, temporary facilities and,
 2. Installation and maintenance of erosion and sediment control measures;
 3. Preparation of Maintenance of Traffic Plans and Detour Plans submitted and approved by the appropriate regulatory agencies and permitting departments.
 4. Move onto the site all Contractor's equipment required for the first month's operations.
 5. Secure construction water supply.
 6. Arrange for and erect Contractor's Work and storage yard and employee's parking facilities.
 7. Obtain all required permits.
 8. Post all OSHA, EPA, Department of Labor and all other required notices.
 9. Submit a detailed construction CPM schedule acceptable to the District as specified.
 10. Submit a schedule of submittals.

1.02 DEMOBILIZATION

- A. Demobilization is the timely and proper removal of all Contractor owned material, or equipment, from the jobsite and the proper restoration or completion of Work necessary to bring the site into full compliance with the contract documents, in addition to the following:
1. Cleanup and removal of debris from work site and stored material locations,
 2. Removal of all construction equipment Maintenance of Traffic (MOT) products and any unused materials and supplies; and

3. Delivery of contractually required documents such as record drawings, warranty documentation, and operation and maintenance manuals.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

**SECTION 01600
MATERIAL AND EQUIPMENT**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Material and equipment incorporated into the Work:
1. Conform to applicable specifications and standards.
 2. Comply with size, make, type and quality specified, or as specifically approved in writing by District and Engineer.
 3. Manufactured and fabricated products:
 - a. Design, fabricate and assemble in accordance with the best engineering and shop practices.
 - b. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
 - c. Two or more items of the same kind shall be identical, by the same manufacturer.
 - d. Products shall be suitable for service conditions.
 - e. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
 4. Do not use material or equipment for any purpose other than that for which it is designed or is specified.
- B. Related Work Described Elsewhere:
1. Agreement
 2. Submittals: Section 01300

1.02 APPROVAL OF MATERIALS

- A. Only new materials and equipment shall be incorporated in the Work. All materials and equipment furnished by Contractor shall be subject to the inspection and approval of District. No material shall be delivered to the site without prior approval of District.
- B. The Contractor shall submit to District, data relating to materials and equipment he proposes to furnish for the Work. Such data shall be in sufficient detail to enable District to identify the particular product to form an opinion as to its conformity to the specifications.

- C. Facilities and labor for handling and inspection of all materials and equipment shall be furnished by the District. If District or Engineer requires, either prior to beginning or during progress of the Work, Contractor shall submit samples of materials for such special tests as may be necessary to demonstrate that they conform to the specifications. Such samples shall be furnished, stored, packed and shipped as directed at Contractor's expense. Except as otherwise noted, Contractor will make arrangements for and pay for the tests.
- D. Contractor shall submit data and samples sufficiently early to permit consideration and approval before materials are necessary for incorporation in the Work. Any delay of approval resulting from Contractor's failure to submit samples or data promptly shall not be used as a basis of claim against District or Engineer.
- E. In order to demonstrate the proficiency of Workers or to facilitate the choice among several textures, types, finishes and surfaces, Contractor shall provide such samples of workmanship or finish as may be required.
- F. The materials and equipment used on the Work shall correspond to the approved samples or other data.

1.03 SUBSTITUTIONS AND PRODUCT OPTIONS

- A. The substitution requirements of this Section are in addition to the requirements of the Agreement.
- B. The intent of these Specifications is to provide the District with a quality facility without discouraging competitive bidding. Substitutions may be submitted and will be evaluated as specified herein.
- C. For products specified only by reference standards, performance and descriptive methods, without naming manufacturer's products, the Contractor may provide the products of any manufacturer complying with the Contract Documents, subject to the review of product data by District as specified herein.
- D. For products specified by naming a manufacturer's product followed by the words "or equal" or "or approved equal", the Contractor may provide any of the named products. He may substitute a product by another manufacturer as an equal only after review by the Engineer and the District's Representative as specified herein. In all cases, any product provided must comply with all of the specified requirements.

1.04 MANUFACTURER'S INSTRUCTIONS FOR INSTALLATION

- A. When Contract Documents require that installation of Work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including electronic copies (PDF format) to District.

- B. Maintain one set of complete instructions at the job site during installation and until completion.
- C. Handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements.
 - 1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with District and Engineer for further instructions.
 - 2. Do not proceed with Work without clear instructions.
- D. Perform Work in accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

1.05 TRANSPORTATION AND HANDLING

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

1.06 STORAGE AND PROTECTION

- A. Store products in accord with manufacturer's instructions, with seals and labels intact and legible.
 - 1. Store products subject to damage by the elements in weather tight enclosures.
 - 2. Maintain temperature and humidity within the ranges required by manufacturer's instructions.
 - 3. Store fabricated products above the ground, on blocking or skids, prevent soiling or staining. Cover products which are subject to deterioration with impervious sheet coverings, provide adequate ventilation to avoid condensation.
 - 4. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
- B. All materials and equipment to be incorporated in the Work shall be handled and stored by Contractor before, during and after shipment in a manner to prevent

warping, twisting, bending, breaking, chipping, rusting, and any injury, theft or damage of any kind whatsoever to the material or equipment.

- C. Cement, sand and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural and miscellaneous steel, and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease, and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete beams shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products shall be handled and stored in a manner to reduce breakage, chipping, cracking and spalling to a minimum.
- D. All materials which, in the opinion of District or Engineer, have become so damaged as to be unfit for the use intended or specified shall be promptly removed from the site of the Work, and Contractor shall receive no compensation for the damaged material or its removal.
- E. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration.
- F. Protection After Installation: Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove covering when no longer needed.
- G. The Contractor shall be responsible for all material, equipment and supplies sold and delivered to the District under this Contract until final inspection of the Work and acceptance thereof by the District. In the event any such material, equipment and supplies are lost, stolen, damaged or destroyed prior to final inspection and acceptance, Contractor shall replace same without additional cost to the District.
- H. Should Contractor fail to take proper action on storage and handling of equipment supplied under this Contract within seven days after written notice to do so has been given, the District retains the right to correct all deficiencies noted in previously transmitted written notice and deduct the cost associated with these corrections from Contractor's Contract. These costs may be comprised of expenditures for labor, equipment usage, administrative, clerical, engineering and any other costs associated with making the necessary corrections.

1.07 STORAGE AND HANDLING OF EQUIPMENT ON SITE

- A. Special attention shall be given to the storage and handling of materials on site. As a minimum, the procedure outlined below shall be followed:
 - 1. Materials shall not be shipped until approved by the District. The intent of this requirement is to avoid unnecessary delivery of unapproved materials and

to reduce on-site storage time prior to installation and/or operation. Under no circumstances shall materials be delivered to the site more than one month prior to installation without written authorization from the District. Materials shipped to the site shall be stored in accordance with Paragraph 1.06, herein.

2. Manufacturer's storage instructions shall be carefully studied by Contractor and reviewed with District by the Contractor. These instructions shall be carefully followed and a written record of this kept by the Contractor.

1.08 WARRANTY

- A. For all major pieces of material, submit a warranty from the material manufacturer to the District. The manufacturer's warranty period shall be concurrent with the Contractor's for one (1) year after the Substantial Completion.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

**SECTION 01700
CONTRACT CLOSEOUT**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Comply with requirements stated in the Agreement and Specification 01700 Contract Closeout for administrative procedures in closing out the Work.

1.02 SUBSTANTIAL COMPLETION

- A. Contractor shall comply with requirements for Substantial Completion in the Agreement, in addition to the following:
 - 1. When the Contractor considers the Work as substantially complete, he shall submit to the District a written notice stating so and requesting the District to make an inspection to determine the status of completion. This request shall be accompanied by a list of items to be completed or corrected.
 - 2. Should the District determine that the Work is not substantially complete; the District will promptly notify the Contractor in writing, given the reasons therefore. The Contractor shall remedy the deficiencies in the Work, and send a second written notice of substantial completion to the District for re-inspection.
 - 3. When the Engineer finds that the Work is substantially complete, he will prepare and deliver to the District a tentative Certificate of Substantial Completion with a tentative list of items to be completed or corrected prior to final payment. After consideration of any objections made by the District, the Engineer will execute and deliver to the District and the Contractor a final Certificate of Substantial Completion with a revised tentative list of items to be completed or corrected.

1.03 FINAL INSPECTION AFTER COMPLETION

- A. Contractor shall comply with requirements for Substantial Completion in the Agreement, in addition to the following:
 - 1. When the Contractor considers the Work complete, he shall submit written certification that:
 - a. Contract Documents have been reviewed.
 - b. Work has been inspected for compliance with Contract Documents.
 - c. Work has been completed in accordance with Contract Documents.

- d. Equipment and systems have been tested in the presence of the District's Representative and are operational.
 - e. Work is completed and ready for final inspection.
- B. The District will make a final inspection if necessary to verify the status of completion after receipt of such certification.
- C. Should the District consider that the Work is incomplete or defective, he will promptly notify the Contractor in writing, listing the incomplete and defective Work, to the best of his knowledge at that time. If the District has inadvertently omitted any items from the list it shall not relieve the Contractor from his obligations shown on the Drawings and specified in the Project Manual. Contractor shall take immediate steps to remedy the stated deficiencies and send a second written certification to the District and Engineer that the Work is complete.
- D. When the District finds that the Work is acceptable under the Contract Documents, he shall request the Contractor to make closeout submittals.
- E. Should the District perform re-inspection due to failure of the Work to comply with the claims of status of completion made by the Contractor, the District will deduct the amount of any compensation or costs paid for additional inspections or tests from the final payment to the Contractor.

1.04 CONTRACTOR'S CLOSEOUT SUBMITTALS TO DISTRICT

- A. Evidence of compliance with requirements of governing authorities.
- B. Project Record Documents: To requirements of Section 01720, Project Record Documents and Survey.
- C. Operating and Maintenance Data, Instructions to District's Personnel: To requirements of Section 01730, Operating and Maintenance Data.
- D. Spare Parts and Maintenance Materials: To requirements of Technical Sections of the Specifications.
- E. Evidence of Payment and Release of Liens: To requirements of General and Special Conditions.
- F. Certificate of Insurance for Products and Completed Operations.
- G. Evidence of all Certifications of Warranties and Bonds.

1.05 FINAL APPLICATION FOR PAYMENT

- A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Agreement.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

**SECTION 01710
CLEANING**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Execute cleaning, during progress of the Work, and at completion of the Work.
- B. Related Work Described Elsewhere:
 - 1. General Conditions and Requirements of the Contract.
 - 2. Each Specification Section: Cleaning for specific Products or Work.

1.02 DISPOSAL REQUIREMENTS

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

PART 2 - PRODUCTS

2.01 MATERIALS

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

PART 3 - EXECUTION

3.01 DURING CONSTRUCTION

- A. Execute daily cleaning to keep the Work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.
- B. Provide on-site containers for the collection of waste materials, debris and rubbish.

- C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

3.02 DUST CONTROL

- A. Construction techniques that minimize the production and distribution of dust shall be used.
- B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.03 FINAL CLEANING

- A. Prior to final completion, or District occupancy, the District shall conduct an inspection of sight-exposed interior and exterior surfaces and all Work areas, to verify that the entire Work is clean.

END OF SECTION

**SECTION 01720
PROJECT RECORD DOCUMENTS AND SURVEY**

PART 1 - GENERAL

1.01 PURPOSE AND DESCRIPTION OF WORK

- A. The purpose of the Project Record Documents is to provide the District with factual information regarding all aspects of the Work, both concealed and visible, to enable future location, identification and modification of the Work without lengthy and expensive site measurement, investigation or examination.
- B. Provide professional surveying and mapping work required for the execution of the contract, including verification of existing survey data, construction layout, and production of the As-Built Drawings. This Work shall be performed by a Surveyor that is licensed by the State of Florida as a professional surveyor and mapper pursuant to Chapter 472, F.S.
- C. The location of the constructed improvements as depicted in the contract drawings is required. To verify the As-Built Drawing accuracies and to insure the Work was constructed in conformance with the contract drawings, the survey documents are required to be certified by the Surveyor.

1.02 DEFINITIONS

- A. Except where specific definitions are used within a specific section, the following terms, phrases, words and their derivation shall have the meaning given herein when consistent with the context in which they are used. Words used in the present tense include the future tense, words in the plural number include the singular number and words in the singular number include the plural number. The word "shall" is mandatory, and the word "may" is permissive.
 - 1. As-Built Drawings: Drawings prepared by the Contractor's Surveyor shall depict the actual location of installed utilities for the completed Work in a full size hard copy and an electronic AutoCAD file (dwg) format.
 - 2. Record Drawings: Drawings, prepared by and certified by the District's Consultant Engineer, shall be a compiled representation of the constructed project, a listing of the sources and the basis of information used in the preparation of the "record drawings", the constructed project meets the Engineer's design intent and note the material deviations from the design documents, and the accuracy of the location information is based upon the Contractor's surveyor data.
 - 3. Surveyor: Contractor's Surveyor that is licensed by the State of Florida as a professional surveyor and mapper pursuant to Chapter 472, F.S.

1.03 QUALIFICATIONS OF THE SURVEYOR

- A. The Surveyor, who is proposed by the Contractor to provide services for the Project, is subject to the approval of the District. Prior to any services being performed, the

Contractor shall submit the name and address of any proposed Surveyor and a written acknowledgement from the Surveyor stating that he has the hardware, software and adequate scope of services in his agreement with the Contractor to fully comply with the requirements of this specification. These submittals shall be provided to the District for approval prior to the Pre-Construction meeting. It is recommended that the Surveyor attend the Preconstruction meeting. Any Surveyor, who has not previously performed work for the District in the past, shall attend the Preconstruction meeting.

1.04 RELATED REQUIREMENTS

- A. All General Conditions, Supplements to the General Conditions, and any Addenda issued by the District are a part of this Section in the same manner as if fully written herein, and shall govern the Work of this Section, except where more stringent articles or requirements are stipulated, then they shall govern this Section.
- B. The Contract Documents are complementary and what is required by anyone shall be as binding as if required by all.
- C. Other requirements affecting Record Documents may appear in pertinent other sections of these specifications.

1.05 QUALITY ASSURANCE

- A. Delegate the responsibility for maintenance of the Record Documents to one person on the Contractor's staff as approved by the District.
- B. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each page of specifications and each sheet of drawings and other documents where such entry is required to show progress and changes properly.
- C. Make entries within 24-hours after receipt of information has occurred.
- D. Survey documents shall comply with the minimum technical standards of Chapter 61G17-6 of the Florida Administrative Code (FAC) and Table 01720-1 Minimum Survey Accuracies specified in, whichever are more stringent. Asset attribute data shall be signed, sealed and dated by the Surveyor. All coordinates shall be geographically registered in the Florida State Plan Coordinate System using the contract drawings control points for horizontal and vertical controls.

**Table 01720-1
Minimum Survey Accuracies**

Asset/Location	Horizontal Accuracy (feet)	Elevation Accuracy (feet)	Location: horizontal center and vertical top, unless otherwise specified
Bench Marks	N/A	0.01	Point
Horizontal Control	0.01	N/A	Point
Easements and Tracts	*	N/A	Survey Monuments
Civil Site, Topo and Foundation Drawings	0.1	0.01	All
Hydrants	0.01	N/A	Operating Nut
Blow off Valves	0.01	N/A	Valve Enclosure
Air Release Valves	0.01	N/A	Valve Enclosure
Master Meters	0.01	N/A	Register
Meter Box	0.01	N/A	Top of Meter Box
Clean-out	0.01	N/A	Top of Clean-out
Pumps and Pump skids	0.01	0.01	Top Center of pump and Pipe Inverts (Inlet/Discharge)
Manholes	0.01	0.1	Top Center of Cover
Manhole	N/A	0.01	Pipe Inverts
System Valves	0.01	0.1	Operating Nut and Valve Body
Buried Valves 4-inches and greater	0.01	0.1	Valve
Fittings	0.01	0.1	Top of Fitting and Ground
Piping at beginning and end and at 25' max intervals	0.01	0.1	Top of Pipe and Ground
Restrained Pipe	0.01	N/A	Limits
Connections	0.01	0.1	Pipe Invert
Bore & Jack Casing	0.01	0.1	Top of Casing at Limits of Casing
Existing Utilities**	0.01	0.1	Conflicts

* Shall conform to the requirements of the "Chapter 61G17-6, 'Minimum Technical Standards', FAC", certified by a Surveyor.

** Existing utilities including but not limited to water, wastewater, reclaimed water, storm, fiber optic cable, electric, gas and structures within the limits of construction.

1.06 SUBMITTALS

- A. Comply with pertinent provisions for the timely submittal requirements under this article and specification section.
- B. Prior to submitting a monthly payment application, the Contractor's progressive As-Built Drawings shall be acceptable to the District.
- C. Progressive As-Built Drawings which will indicate the horizontal and vertical locations of all current constructed improvements with sufficient information and notes to easily determine if the improvements were constructed in conformance with the Contract Documents. The progressive As-Built Drawings shall include a Surveyor's certified statement regarding the constructed improvements being within the specified accuracies or if not indicating the variances, as described in Table 01720-1 Minimum Survey Accuracies.
- D. Prior to submitting a request for final payment or the District issuing a Certificate of Completion for the Work, the Contractor shall submit the final Record Documents to the District for approval. Retainage funds will be withheld at the District's discretion based on the quality and accuracy of the final Record Documents.

1.07 RECORD DOCUMENTS AT SITE

- A. Maintain at the site and always available for District's use one record copy of:
 - 1. Construction Contract, Drawings, Specifications, General Conditions, Supplemental Conditions, Bid Proposal, Instruction to Bidders, Addenda, and all other Contract Documents.
 - 2. Change Orders, Verbal Orders, and other modifications to Contract.
 - 3. Written instructions by the District as well as correspondence related to Requests for Information (RFIs).
 - 4. Accepted Shop Drawings, Samples, product data, substitution and "or-equal" requests
 - 5. Field test records, inspection certificates, manufacturer certificates and construction photographs.
 - 6. Progressive As-Built Drawings
- B. Maintain the documents in an organized, clean, dry, legible condition and completely protected from deterioration and from loss and damage until completion of the Work, transfer of all record data to the final Record Documents and for submittal to the District.

PART 2 - PRODUCTS

2.01 AS-BUILT DRAWINGS

- A. Maintain the electronic As-Built Drawings to accurately record progress of Work and change orders throughout the duration of the Contract.
- B. Date all entries. Enter RFI No., Change Order No., etc. when applicable.

- C. Call attention to the entry by highlighting with a “cloud” drawn around the area affected.
- D. In the event of overlapping changes, use different colors for entries of the overlapping changes.
- E. Design call-outs shall have a thin strike line through the design call-out and all As-Built information must be labeled (or abbreviated “AB”) and be shown in a bolder text that is completely legible.
- F. Make entries in the pertinent other documents while coordinating with the Engineer and the District for validity.
- G. Entries shall consist of graphical representations, plan view and profiles, written comments, dimensions, State Plane Coordinates, details and any other information as required to document field and other changes of the actual Work completed. As a minimum, make entries to also record:
 - 1. Depths of various elements of foundation in relation to finish floor datum and State Plane Coordinates and elevations.
 - 2. Plan view and profile drawings: State Plane coordinates and elevations or depths for all assets shown in the Asset Attribute Data Table on each drawing if the fittings, valves, appurtenances, etc. are shown on that drawing sheet.
 - 3. When electrical boxes, or underground conduits and plumbing are involved as part of the Work, record true elevations and locations, dimensions between boxes.
 - 4. Actually installed pipe or other Work materials, class, pressure rating, diameter, size, specifications, etc. Similar information for other encountered underground utilities, not installed by Contractor, their owner and actual location if different than shown in the Contract Documents.
 - 5. Details, not on original contract Drawings, as needed to show the actual location of the Work completed in a manner that allows the District to find it in the future.
 - 6. The Contractor shall mark all arrangements of conduits, circuits, piping, ducts and similar items shown schematically on the construction documents and show on the As-Built Drawings the actual horizontal and vertical alignments and locations.
 - 7. Major architectural and structural changes including relocation of doors, windows, etc. Architectural schedule changes according to contractor’s records and shop drawings.

2.02 RECORD DOCUMENTS

- A. A full size, two (2) hard copy set of the final Record Documents and shall include all of the documents described below under this subsection 2.02.
- B. The following documents shall be signed and sealed by the Surveyor:

1. Survey and Survey Map Report for the location of constructed pipes within any easements and right-of-way. As a minimum the Survey Map Report shall identify or describe the locations where the pipe centerline was constructed within three feet of the easement or right-of-way boundary, where the pipe was constructed outside the easement or right-of-way boundary, any corners that had to be reset, measurements and computations made, boundary issues, and accuracies obtained. Survey map report shall be dated after the Work within the right-of-ways or easements have been completed.
 2. Buried Valves 4-inches and greater
- C. Digital Set of the final Record Documents including but not limited to:
1. Scanned digital copies of the final As-Built Drawings
 2. Electronic Survey documents electronically sealed by the Surveyor
 3. Final Record Documents information
 4. Digital As-Built Drawing in the Engineer's current version of AutoCAD file (dwg) format for the Contract Drawings, updated to match the final Record Drawing information.
- D. Scanned Documents: Scan the Survey Documents and other Record Documents reflecting changes from the Bid Documents.
- E. The scanned As-Built drawing sets shall be complete and include the title sheet, plan/profile sheets, cross-sections, and details. Each individual sheet contained in the printed set of the As-Built Drawings shall be included in the electronic drawings, with each sheet being converted into an individual tif (tagged image file). The plan sheets shall be scanned in tif format Group 4 at 400 dpi resolution to maintain legibility of each drawing. Then, the tif images shall be embedded into a single pdf (Adobe Acrobat) file representing the complete plan set. Review all Project Record Documents to ensure a complete record of the project.
- F. Provide an encompassing digital AutoCAD file that includes all the information of the As-Built Drawings and any other graphical information in the As-Built Drawings. It shall include the overall Work, utility system layout and associated parcel boundaries and easements. Feature point, line and polygon information for new or altered Work and all accompanying geodetic control and survey data shall be included. The surveyor's certified as-built asset attribute data shall be added to the As-Built Drawings and Surveyor shall electronically seal the data in a comma-delimited ASCII format (txt).

PART 3 - EXECUTION

3.01 SURVEY FIELD WORK

- A. Locate, reference, and preserve existing horizontal and vertical control points and property corners shown on the Drawings prior to starting any construction Work. If the Surveyor performing the Work discovers any discrepancies that will affect the Project, the Contractor must immediately report these findings to the District. All

survey work shall meet the requirements as defined in Florida Administrative Code 61G17-6. Reference and preserve all survey points during construction. If survey points are disturbed, it is the responsibility of the Contractor's Surveyor to reset the points at the Contractor's expense. Copies of the Surveyor's field notes and/or electronic files for point replacement shall be provided to the District.

1. The Surveyor shall locate all improvements for the project using State Plane Coordinates as the horizontal datum and the benchmark referenced on the Drawings as the vertical datum. The District will provide electronic files of the Drawings to be used by the Surveyor in complying with these specifications.
 2. The construction layout shall be established from the reference points shown or listed on the Drawings. The accuracy of any method of staking shall be the responsibility of the Contractor. All construction layout staking shall be done such as to provide for easy verification of the Work by the District.
- B. Use survey control points to layout such work tasks as the following:
1. Clearing, grubbing, work limits, right-of-way lines and easements
 2. Locations for pipelines and all associated structures and appurtenances
- C. The Surveyor shall reference and replace any project control points, boundary corners, benchmarks, section corners, and right-of-way monuments that may be lost or destroyed, at no additional cost to the District. Establish replacement points based on the original survey control. Copies of all reference field notes and/or electronic files for point replacement shall be submitted to the District.

3.02 CONSTRUCTION PROGRESS MEETINGS

- A. Contractor shall provide progressive and a final version of the Record Documents both as paper copies and electronic format described below.
1. Construction Contract, As-Built Drawings, Specifications, General Conditions, Supplemental Conditions, Bid Proposal, Instruction to Bidders, Addenda, and all other Contract Documents.
 2. Specifications and Addenda: Record manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed as well as any changes made by Field Order, Change Order or other.
 3. Change orders, verbal orders, and other modifications to Contract.
 4. Written instructions by the District as well as correspondence related to Requests for Information (RFIs).
 5. Accepted Shop Drawings, samples, product data, substitution and "or-equal" requests.
 6. Field test records, inspection certificates, manufacturer certificates and construction photographs.
- B. Progressive record documents shall include the following updated information certified by the Surveyor:

1. Surveyor shall obtain field measurements of vertical and horizontal dimensions of constructed improvements.

3.03 FINAL RECORD DOCUMENTS SUBMITTAL

- A. Submit the Final Record Documents within 20 days after Substantial Completion.

1. Participate in review meetings as required and make required changes and promptly deliver the Final Record Documents to the Engineer or District.

3.04 STORAGE AND PRESERVATION

- A. Store Record Documents and samples at a protected location in the project field office apart from documents used for construction.

1. Provide files and racks for storage of documents
2. Provide locked cabinet or secure space for storage of samples.

- B. File documents and samples in accordance with CSI format with section numbers matching those in the Contract Documents.

- C. In the event of loss of recorded data, use means necessary to again secure the data to the District's approval.

1. Such means shall include, if necessary in the opinion of the District, removal and replacement of concealing materials.
2. In such cases, provide replacements of the concealing materials to the standards originally required by the Contract Documents.

END OF SECTION

**SECTION 01730
OPERATION AND MAINTENANCE DATA**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Detailed information for the preparation, submission, and District's review of Operations and Maintenance (O&M) Data, as required by individual Specification sections.

1.02 DEFINITIONS

- A. Preliminary Data: Initial and subsequent submissions for District's review.
- B. Final Data: Engineer-accepted data, submitted as specified herein.
- C. Maintenance Operation: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

1.03 SEQUENCING AND SCHEDULING

- A. Equipment and System Data:
 - 1. Preliminary Data:
 - a. Do not submit until Shop Drawing for equipment or system has been reviewed and approved by District.
 - b. Submit prior to shipment date.
 - 2. Final Data: Submit data not less than 30 days prior to installation of equipment or system equipment or system field functional testing.

1.04 DATA FORMAT

- A. Prepare preliminary data in the form of an instructional manual. Prepare final data on electronic media.
- B. Instructional Manual Format:
 - 1. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.
 - 2. Size: 8-1/2 inches by 11 inches, minimum.
 - 3. Cover: Identify manual with typed or printed title "OPERATION AND MAINTENANCE DATA" and list:
 - a. District's Project number and title.
 - b. Designate applicable system, equipment, material, or finish.
 - c. Identity of general subject matter covered in manual.
 - d. Identity of equipment number and Specification section.

4. Title Page:
 - a. Contractor name, address, and telephone number.
 - b. Subcontractor, Supplier, installer, or maintenance contractor's name, address, and telephone number, as appropriate.
 - i. Identify area of responsibility of each.
 - ii. Provide name and telephone number of local source of supply for parts and replacement.
 5. Table of Contents:
 - a. Neatly typewritten and arranged in systematic order with consecutive page numbers.
 - b. Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.
 6. Paper: 20-pound minimum, white for typed pages.
 7. Text: Manufacturer's printed data, or neatly typewritten.
 8. Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.
 9. Material shall be suitable for reproduction, with quality equal to original. Photocopying of material will be acceptable, except for material containing photographs.
- C. Electronic Media Format:
1. Portable Document Format (PDF):
 - a. After all preliminary data has been found to be acceptable to District, submit Operation and Maintenance data in PDF format on CD.
 - b. Files to be exact duplicates of Engineer-accepted preliminary data. Arrange by specification number and name.
 - c. Files to be fully functional and viewable in most recent version of Adobe Acrobat.

1.05 SUBMITTALS

- A. Informational:
1. Data Outline: Submit a detailed outline of proposed organization and contents of Final Data prior to preparation of Preliminary Data.
 2. Preliminary Data:
 - a. Submit PDF for District's review.
 - b. If data meets conditions of the Contract:
 - i. Submit PDF to Resident Project Representative.
 - ii. Submitted PDF will be retained in Engineer's file for District's use.
 - c. If data does not meet conditions of the Contract:

- i. A PDF will be returned to Contractor with Engineer's comments for revision.
 - ii. Engineer's comments will be retained in Engineer's file.
 - iii. Resubmit PDF in accordance with Engineer's comments.
3. Final Data: Submit three (3) hard copies in format specified herein and one (1) electronic version.

1.06 DATA FOR EQUIPMENT AND SYSTEMS

A. Content for Each Unit (or Common Units) and System:

1. Product Data:
 - a. Include only those sheets that are pertinent to specific product.
 - b. Clearly annotate each sheet to:
 - i. Identify specific product or part installed.
 - ii. Identify data applicable to installation.
 - iii. Delete references to inapplicable information.
 - c. Function, normal operating characteristics, and limiting conditions.
 - d. Performance curves, engineering data, nameplate data, and tests.
 - e. Complete nomenclature and commercial number of replaceable parts.
 - f. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
 - g. Spare parts ordering instructions.
 - h. Where applicable, identify installed spares and other provisions for future work (for example, reserved panel space, unused components, wiring, terminals).
2. As-installed, color-coded piping diagrams.
3. Charts of valve tag numbers, with the location and function of each valve.
4. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:
 - a. Format:
 - i. Provide reinforced, punched, binder tab; bind in with text.
 - ii. Reduced to 8-1/2 -inch by 11 -inch, or 11 -inch by 17 -inch folded to 8-1/2 -inch by 11 -inch.
 - iii. Where reduction is impractical, fold and place in 8-1/2 -inch by 11-inch envelopes bound in text.
 - iv. Identify Specification section and product on Drawings and envelopes.
 - b. Relations of component parts of equipment and systems.
 - c. Control and flow diagrams.
 - d. Coordinate drawings with Project record documents to assure correct illustration of completed installation.

5. Instructions and Procedures: Within text, as required to supplement product data.
 - a. Format:
 - i. Organize in consistent format under separate heading for each different procedure.
 - ii. Provide logical sequence of instructions for each procedure.
 - iii. Provide information sheet for District's personnel, including:
 - I.* Proper procedures in event of failure.
 - II.* Instances that might affect validity of guarantee or Bond.
 - b. Installation Instructions: Including alignment, adjusting, calibrating, and checking.
 - c. Operating Procedures:
 - i. Startup, break-in, routine, and normal operating instructions.
 - ii. Test procedures and results of factory tests where required.
 - iii. Regulation, control, stopping, and emergency instructions.
 - iv. Description of operation sequence by control manufacturer.
 - v. Shutdown instructions for both short and extended duration.
 - vi. Summer and winter operating instructions, as applicable.
 - vii. Safety precautions.
 - viii. Special operating instructions.
 - d. Maintenance and Overhaul Procedures:
 - i. Routine maintenance.
 - ii. Guide to troubleshooting.
 - iii. Disassembly, removal, repair, reinstallation, and re-assembly.
 6. Guarantee, Bond, and Service Agreement: In accordance with Section 01700, Contract Closeout.
- B. Content for Each Electric or Electronic Item or System:
1. Description of Unit and Component Parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, nameplate data, and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 - d. Interconnection wiring diagrams, including control and lighting systems.
 2. Circuit directories of panelboards.
 3. Electrical service.
 4. Control requirements and interfaces.
 5. Communication requirements and interfaces.
 6. List of electrical relay settings, and control and alarm contact settings.

7. Electrical interconnection wiring diagram, including as applicable, single-line, three-line, schematic and internal wiring, and external interconnection wiring.
 8. As-installed control diagrams by control manufacturer.
 9. Operating Procedures:
 - a. Routine and normal operating instructions.
 - b. Startup and shutdown sequences, normal and emergency.
 - c. Safety precautions.
 - d. Special operating instructions.
 10. Maintenance Procedures:
 - a. Routine maintenance.
 - b. Guide to troubleshooting.
 - c. Adjustment and checking.
 - d. List of relay settings, control and alarm contact settings.
 11. Manufacturer's printed operating and maintenance instructions.
 12. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
- C. Maintenance Summary:
1. Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.
 2. Format:
 - a. Use Maintenance Summary Form bound with this section or electronic facsimile of such.
 - b. Each Maintenance Summary may take as many pages as required.
 - c. Use only 8-1/2-inch by 11-inch size paper.
 - d. Complete using typewriter or electronic printing.
 3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
 4. Recommended Spare Parts:
 - a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.
 - b. "Unit" is the unit of measure for ordering the part.
 - c. "Quantity" is the number of units recommended.
 - d. "Unit Cost" is the current purchase price.

1.07 SUPPLEMENTS

- A. The supplements listed below, following "End of Section", are part of this Specification.
 1. Forms: Maintenance Summary Form.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

MAINTENANCE SUMMARY FORM

PROJECT: _____ CONTRACT NO.: _____

1. EQUIPMENT ITEM _____

2. MANUFACTURER _____

3. EQUIPMENT/TAG NUMBER(S) _____

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____

5. NAMEPLATE DATA (hp, voltage, speed, etc.) _____

6. MANUFACTURER'S LOCAL REPRESENTATIVE _____

a.

Name _____

Telephone No. _____

b.

Address _____

7. MAINTENANCE REQUIREMENTS

Maintenance Operation Comments	Frequency	Lubricant (If Applicable)
List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation.	Refer by symbol to lubricant required.

8. LUBRICANT LIST

Reference Symbol	Shell	Exxon Mobile	Chevron Texaco	BP Amoco	Or Equal
List symbols used in No. 7 above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				

9. RECOMMENDED SPARE PARTS FOR DISTRICT'S INVENTORY.

<i>Part No.</i>	<i>Description</i>	<i>Unit</i>	<i>Quantity</i>	<i>Unit Cost</i>
<i>Note: Identify parts provided by this Contract with two asterisks.</i>				

**SECTION 02320
EXCAVATING, BACKFILLING, AND COMPACTION**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Dewatering, excavating, shoring, sheeting, bracing, trenching, backfilling, and all other earthwork operations required for utility and other underground lines and appurtenances.
- B. Providing access to open trenches after utility lines have been installed and bedded, but prior to backfilling being commenced, to permit recording of record or "as-built" survey information.

1.02 QUALITY ASSURANCE

A. Tests and inspections:

1. Test methods:

- a. Maximum dry density of backfill materials shall be determined by ASTM D1557, Procedure A.
- b. Field density tests shall be determined by ASTM D1556, ASTM D2922, or ASTM D2937.

2. Required tests:

- a. Backfill material: Determine suitability of backfill and bedding material not previously evaluated.
- b. Maximum density tests: Determine optimum moisture content and maximum dry density of backfill and bedding materials placed and compacted.
- c. Field density tests: Determine in-place density of backfill materials placed and compacted. One test for every 100 linear feet of trench and one test for each 1 foot vertical lift.
- d. Other tests as may be required by the District.

3. Required inspections:

- a. Excavation inspection: Detailed inspection of exposed excavations prior to placing bedding and backfill material.
- b. Bedding conditions: Determine and evaluate condition of bedding to receive utility lines.

- B. Requirements of regulatory agencies: In addition to complying with other legal requirements, comply with the following.
1. Code of Federal Regulations Title 29 CFR Part 1926, Subpart P, Excavations.
 2. Occupational Safety and Health Administration Document 2226.
 3. Florida Statutes, Chapter 553 Building Construction Standards, Part VI, Trench Safety Act.
- C. Reference specifications and standards:
1. ASTM: D422 Particle-Size Analysis of Soils.
 2. ASTM: D1556 Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 3. ASTM: D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³).
 4. ASTM: D2419 Sand Equivalent Value of Soils and Fine Aggregate.
 5. ASTM: D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 6. ASTM: D2937 Density of Soil In-Place by the Drive-Cylinder Method.
 7. CFR: Title 29 CFR Part 1926 Safety and Health Regulations for Construction.
 8. Florida Statutes: Chapter 553 Building Construction Standards.
 9. OSHA: Document 2226 Excavations.

1.03 SUBMITTALS

- A. Procedures: In accord with Section 01300.
- B. Drawings and engineering design calculations: Signed and sealed engineering drawings and calculations for required shoring, sheeting, or cribbing for approval prior to starting installation of shoring, sheeting, or cribbing.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Source of materials: Materials may be obtained by selective stockpiling of excavated soils and/or from an on-site or off-site borrow pit approved by the District.
1. Select bedding material shall be clean, natural, excavated sand, free from roots, organic material, trash or other debris, maximum size 1 inch containing less than 15 percent by weight passing the No. 200 sieve.

2. Backfill material for pipe zone shall be free from stones, roots, foreign material and organic material. Maximum size of particles shall be 1-inch with less than 15 percent by weight passing the No. 200 sieve. This material may be clean natural sand or gravel, imported quarry waste or select excavated material, provided that such material consists of loam, sand, sandy clay loam, gravel or other materials of the GM/GC classification, as classified in accordance with ASTM D2487.
3. Backfill above the pipe zone shall be excavated material obtained from the Contractor's excavations. Such materials shall be free of roots, trash, debris, deleterious materials, broken concrete or paving materials, organic materials, boulders, rocks or stones larger than three (3) inches and expansive soils.
4. Gravel shall be 1-inch minus crushed rock, meeting the requirements of No. 57 aggregate as specified in Section 901 of the FDOT Standard Specifications.
5. Deficiency of Backfill: Where excavated material is indicated as backfill on the drawings or specified herein and there is a deficiency due to the rejection of part of the material, the required quantity of sand, gravel or other approved backfill material shall be obtained from a source secured by the Contractor.

PART 3 - EXECUTION

3.01 PROTECTION

- A. Public and adjacent properties: Protect in accord with applicable laws and ordinances.
- B. Existing on-site features, plant life, including trees, scheduled to remain:
 1. Protect from damage at all times.
 2. Do not allow earth-moving equipment within the branch spread perimeter (drip line) of existing trees.
 3. Do not cut tree roots over 2 inches in diameter without prior approval from the District.
 4. Support trees during excavation in an approved manner.
 5. When excavation adjacent to existing trees is necessary, use all possible care to avoid injury to trees and tree roots. Excavate by hand all areas where 2 inches and larger roots occur. Tunnel under and heavily wrap with burlap roots 2 inches and larger in diameter, except directly in the path of pipe or conduit, to prevent scarring or excessive drying. When a trenching machine runs close to trees having roots smaller than 2 inches in diameter, hand trim wall of trench adjacent to tree, making clean cuts through roots. Paint roots 1 inches and larger in diameter with two coats of Tree Seal, or District-approved equivalent. Close trenches adjacent to trees within 24 hours; when this is not possible, shade side of trench adjacent to tree with burlap or canvas.

6. All work around and adjacent to existing trees, including inspection prior to backfill, shall be approved by the District. Obtain District's approval in writing for all procedures prior to commencement of work. Trees that die due to damage or unacceptable work shall be back-charged to Contractor.
- C. Where utility line excavation occurs in lawn, grassed, or landscaped areas, carefully remove and stockpile sod and plants to preserve for transplanting.
1. Place excavated material from trenches on lawn or grass, provided a drop cloth or other approved method is employed to protect lawn or grass from permanent damage. Do not keep stockpiled materials on lawn or grass for more than 72 hours
 2. Immediately after completion of backfilling and testing of utility lines, replace sod and replant plants in a manner to restore lawn, grass, and landscaping to its original condition within practical limits. Replace damaged landscaping at no cost to the District as part of the work of this Section.
- D. Open trenches: Barricade all open trenches during work hours and cover at the close of each day's work. Maximum length of open trenches shall be 350 feet.
- E. Dust control:
1. Throughout entire construction period, effectively dust-palliate working area, unpaved roads, and involved portions of site.
 2. Palliation: Intermittently water and sprinkle with such frequency as will satisfactorily allay dust at all times. Chemical treatment of any type is not permitted.
- F. Water control:
1. Maintain trenches and other excavations free of water while lines are being placed and until backfill has been completed and approved.
 2. Maintain adequate pumping equipment at all times to provide for emergencies.
 3. Dispose of water in such a manner as not to create a nuisance, cause damage to property, or interfere with activities of other contractors. Prevent water from migrating outside of construction areas. Use District-approved methods and materials to confine water to construction areas. Failure to contain water is not permitted.
 4. Dewater as required to maintain site in a relatively dry condition, including well point dewatering.
 5. Methods of dewatering and disposal of water are subject to the District's approval.
- G. Bracing and shoring:

1. The Contractor shall furnish, install and maintain sheeting, bracing, shoring and sloping required to support the sides of the excavation, and to prevent any movement which may damage adjacent utilities, pavements or structures, damage or delay the work or endanger life and health. All voids outside the supports shall be immediately filled and compacted.
 2. Support excavations in accord with all legal requirements.
 3. Set and maintain sheet piling and shoring timbers in a manner that will prevent caving of walls of excavations or trenches and not impose other loads or surcharges on lines.
 4. When it is impractical to remove shoring and bracing, obtain approval from the District to leave in place. Record locations of such "in-place" shoring and bracing on Project Record Documents and indicate type of material and thickness.
- H. Stockpiled excavated materials: Confine excavated materials to immediate area of stockpiled location.
- I. When obstructions that are not shown on the plans are encountered during the progress of the work and an alteration or revision to the plans is required, the District will have the plans revised or may order the removal, relocation or reconstruction of the obstruction.

3.02 EXCAVATION

- A. General: Include removal of materials and obstructions that interfere with the execution of the Work.
1. Unless indicated otherwise, excavation for utilities lines shall be by open trench.
 2. Sides of trenches shall be as nearly vertical as practicable.
 3. The excavation and preparation of trenches shall not proceed in advance of installation more than 100 feet, except as approved by the District. Trenching shall not, under any conditions, exceed the installation that can be bedded, inspected, tested, backfilled and compacted in one working day.
- B. Trench widths:
1. Lines less than 6 inches outside diameter: 18 inches, minimum.
 2. Larger lines: Clear distance on each side of line of not less than 12 inches.
- C. Trench depth: Excavate trenches to lines and grades as necessary for construction of utility lines indicated.
- D. Over-excavation: Backfill over-depth excavations to required grade with specified bedding and backfill material at no additional cost to the District. Compact bedding and backfill material to specified density.

- E. Perform any dewatering and pumping required to keep excavations free of standing water.
- F. Refer to geotechnical reports for seasonal high groundwater table elevation estimates. It is the sole responsibility of contractor to make its own judgments as to the actual conditions, and to draw its own conclusions as to means and methods required for performance of the work. Provide dewatering, if required, at whatever elevation groundwater is actually encountered.
- G. A plan for any proposed dewatering shall be submitted for approval prior to commencement of any such work. Any permitting for dewatering which may be required shall be the responsibility of Contractor.
- H. Sequence, schedule, coordinate, and perform the work so as to maintain safe, unobstructed passage as required for emergency egress and general site access. Provide any and all bridging of trenches of work, barricades, etc., that may be required to comply with this requirement.
- I. When the trench bottom is found to contain unsuitable material which is unstable to such a degree that in the judgment of the District it cannot be removed, a foundation for the pipe, structure and/or appurtenance shall be constructed using piling, treated timber, concrete or other material approved by the District.
 - 1. Unsuitable materials are soils, exposed at the trench bottom that are compressible, expansive, contain extraneous rubble, offer uneven foundation support, or have a natural moisture content three (3) percent in excess of the soils optimum moisture content. Unsuitable materials/soils shall include, but not be limited to, muck, peat, expansive clays, boulders, soils in a quick condition, rubble, any portion of trees, roots or similar vegetation, wood or other unyielding material.
 - 2. The Contractor shall notify the District immediately when unstable material is encountered. The District will investigate the questionable material to determine its stability. Should the District require soils testing to aid in his determination, then all tests revealing suitable materials shall be paid for by the Contractor.
 - 3. Where the District determines that unstable material is present below the pipe envelope which will not provide adequate support for the pipe, the Contractor shall remove the unstable material and replace with a minimum of six (6) inches of Gravel up to the bottom of the pipe envelope.

3.03 BACKFILL

- A. General:
 - 1. Backfill consists of bedding, backfill, and restoration of surface.

2. Do not cover lines until they have been inspected and approved for alignment and grade and recording of record or "as-built" survey information has been performed.
3. The minimum distance between test sampling points along the trench shall be in accordance with the following table:

TRENCH ZONE	STANDARD PROCTOR ASTM D1557	FIELD DENSITY ASTM D1556	RELATIVE DENSITY	
			GREEN AREA	PAVED AREA
PIPE BEDDING	ONE TEST FOR EACH SOIL TYPE FOUND	ONE TEST FOR EVERY 100 LINEAR FEET * ONE PER MANHOLE *	98%	98%
HAUNCHING			98%	98%
PIPE ZONE			95%	95%
BACKFILL ABOVE PIPE ZONE			95%	98%
MANHOLE FOUNDATION			95%	98%

* Per lift

4. The Contractor shall not achieve compaction by the use of heavy rolling equipment or by running heavy construction equipment on or in the trench. Backfilling and compaction shall have been completed, tested and the degree of compaction verified before heavy equipment is operated over the trench.
 5. Puddling or flooding with water to achieve compaction shall not be permitted.
 6. When unsatisfactory compaction is revealed, the Contractor shall immediately re-excavate the trench, replace and re-compact the backfill to the required relative densities over the entire depth of the trench.
 7. Partial Backfill During Testing: When conditions require that pipe testing should be accomplished before completion of backfilling or with pipe joints accessible for examination, sufficient backfill material shall be placed over the pipe barrel, between the joints, to prevent pipe movement.
- B. Bedding: Bedding is defined as material supporting and extending to the invert of utility line. Provide 6 inches minimum layer of Select Granular Bedding and compact bedding to 98% of the maximum dry density in accord with ASTM D1557 using mechanical equipment. Bedding shall not be required under or around structures, except at utility lines.
- C. Backfill: Backfill includes material from 12 inches above the lines to, and including, surface restoration.

1. Commence backfilling immediately after approval and survey information recording, to preclude damage to utility lines.
2. Carefully place backfilling around utility lines so as not to displace or damage line, and fill symmetrically on each side of line to 12 inches above top of line.
3. Do not backfill against structures until concrete has attained sufficient strength to withstand loads, and structures have been approved.
4. Place backfill in loose uniform lifts not exceeding 8 inches, unless otherwise specified.
5. Use mechanical compactors for compaction of backfill.
6. Pipe Zone Backfill
 - a. Backfill the pipe zone to 12 inches above the top of the pipe for the full width of the trench with Backfill Material For Pipe Zone as specified in paragraph 2.01.A.2.
 - b. Haunching (Up to Springline of Pipe): Place in the trench in horizontal lifts not exceeding 6 inches in uncompacted thickness on both sides of the pipe. Thoroughly tamp and compact the material to obtain a relative density of not less than 98 percent of the maximum density. Use particular attention in placing material on the underside or haunches of the pipe to provide a solid backing to eliminate any voids.
 - c. Remainder of Pipe Zone: Place on both sides of the pipe. Tamp and compact the material to obtain a relative density of not less than 95 percent of maximum density.
7. Trench Backfill Above Pipe Zone
 - a. Place Backfill Material For Pipe Zone as specified in paragraph 2.01.A.3 in all areas beneath structures, piping, utilities, roads, pavements, or other facilities. Compact each lift to not less than 98% maximum density.
 - b. In other areas, backfill the trench above the pipe zone with material conforming to Backfill Above The Pipe Zone. Place in 12-inch layers and compact each layer by means of mechanical tampers or vibratory compactors to 95% maximum density in field areas and to 98% maximum density under all roadways, walks, paved surfaces and structures. Backfill to the required surface grade and compact so that no surface settlement occurs.
8. Coordinate and ensure installation of underground utilities marking in accord with Section 02505.

D. Minor structures

1. Support catch basins, vaults, manholes and other minor structures on bottom and all sides by soils compacted to 95% of the maximum dry density in grass

or filed areas and to 98% maximum dry density under all roadways, walks, paved surfaces and structures in accord with ASTM D1557 for full depth of fill.

- a. The pre-cast vaults shall be carefully placed on the prepared foundation so as to be fully and uniformly supported in true alignment, making certain that the pipe can pass through on the designed line and grade.
 - b. Pre-cast vaults shall be handled by lifting rings only.
 - c. Pre-cast vaults and manholes shall be placed and aligned to provide vertical alignment with not more than one eighth (1/8) inch maximum tolerance for five (5) feet of depth. The completed unit shall be rigid, true to dimensions and alignment.
- E. Maintain the surface of the backfilled trench level with the existing grade until the entire project is accepted by the District. Any subsequent settlement of the finished surface during the warranty period shall be considered to be as a result of improper or insufficient compaction and shall be promptly repaired by the Contractor at no cost to the District.
1. The maintenance shall include, but not be limited to, the addition of roadway material to keep the surface of backfilled trenches reasonably smooth, free from ruts and potholes, and suitable for normal traffic flow.

3.04 ADJUST AND CLEAN

- A. Surface restoration:
1. Restore surface areas over trenches equivalent to conditions which existed prior to start of work.
 2. Reconstruct surfaces in accord with applicable Sections of the Specifications.
- B. Disposal:
1. Debris:
 - a. Remove and dispose of all rubbish, debris, and vegetation as it accumulates.
 - b. Dispose of debris off-site or at an on-site disposal area designated by District.
 2. Excess soil: Stockpile at an on-site area designated by District.

END OF SECTION

SECTION 02355
STEEL H-SECTION PILES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install steel H-Section piling. Included are furnishing, driving, cutting-off, and all other Work for piling.

1.02 RELATED SECTIONS

- A. Section 01300 – SUBMITTALS

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. ASTM A36, Standard Specification for Carbon Structural Steel.
- B. ASTM A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- C. ASTM A588, Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi Minimum Yield Point to 4-inches Thick.
- D. ASTM A690, Standard Specification for High-Strength Low-Alloy Steel H-Piles and Sheet Piling for Use in Marine Environments.
- E. ASTM D1143, Standard Test Method for Piles under Static Axial Compressive Load.
- F. ASTM D3689, Standard Test Method for Individual Piles Under Static Axial Tensile Load.
- G. ASTM D3966, Standard Test Method for Piles Under Lateral Loads.
- H. ASTM D4945, Standard Test Method for High-Strain Dynamic Testing of Piles.
- I. AWS D1.1, Structural Welding Code – Steel.
- J. SSPC-PS 10.01, Hot-Applied Coal Tar Enamel Painting System.
- K. SSPC-PS 11.01, Black (or Dark Red) Coal Tar Epoxy Polyamide Painting System.
- L. SSPC-SP6, Commercial Blast Cleaning.

1.04 SUBMITTALS

- A. Submit Working Drawings as specified in Section 01300 SUBMITTALS. The data submitted shall include the following:

1. Submit working drawings in advance of the start of pile driving showing the location of all piles. Assign an identification number for each pile coinciding with the identification number used in the driving record of each pile. These drawings shall include the driving sequence anticipated for the Work.
2. Full data on type of pile proposed and on hammer and other equipment to be utilized.
3. The proposed pile installation procedures.
4. Details of pile splices.
5. Details of welded assembly for connection to structure.
6. Qualifications of personnel performing welding.
7. Qualifications of personnel supervising the performance of pile installation meeting the requirements as described herein

B. Driving Records:

1. Submit two copies of the driving record of each pile to the District not later than two days after driving. Include the Project name and number, name of CONTRACTOR, pile location and number, computed pile capacity, type and size of hammer used, type of pile driving cap used, rate of operation of pile driving equipment, pile dimensions, elevation of point, elevation of butt before and after cut-off, ground elevation, continuous record of number of blows for each foot of penetration, pile deviation, pile uplift and reaction, and any unusual occurrences during pile driving.
2. Submit Record Drawings showing exact location of each pile as driven.

- C. During progress of the Work, keep an up to date set of Drawings showing field modifications. Immediately upon completion of work, provide Record Drawings showing the actual in-place installation of all Work constructed and/or installed under this Section. Drawings shall include all necessary plans, sections and details, with all reference dimensions and elevations required for complete Record Drawings of the Work.

1.05 QUALITY ASSURANCE

A. CONTRACTOR Qualifications shall meet the requirements of the following.

1. Pile Driver (Installer) Qualifications: An experienced pile driver, with a minimum of 5 years documented experience, to assume engineering responsibility and perform work of this Section. The pile driver shall have specialized experience in installing piles similar to those required for this Project on a minimum of three previous projects and with a record of successful in-service performance.

- B. Comply with all rules, regulations, laws and ordinances of the State of Florida, OSHA and of all other authorities having jurisdiction. All labor, materials, equipment and services necessary to make the work comply with such requirements shall be provided by the CONTRACTOR without additional cost to the District.

1.06 JOB CONDITIONS

A. Product Delivery, Storage and Handling:

1. CONTRACTOR shall deliver, store, handle and protect all products, materials and equipment.
2. Deliver materials to the site in such quantities and at such times as to assure the continuity of pile installation operations for each pile.
3. Store piles in orderly groups above ground and blocked during storage to minimize possible distortion.
4. Lifting points shall be clearly marked on the piles by the manufacturer, and all handling and storage shall be undertaken with consideration for required support.
5. Piles shall be picked up into the leads by the designated lifting points.
6. Piles shall be clearly marked with the length of the pile prior to delivery.

B. Site Information:

1. CONTRACTOR shall review and understand the information contained in the Geotechnical Report. The geotechnical investigation report is made available to the CONTRACTOR for information on factual data only and shall not be interpreted as a warranty of subsurface conditions whether interpreted from written text, boring logs, or other data.
2. The CONTRACTOR shall visit the site and become thoroughly familiar with all site conditions affecting the work and review the location of all piles for potential obstruction or interference during pre-drilling and driving.
3. Test borings and other exploratory operations may be made by the CONTRACTOR at no additional cost to the District, provided such operations are acceptable to the District, in accordance with Contract Documents.

C. Line and Level:

1. Benchmarks and elevations are shown on the Contract Drawings for the use of the CONTRACTOR in establishing lines and levels for the work. The CONTRACTOR shall establish and locate all other lines and levels

and be responsible for the correct location and deviation measurements of all piles.

2. All piles shall be installed at the proper locations and orientations as shown on the plans. Pile locations shall be checked during installation and appropriate measures taken, as necessary, to maintain the correct pile location and orientation.
3. The CONTRACTOR shall cooperate with the District and provide them safe access to the pile installation locations in order to perform their work.

D. Protection:

1. The CONTRACTOR shall protect adjacent property, public utilities and structures, and completed work, from damage associated with the pile driving operation. Damage due to pile driving as a result of CONTRACTOR'S work shall be repaired by the CONTRACTOR at no additional cost to the District.

E. Cost of Redesign:

1. Piling driven incorrectly, out of position, or which is defective in any way shall be corrected as directed by the District and as described hereinafter.
2. The District will record all time required by it and the District's consultants, if any, in redesigning piling, foundations or other related structural work and in making revisions to the Contract Documents as a result of improperly installed piles.
3. CONTRACTOR shall reimburse the District for the additional services of the District and their consultants based on a charge of 2.5 times salary costs.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel:

1. Provide hot-rolled carbon steel structural shapes and plates, complying with ASTM A588 or ASTM A572, Grade 50, unless otherwise shown or specified. Piles shall be epoxy coated with color chosen by the District.
2. Provide carbon steel angles and plates complying with ASTM A36, unless otherwise shown or specified.
3. Cut to mill tolerances on piles that are to be spliced.

4. The H-pile steel shall be of sufficient strength and rigidity to withstand all driving and handling stresses and to maintain initial shape within the tolerances specified hereinafter. Pile materials shall be new and of uniform quality.
5. Piles shall be coated according to the following requirements:
 - a. Surface Preparation – Prepare the substrate by providing a depth of anchor profile in accordance with the manufacturer’s product data sheet, but in no case less than 2.5 mils. Re-blast piles not coated during the same shift or if the surface to be coated no longer meets the requirements SSPC-SP 10.
 - b. Unless otherwise shown in the Drawings, apply the inorganic zinc primer to all surfaces of piles. Unless otherwise shown in the Drawings, apply coal tar-epoxy coatings to the exposed sides of piles from the top of the piles to a depth of five feet below the lower of the design ground surface or the design scour depth. Apply the coal tar-epoxy in accordance with the following specific requirements:
 - i. Apply the coal tar-epoxy system in two coats. The time interval between the first coat and the second coat will be in strict accordance with the coating manufacturer’s published specifications. Apply the first coat to yield a dry film thickness of 8 to 10 mils. Apply the second coat to attain a total dry film thickness of the two coats between 16 and 20 mils.
 - ii. Ensure that no portion of the coating is less than the specified minimum film thicknesses. The total minimum film thickness for any combination of coats will be the sum total of the averages of the specified thickness range of the individual coats.
 - iii. After applying the coating on the steel piles, the Engineer will thoroughly inspect the surfaces and make film thickness measurements at the approximate rate of one for each 25 square feet of area unless deficient thickness is found. In this case, the rate of sub-measurements will be increased as required to determine the extent of the deficient area.

2.02 FABRICATION

A. Pile tips:

1. Pile tips as driven shall be square and blunt unless shown otherwise on the Contract Drawings. Manufactured pile tips shall not be used for the piles.

2.03 DRIVING EQUIPMENT

A. General:

1. Piles shall be driven with a single-acting steam or diesel hammer of a type approved by the District. CONTRACTOR shall select a hammer with sufficient energy to drive the piling to the required tip elevation without causing damage to the pile. The valve mechanism of single-acting hammers shall be maintained in first-class condition so that the length of the stroke is maintained. If diesel hammers are used, they shall be equipped with chambers and gages arranged so that precise energy information can be read and recorded. CONTRACTOR shall provide all material relative to construction and performance of the hammer as the District may request. Hammer shall be in good operating condition at all times during driving.
 - a. Unless otherwise indicated on the Contract Drawings or approved by the District, the hammer shall have a rated driving energy of 66,000 foot-pounds per blow for HP12 x 53 piles and as determined by wave equation analyses.

B. Driving Caps: Equip hammer with cushioned or blocked driving cap, conforming to the pile shape. The cushion shall be consistent with wave equation analyses and dynamic testing. The cushion or block shall be replaced when burned or otherwise worn. Keep bearing surfaces of driving cap true and smooth.

C. Leads: Use fixed or rigid type pile driver leads that will hold the pile firmly in position and alignment and in axial alignment with the hammer. Free-swinging leads will not be permitted. Extend leads to within 2 feet of the elevation at which the pile enters the ground.

PART 3 - EXECUTION

3.01 INSPECTION

- A. CONTRACTOR shall examine the areas and conditions under which steel H-Section piles are to be installed. Notify the District, 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 the District.

3.02 PRE-DRIVING WORK

- A. Site Conditions:

1. Do not drive piles until the earthwork in the area which piles are to occupy has been completed, as follows:
 - a. Excavations: Stop earth excavation at an elevation of 6-inches to 12-inches above the bottom of the footing before piles are driven. Final excavation to the required elevation of footing bottoms shall be done after the piles have been installed and tested.
 - b. Fills: Construct and compact fills to the elevation of the grade shown.
 2. Do not drive pile within 15 feet of any concrete or masonry structure which has not attained its full design strength.
 3. When piles are located in an area where pre-drilling is to occur, the piles shall not be driven until the pre-drilling has been completed.
- B. Pile Length Markings:
1. Mark length of pile by painting the number of feet from the pile point at 5-foot intervals and painting a horizontal line, at 12-inch intervals, starting 30 feet below pile cut-off.
- C. Welding:
1. All shop and field welding shall be performed by certificated welders under the immediate supervision of a representative of an approved standard testing agency or an inspection agency. The costs of all welding inspections shall be borne by the CONTRACTOR.
- D. Splices:
1. Splices should be minimized. Where necessary, two splices shall be permitted per length of pile, unless indicated otherwise on the Contract Drawings.
 2. Clean surfaces to be welded of all rust, scale, oil, paint, and foreign material. Use only pile members with identical cross-sections for splicing.
 3. Make splices before starting driving operations, wherever possible. If a welded splice is required during the driving operation, make the splice when the top of the driven pile portion is at least 3 feet above the ground, to permit inspection of the welded connection during welding and during subsequent driving. The sections of piles to be spliced shall be secured in alignment such that there is no eccentricity between the axes

of the two spliced lengths, or angle between them, after the splice has been completed. Splices performed during driving shall be completed during a stoppage of pile driving not to exceed 60 minutes or as necessary to prevent soil freezing around the pile.

4. Splices shall be 100 percent full penetration butt welded, producing a straight pile alignment through the splice and developing the full strength of the pile in both bearing and bending. Length of pile to be spliced shall be secured in proper alignment so that no eccentricity results.
5. All welding shall be performed in accordance with the applicable provisions of AWS D1.1 and Section 15018 WELDING. Ultrasonic testing of welds at pile splices shall be performed by an independent testing agency approved and paid by the CONTRACTOR. Testing shall be in conformance with ASTM E164-03. The CONTRACTOR shall cooperate with the testing agency to facilitate inspection. Welds which do not conform to applicable specifications shall be repaired at no additional cost as directed by the District.
6. No splices will be permitted within 60 feet of the pile tip.
7. Welded spliced piles shall not be driven until the weld has been accepted by the District's representative. Welds that do not conform to specifications shall be gouged and repaired as directed by the District's representative.

3.03 DRIVING PILES

A. General:

1. The driving shall be performed in an orderly sequence progressing in one direction across each foundation element. No piles shall be installed in an area surrounded by previously driven piles. Piles shall only be driven in the presence of the District or its representative.
2. The CONTRACTOR shall provide the necessary pile driving equipment for full-time operation at the site during the work to complete the work on schedule. The work shall require the mobilization of crane-mounted equipment for installation of the piles. The CONTRACTOR shall provide at least one fully equipped pile-driving rig in full-time operation at the site during the work, and shall mobilize additional equipment, if necessary, to complete the work on schedule.
3. Confirm the following driving criteria by the test piles at each structure. Drive piles to or into the dense sand of the Potomac Group P2 stratum to an average penetration resistance of ten blows per inch for the final 6 inches for HP14 piles and eight blows per inch for the final 6 inches for HP12 piles. If an abrupt increase in driving resistance is encountered, terminate driving when pile penetration is less than 1/2-inch in ten successive blows. Continuously drive each pile at the locations

indicated, to the required point elevation and driving resistance established by the driving and loading of test piles.

4. When the determination of the final driving resistance is being made, the steam, diesel, air, or hydraulic hammer shall be operated at a speed not less than 95 percent of the maximum blows per minute for which the hammer is rated by the manufacturer. The CONTRACTOR shall maintain the boiler or air pressure recommended by the manufacturer and shall employ the proper size hose and connections. When the determination of final driving resistance is being made with a diesel hammer, the energy being delivered to the pile shall be determined as the product of the weight of the ram times the observed or equivalent stroke for open diesel hammers; for closed diesel hammers, the energy shall be that indicated by an output gauge calibrated to measure total hammer energy.
5. Carefully maintain the center of gravity for each group or cluster of piles to conform to the locations shown.
6. Hammer and piles shall be supported in rigid leads designed to hold the pile firmly in position and in alignment with the hammer. Carefully plumb the leads and the pile before driving. Take care during driving to prevent and to correct any tendency of piles to twist or rotate.
7. When handling and driving long piles, take special precautions to ensure against overstress or leading away from a true position when driving.
8. As soon as driving of all piles is completed, excavate to final elevation around the piles, cut to required cutoff elevation, install welded attachments, and place the concrete working mat around the piles as indicated on the Contract Drawings.

B. Driving Tolerances:

1. Drive piles within the following maximum tolerances:
 - a. Location: 3 inches from the location indicated for the center of gravity of each single pile or 1.5 inches for the centroid of pile groups.
 - b. Plumbness: Piles shall not be out of plumb more than 2.5 percent of their length when installed. Maintain 1 inch in 10 feet from the vertical, or a maximum of 4 inches, measured when the pile is above ground, in the leads.

C. Corrective Action:

1. The District may survey the piles at any time. If any heave or any other discrepancy is detected, CONTRACTOR shall redrive or replace the pile or piles, at no additional cost to the District.

2. Immediately after a pile group is installed, the CONTRACTOR'S Licensed Surveyor shall establish a reference point and its elevation on each pile for the purpose of checking uplift of the pile top as additional piles are installed. If uplift of 0.04 feet or more occurs as a result of pile installation at other locations, the pile shall be redriven to its original elevation, and deeper if necessary, to the approved final driving resistance.
3. The radius of uplift shall be initially assumed to be 35 ft. This radius may be expanded or contracted by the District's representative based on actual field measurements and is defined as the maximum distance between piles such that pile driving causes uplift of 0.04 feet or more in the affected pile.
4. The District will check the piling and determine its acceptability. If not acceptable, the District will advise CONTRACTOR what additional piles must be furnished and driven or other corrective measures to be taken.
5. The District will provide redesign, as required, because of piles driven out of location. All corrective measures, including cost of the District's redesign, shall be at CONTRACTOR'S expense.
6. Partial surveys of piles at cutoff elevation can be submitted to the District for review, as driving proceeds, in order to expedite the Work.

D. Related Activities:

1. Jetting, spudding, and predrilling (at locations not indicated on Contract Drawings) of piles shall not be employed, except with the written consent of the District.

E. Damaged or Misdriven Piles:

1. Damaged piles, and piles driven outside the required driving tolerances, will not be accepted.
2. Withdraw piles rejected after driving, and replace with new piles.
 - a. Solidly fill spaces that are left by withdrawn piles, which will not be filled by new piles, using cohesionless soil material such as gravel, broken stone, and gravel-sand mixtures. Place and compact throughout the length of the space.
3. If abandonment of piles is required because of damage, mislocation, misalignment or obstructions encountered, or failure to meet the driving criteria, CONTRACTOR shall install replacement piles as required, at no additional cost to the District.

4. Drive additional piles where the centerline deviation exceeds 3 inches and a redesign indicates a load on any pile exceeding 110 percent of the design load. Where these additional piles necessitate changes in pile cap dimensions or reinforcement, CONTRACTOR shall carry out all corrective measures required to obtain the approval of the District, at no additional cost to the District. Should it be impractical to drive additional piles in particular situations, provide reinforced concrete straps or other measures, as directed by the District, for redistributing the design loading, at no additional cost to the District.
5. Piles which are bent, crimped, buckled, or otherwise unsatisfactory as hereinafter specified, and which cannot be removed or repaired, shall be abandoned.
6. Piles indicating sudden or peculiar decrease in penetration resistance during driving will be assumed to be broken and will be rejected unless the District's representative review of available data indicates that sudden decrease in driving resistance is due to natural, subsurface conditions and continued acceptable driving behavior is observed.

F. Cutting-Off:

1. Cut-off the tops of driven piles, square with pile axis and at the elevations indicated with a cutting torch or other acceptable method.
2. Piles driven below the required cutoff elevation will not be acceptable and shall be replaced, at no additional cost to the District.

G. Top Plates:

1. After pile is cutoff, where indicated on the Contract Drawings, weld top plates in place, square and level on top of pile. Air holes may be drilled, punched or burned to prevent air pockets under the plate during concrete placement, if acceptable to the District.

3.04 FIELD QUALITY CONTROL

- A. Install and load test piles in order to verify design pile lengths and load capacities. Provide complete testing materials and equipment as required, and perform tests only in the presence of the District or its representative.
- B. Test piles, furnished and driven by CONTRACTOR may be located, cut off, and become part of the foundation system provided they conform to these Specifications requirements.
- C. Reaction piles, furnished and installed by CONTRACTOR to perform pile testing, may be located, cut-off, and become part of the foundation system provided they conform to the Specification requirements.

- D. Test Piles Required: Provide test piles in the locations shown and for the types of tests indicated on the Contract Drawings. In addition, provide dynamic pile load testing as specified below.
- E. Driving Test Piles:
 - 1. Use test piles of the same size and design as required, and drive with the appropriate pile driving equipment operating at the rated driving energy to be used in driving for permanent piles.
 - 2. Drive test piles at the locations shown or as designated by the District to a tip elevation determined from elevation and pile length information shown on the Contract Drawings, or to the specified driving resistance, whichever occurs first.
- F. Pile Design Load Capacities: The design load capacities per pile shall be as shown on the Drawings.

END OF SECTION

**SECTION 02360
STEEL SHEET PILES**

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This section covers all members to be used in the construction of steel sheet pile. This specification also covers the installation of steel sheet piling and trimming of the sheet pile to the lines and grades shown on the drawings or as required. This work also includes pre-drilling to facilitate driving sheet pile to the designated elevations.

1.02 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation.
- B. Provide qualification of proposed sheet pile installer.
- C. Contractor shall provide information from the manufacturer that indicates the sheet piling meets or exceeds the specification listed in this section.
- D. Contractor shall submit verification from the manufacturer that the hammer can deliver the required energy.
- E. Qualifications of independent vibration consulting and monitoring firm as specified herein.
- F. Splice locations, if necessary, shall be reviewed and accepted by engineer prior to installation.

1.03 REFERENCE STANDARDS

- A. American Concrete Institute (ACI)
 - 1. ACI 318/318R - Building Code Requirements for Structural Concrete and Commentary
- B. American Petroleum Institute (API)
 - 1. API Spec 5L - Specification for Line Pipe.
- C. American Society for Testing and Materials (ASTM)
 - 1. ASTM A36 – Standard Specification for Carbon Structural Steel.
 - 2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 3. ASTM A139 = Standard Specification for Electric-Fusion (ARC) – Welded Steel Pipe (NPS 4 and Over).
 - 4. A252 - Standard Specification for Welded and Seamless Steel Pipe Piles
 - 5. A328 – Standard Specification for Steel Sheet Piling.

6. A572 – Standard Specification for High-Strength Low-Alloy Columbium - Vanadium Structural Steel.
 7. A690 – Standard Specification A690 – Standard Specification for High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments.
 8. ASTM A1011/A101M – Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- D. American Water Works Association (AWWA)
1. AWWA C200 – Steel Water Pipe – 6 in. (50 mm) and Larger.
- E. American Welding Society (AWS)
1. AWS D1.1 – Structural Welding Code - Steel

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Sheet piling installer shall have, as a minimum, three (3) successful past installations of sheet piling of comparable overall heights and sections and comparable penetration into soils similar to those found on the project.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All Steel sheet piling shall be new and unspliced material throughout, unless otherwise reviewed and accepted by Engineer.

2.02 MATERIALS

- A. Steel sheet piling shall meet the requirements of ASTM A328, (Grade 50)
- B. Steel corners, tees, wyes, and crosses shall meet the requirements of ASTM A328 or ASTM A690.
- C. Steel sheet piles required for the project shall be the type and weight shown on the drawings. Sheet piling shall be constructed with a weathering finish.
1. Additional length beyond those indicated on the drawings may be required to provide the trimming of tops of sheet piling.
- D. The interlocks between steel sheet pile sections shall be configured such that the average width of the annular space between all contact points of the interlocks shall be a maximum of one-eighth (1/8) inch, as determined by Engineer.
- E. Steel sheet piles and interlocks shall not have excessive kinks, camber or twist that would prevent the pile from reasonably free sliding to grade.

- F. All fabricated connections shall be made with the use of angles or bent plates, as necessary, and shall be adequately welded or connected with high strength bolts as accepted by Engineer.
- G. Handling Holes:
1. If handling holes are provided they shall be two (2) standard two and nine-sixteenth (2-9/16) inch diameter handling holes located six (6) inches from one end.
 2. The holes shall be plugged by welding a piece of steel over the hole prior to installing any riprap, backfill or drop structure cap.
 3. The plated hole shall be watertight.
- H. A vibratory hammer shall be utilized for driving the sheet piling providing that such operations do not exceed vibration/noise requirements of the specifications. Impact hammer shall be utilized when vibratory hammer is unable to drive temporary sheet piling to required depth and/or unable to meet vibration requirements. Impact hammer shall also meet noise requirement.
- I. Piles shall be coated according to the following requirements:
1. Surface Preparation – Prepare the substrate by providing a depth of anchor profile in accordance with the manufacturer’s product data sheet, but in no case less than 2.5 mils. Re-blast piles not coated during the same shift or if the surface to be coated no longer meets the requirements SSPC-SP 10.
 2. Unless otherwise shown in the Drawings, apply the inorganic zinc primer to all surfaces of piles. Unless otherwise shown in the Drawings, apply coal tar-epoxy coatings to the exposed sides of piles from the top of the piles to a depth of five feet below the lower of the design ground surface or the design scour depth. Apply the coal tar-epoxy in accordance with the following specific requirements:
 - a. Apply the coal tar-epoxy system in two coats. The time interval between the first coat and the second coat will be in strict accordance with the coating manufacturer’s published specifications. Apply the first coat to yield a dry film thickness of 8 to 10 mils. Apply the second coat to attain a total dry film thickness of the two coats between 16 and 20 mils.
 - b. Ensure that no portion of the coating is less than the specified minimum film thicknesses. The total minimum film thickness for any combination of coats will be the sum total of the averages of the specified thickness range of the individual coats.
 - c. After applying the coating on the steel piles, the Engineer will thoroughly inspect the surfaces and make film thickness measurements at the approximate rate of one for each 25 square feet of area unless deficient thickness is found. In this case, the rate of sub-measurements will be increased as required to determine the extent of the deficient area.

2.03 STORAGE AND HANDLING

- A. Do not subject piles to damage by impact bending stresses in transporting to and store piles outside.
- B. Store and Handle piles such that corrosion protection coating will not be damaged.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

- 1. All welding or gas cutting shall be in accordance with the current standards of the American Welding Society.
- 2. Virtual Refusal:
 - a. Steel sheet piling shall be driven to the depths shown in the drawings or to virtual refusal if approved by Engineer. Contractor shall provide pre-drilling where necessary to reach those depths specified on the drawings.
 - b. Virtual refusal is defined as ten (10) blows per inch with an approved pile hammer.
 - c. A pile hammer shall be used to determine virtual refusal.
 - d. The hammer shall be operating at the manufacturer's recommended stroke and speed when virtual refusal is measured.

B. Sheet Pile Installation:

- 1. Steel sheet piling shall be assembled before driving and then driven as a continuous wall, progressively in stages to keep the piles aligned correctly and minimize the danger of breaking the interlock between the sheets.
- 2. Steel sheet piling shall be driven to form a tight bulkhead.
- 3. A driving head shall be used and any piling which is damaged in driving or which has broken interlocks between sections shall be pulled and replaced at contractor's expense.
- 4. The piling shall be driven within the following tolerances:
 - a. Alignment:
 - i. Sheet pile shall be driven to form a relatively straight line between the termini points shown on the drawings.
 - ii. Horizontal deviation of any point from a straight line connecting the two ends of the wall section shall be a maximum of four (4) inches.
 - b. Plumbness: Each individual sheet pile section shall be driven vertical, within a horizontal tolerance of two percent (2%) of any vertical length measured along the pile.
 - c. Elevation:

- i. Tops of sheet pile sections shall be within a tolerance of one (1) inch from plan elevations.
 - ii. Contractor shall not be paid for excess sheet pile trimmed off the end of the pile to meet final grade.
- C. Contractor shall brace and/or provide soil grading as necessary during construction operations in order to provide lateral stability for the sheet pile wall. The sheet pile wall has been designed for the soil grades of the final configurations denoted on the drawings only. Other temporary configurations during the construction period shall not be allowed. Backfill behind sheet pile shall not exceed the level shown on the drawings prior to installation of helical tie-back anchors.
- D. Care shall be taken during driving to keep from causing deformations of the top of the piles, splitting of section, or breaking of the interlock between sections. Care shall also be taken during driving to prevent and correct any tendency of steel sheet piles to twist or get out of plumb.
- E. Steel Z piling shall be driven with the ball-end leading. Proper care and planning shall be used to allow for this construction procedure in both immediate and possible future walls.
- F. Alternate Z piles shall be reversed end for proper interlocking in the “normal” position. Piles shall also be aligned properly to maintain a “normal” driving width.
- G. Steel sheet pile that is full length shown on the drawings and is required to be driven below the specified cutoff elevation shall be spliced with additional steel sheet piling with a full penetration butt weld.

END OF SECTION

**SECTION 02578
SODDING**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Permanent sodding at locations indicated on Drawings.

1.02 SUBMITTALS

- A. Procedures: In accordance with Section 01300.
- B. Description of type grass and location from which harvested, for approval by the District.

1.03 PRODUCT HANDLING

- A. Dumping sod from vehicles will not be permitted.
- B. If stacked during transit or storage, the sod shall be placed with all roots facing the bottom of the pallet.
- C. During delivery and while in stacks, sod shall be kept moist and cool and protected from sun and air.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Sod:
 - 1. Sod shall be well-matted with root growth.
 - 2. Unless otherwise directed by the District, sod grass shall match the grass type adjacent to which it will be planted.
 - 3. Purchase in mature state from local suppliers.
 - 4. Number 1 quality, fresh, premium from certified seed. The turf shall be sufficiently dense so that no surface media is visible when mowed to a height of 1-1/2 inches. Maximum mowing height shall be 2-1/2 inches. At the time of sale, the turf shall contain no more than 1% undesirable grasses and not more than two weeds per 500 square feet. The thickness of the media portion of the sod shall not exceed 1/2 inch.

- a. Sod shall not be acceptable if it contains any of the following weeds: Bermuda grass, quack grass, Johnson grass, poison ivy, nutsedge, nimbleill, thistle, bindwind, bent grass, wild garlic, frond ivy, perennial sorrel, Brome grass, or Kikuyu grass.
- b. The soil media shall be friable and well-drained. Standard size sections of sod shall be strong enough that they can be picked up and handled without damage.

PART 3 - EXECUTION

3.01 HARVESTING

- A. Use approved sod cutters for cutting and removing sod. Exercise care to retain native soil intact.
- B. Cut sod to a thickness sufficient to secure a dense stand of live grass.
- C. Sod shall not contain noxious weeds in excess of 0.50%.

3.02 SOIL PREPARATION

- A. Remove rocks, weeds, and debris from area to be sodded. Work-up soil to a depth of 6 inches and break up all clods to less than 1 inch in size. Soil prep all areas as described elsewhere in Specifications.
- B. Carefully smooth surface areas to be sodded. Roll areas to expose soil depressions or surface irregularities. Regrade as required to obtain optimum conditions.

3.03 PLANTING

- A. At time of planting, sod shall be live, fresh, and uninjured, with native soil mat adhering firmly to root structure.
- B. Pre-irrigate soil to wet it to a depth of 2 inches. Soil should be damp, but not muddy.
- C. Plant sod within 24 hours after it has been delivered to site. Do not leave it exposed to direct sun any longer than is necessary.
- D. Lay first strip of sod slabs along a straight line (use a string in irregular areas). Use a 2 x 4 laid on its side as a "kicker" to butt against sod strips and force them into place. Butt joints tightly, do not overlap edges. On second strip, stagger joints (much as in laying bricks). Use a sharp knife to cut sod to fit curves, edges, and sprinkler heads. Do not use sod strips less than 10 inches wide.

- E. Do not lay entire lawn area before watering. When a conveniently large area has been sodded, water lightly to prevent drying out. Continue to lay sod, and to water, until installation has been completed.
- F. After laying of sod has been completed, roll lightly with lawn roller filled with water to eliminate irregularities and to form good contact between sod and soil. Avoid very heavy rollers or excessive initial watering to avoid roller marks.
- G. Thoroughly water complete lawn surface. Soil should be moistened at least 2 inches deep. Repeat sprinkling at regular intervals to keep sod moist 2 inches deep at all times. After sod is established, decrease watering frequency and increase amount of water per application as needed. Do not allow water to pond. Avoid excessive watering. Soil shall be moist but not saturated. Monitor irrigation as required.
- H. Replace all dead or dying sod with equivalent quality material as directed by the District.
- I. Minimize traffic over sod areas during its growth establishment (90 days).
- J. Sod areas on which an acceptable stand of grass is not present shall be re-sodded.
 - 1. An acceptable stand is living grass from at least 90 percent of the sod placed according to this Specification.
 - 2. Areas on which there is not an acceptable stand of grass shall continue to be replanted throughout the maintenance period until an acceptable stand of grass is present.

END OF SECTION

**SECTION 02579
ENGINEERED TURF**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Specifications for the Engineered Turf component of the HydroTurf® CS System.
- B. Specifications for approved subgrade below the HydroTurf System.
- C. Specifications for the HydroBinder® Infill Component of the patented HydroTurf® System at locations indicated on Drawings.

1.02 SUBMITTALS

- A. Procedures: In accordance with Section 01300.
- B. Manufacturer
 - 1. Manufacturing Quality Control Testing – Engineered Turf Component
 - a. Certificate of Compliance: Certificate of Compliance shall indicate that the engineered turf meets or exceeds the property values in Table 1. Also, the turf fiber color / blend shall be indicated.
 - b. Provide inspection records of the tufting procedures for every 300,000 sq.ft. of Engineered Turf, including:
 - i. Inspection records that indicate the following properties:
 - I.* Tufting Gauge;
 - II.* Pile height;
 - III.* Roll length and roll numbers;
 - IV.* Total product weight;
 - V.* Tensile Strength Product (lbs./ft.) (MARV) ASTM D 4595; and
 - VI.* Tensile Strength of Yarn (lbs.) (MARV) ASTM D 2256.
- C. Conformance Testing – Engineered Turf
 - 1. Obtain one Engineered Turf sample for every 400,000 sq. ft. of material supplied to the site;
 - 2. Forward samples to the independent testing laboratory and test for the following:

- a. Total product weight;
 - b. CBR Puncture ASTM D6241;
 - c. Tensile Strength Product ASTM D 4595; and
 - d. Tensile Strength of Yarn ASTM D2256.
3. Refer to the properties table under Section 2 for required values for the above properties.

D. Geosynthetics Installer

1. Prior to beginning the installation of the HydroTurf CS System, geosynthetics installer shall submit the following to the District's Representative for Engineered Turf component:
 - a. Verify in writing that geosynthetics installer's personnel have the following experience:
 - i. Geotextile seamers shall have installed at least 1,000,000 square feet of like materials.
 - b. The District's Representative shall be responsible for approving resumes and qualifications of geosynthetics installer personnel; and
 - c. Geosynthetics installer personnel shall attend HydroTurf CS orientation prior to starting the work.

1.03 REFERENCES

A. Latest Version of American Society for Testing and Materials (ASTM) standards:

1. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
2. ASTM C150 - Standard Specification for Portland Cement
3. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar
4. ASTM D1335 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings
5. ASTM D1577 - Standard Test Methods for Linear Density of Textile Fibers
6. ASTM D1907 - Standard Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method
7. ASTM D2256 - Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method
8. ASTM D4595 - Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method

9. ASTM D5321 - Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
 10. ASTM D5793 - Standard Test Method for Binding Sites per Unit Length or Width of Pile Yarn Floor Coverings
 11. ASTM D5823 - Standard Test Method for Tuft Height of Pile Floor Coverings
 12. ASTM D5848 - Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings
 13. ASTM D6241 - Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe
- B. American Concrete Institute (ACI) - 306R-10 Guide to Cold Weather Concreting

PART 2 - PRODUCTS

2.01 HYDROTURF CS

A. Delivery, Storage and Handling

1. Delivery:

- a. Deliver materials to the site only after the Engineer and the District approve required submittals.
- b. Contractor shall ensure that all rolls delivered to the site have been properly identified with the following for Engineered Synthetic Turf:
 - i. Manufacturer's name
 - ii. Product identification
 - iii. Lot number
 - iv. Roll number
 - v. Roll dimensions
- c. The Engineered Synthetic Turf shall meet the following delivery requirements:
 - i. The synthetic turf is wrapped in rolls with protective covering.
 - ii. The rolls are not damaged during unloading.
 - iii. Protect the synthetic turf from mud, soil, dirt, dust, debris, cutting, or impact forces.
 - iv. Each roll must be marked or tagged with proper identification.
- d. Separate damaged materials from undamaged materials and store at locations designated by the District until proper disposition of material is determined by the Engineer and the District.
- e. Separate rolls without proper documentation and store until the District's approval is received.

2. On-Site Storage:
 - a. Store in space allocated by the District.
 - b. Protect from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or other damage.
 - c. Store the engineered turf on level prepared surface (not on wooden pallets). The prepared surface for the engineered turf should be graded to drain away from HydroTurf components.
 - d. Stack the engineered turf no more than three rolls high.
 3. On-Site Handling:
 - a. Use appropriate handling equipment to load, move or deploy engineered turf. Appropriate handling equipment includes cloth chokers / straps, and spreader bar for loading, spreader and roll bars for deployment. Dragging rolls and / or panels on the ground surface shall not be permitted.
 - b. Do not fold engineered turf material. Folded material shall be rejected.
 - c. The installer is responsible for storage, and transporting material from storage area to installation area.
 4. Damaged Engineered Synthetic Turf:
 - a. Damaged engineered synthetic turf shall be documented by Contractor.
 - b. Damaged engineered synthetic turf shall be repaired, if approved by the District, in accordance with these specifications or shall be replaced at no additional cost to the District.
- B. Engineered Synthetic Turf – Hydroturf CS
1. Manufacturer: Shaw Industries, Inc.
 - a. The engineered turf component shall meet or exceed property values listed in **Table 02579-1** as an individual component and as the performance property as the HydroTurf CS system.
 - b. Engineered synthetic turf shall be supplied by Watershed Geosynthetics as a component of the HydroTurf CS Revetment System.
 2. The engineered synthetic turf shall be comprised of the following components:
 - a. Polyethylene slit tape fibers; and
 - b. Two polypropylene backing geotextiles
 3. The polyethylene yarn shall conform to the color selected by the District.

Table 02579-1 – Property Values for Engineered Synthetic Turf Component of HydroTurf CS

Property	Test Method	Value
<i>Engineered Turf Component</i>		
Tufted Pile Height (inches)	ASTM D 5823	1.25 ± 0.25
CBR Puncture, lbs	ASTM D6241	800 (MARV)
Tensile Strength, MD/XMD, lbs/ft	ASTM D4595	1000 (MARV)
Pile Weight	ASTM D5848	19 ± 2.0 oz./sq. yd
Total Product Weight		25 ± 2.0 oz./sq. yd
Yarn	ASTM D 1577	Polyethylene Fibrillated Tape Fiber
Tensile Strength of Yarn	ASTM D2256	15 lbs min
Aerodynamic Evaluation	GTRI Wind Tunnel	120 mph with max. uplift of 0.12 lb/sf
UV Resistance and Stability of Synthetic Turf	ASTM G147 ASTM G7	>60% Retained Tensile Strength at 100-year exposure (projected)
Standard Roll Dimensions	15-ft (4.57-m) Wide x 300-ft (91.4-m) Long	
Roll Area (approximate)	4500 ft ² (418-m ²)	
<i>HydroTurf CS System Performance Properties</i>		
Full-Scale Steady State Overtop Test	ASTM D7277 / ASTM D7276	40 ft/s of velocity
Manning's N Value	ASTM D7277 / ASTM D7276	0.017 – 0.020
Full-Scale Steady State Hydraulic Jump Test	Colorado State University (CSU)	Dissipates 30 horsepower per ft (min)
Full-Scale Wave Overtopping Test – Cumulative Volume	CSU Wave Simulator	165,000 ft ³ /ft (min)
Full-Scale Wave Overtopping Test – Maximum Average Wave Discharge	CSU Wave Simulator	4.0 cfs/ft
Internal Friction of Combined Components (Low Confining Stress)	ASTM D 5321	23° min (peak) MicroSpike 33° min (peak) Super GripNet

2.02 HYDROTURF HYDROBINDER INFILL COMPONENT

A. Description

1. HydroBinder is a proprietary cementitious product used as the infill component of the HydroTurf system.
2. HydroBinder shall be supplied by Watershed Geosynthetics as a component of the HydroTurf Revetment System.

B. Materials

1. The infill shall be HydroBinder Cementitious Infill.
2. The infill material may be delivered in either pallet form of 80 lb. bags or 3000 lb. bulk bag super sacks.
3. Cement, except as otherwise specified herein, shall be a brand of Portland Cement, meeting ASTM C 150 and shall be Type I or Type II.
4. The cementitious infill mix shall conform to the requirements of ASTM C 387 for high strength mortars.
5. The cementitious infill mix shall have a minimum 28-day compressive strength of 5000 psi as measured in accordance with ASTM C 109.

PART 3 - EXECUTION

3.01 PREPARATION

A. Surface Preparation:

1. Subgrade shall be smooth (free from ruts, depressions, etc.), uniform, firm and unyielding, and free from rocks, roots or other debris.
2. No rocks or protrusions greater than 0.75 inch in diameter shall be exposed at the subgrade surface.
3. Approved subgrade shall be capable of supporting the weight of the product, installation equipment, and maintenance equipment.
4. Daily evaluation shall be performed to show that no changes have occurred that would render the subgrade unacceptable.

B. Anchor Trench Preparation

1. Anchor trenches shall be excavated to the grades and dimensions as specified on the construction plans.
2. Anchor trenches shall be straight and uniform with no rough edges.
3. The inside edge of the anchor trench shall be rounded and smooth.
4. Anchor trenches shall be free of sharp objects and other deleterious material.

C. Non-Conforming Work

1. Subgrade or its components not meeting specifications either before or during deployment of the HydroTurf, shall be reported to the District and Engineer and corrected as required.

3.02 INSTALLERS

- A. Installer shall be trained by Watershed Geosynthetics, LLC.

3.03 INSTALLATION

- A. Engineered turf component:
 - 1. Construction quality assurance personnel shall verify that:
 - a. Engineered Turf tufts are not excessively pulled out by the installation process; and
 - b. After the first panel is deployed, all subsequent panels are deployed on top of the previous panel, seamed, and then flipped into position.

3.04 ENGINEERED TURF COMPONENT DEPLOYMENT

- A. Prior to installation of Engineered Turf Component, the construction quality assurance personnel must observe the following:
 - 1. HydroTurf CS geomembrane component has been seamed, tested, approved, and is released for further component deployment by the Engineer; and
 - 2. The supporting surface (e.g., the geomembrane) is substantially free of debris or large scraps.
- B. During deployment of Engineered Turf, the construction quality assurance personnel must observe the following:
 - 1. Observe the turf as it is deployed and record defects and disposition of the defects (i.e., panel rejected, patch installed, etc.);
 - 2. That repairs are made in accordance with specified herein and the HydroTurf installation guidelines;
 - 3. Equipment used does not damage the turf or underlying geomembrane;
 - 4. That all panels are deployed from the top of the slope in a way that the Engineered Turf filaments are pointing upslope after deployment is complete;
 - 5. That the turf is anchored to prevent movement by the wind (the geosynthetics Installer is responsible for any damage resulting to or from windblown Engineered Turf);
 - 6. That the turf remains substantially free of contaminants;
 - 7. That the turf is laid substantially smooth;
 - 8. That on slopes, the turf is secured with sandbag anchoring at the top of the slope after deployment;
 - 9. Fusion Seaming Method

- a. Engineered Turf fusion seaming device will be a DemTech VM20/4/A (Model No. VM-20/4/A Pro-Wedge Welder 120V, VM20 Outfitted with 100-KIT/4S/VC/A.2 Welding Kit, 4-in, 220V, S.S.) fusion welder only.
- b. Fusion seams require a minimum of 5 inches of overlap.
- c. Demonstrate the preparation methods and equipment utilized for removal of the salvage from the outside edge of the rolls of turf (i.e. trimming & cutting devices). Mechanical trimming and cutting devices will be utilized for salvage trimming. Box blades and knives shall not be utilized for salvage preparations. Fraying of geotextile strands when performing the removal of salvage is not acceptable.
- d. Frayed or loose edges and/or geotextile strands shall be cut off or removed.
- e. Since the temperature and speed controls of the DemTech VM-20 wedge welder are variable and can be increased / decreased depending on weather and environment conditions, the temperature and speed shall be confirmed with a trial seam. This trial seam shall be field tested. Trial seams shall be performed at the being of each day and during the day when the weather (i.e., temperature, humidity, etc.) conditions change.
- f. Trial seams shall be performed as outlined in the HydroTurf Installation Guidelines (most recent revision).
- g. Production field seaming shall be performed and verified in the same manner as trial seams. The field seams shall be inspected every hour at a minimum. This inspection of the field seams shall be the same as the inspection for the trial seams.
- h. Production fusion seams shall be continuous and have no gaps.
- i. Any damage and defects (including burnouts) that occur during production seaming will be repaired as outlined in Section 3.05 and HydroTurf Installation Guidelines (most recent revision).
- j. All seams not passing the visual inspection shall be repaired.
- k. After seaming operations, the edges of the synthetic turf panels shall be sufficiently anchored with sandbags in the top of slope perimeter anchor trenches unless otherwise noted on the construction drawings.

3.05 EQUIPMENT ON THE TURF

- A. Construction equipment on the deployed synthetic turf shall be minimized to reduce the potential for synthetic turf material puncture. Small equipment such as generators shall be placed on scrap synthetic turf / geosynthetic material (rub sheets) above engineered synthetic turf.
- B. During Construction:
 1. On slopes exceeding 15%
 - a. No equipment will be allowed until HydroBinder Infill is in place.

2. On slopes less than 15%
 - a. ATV type vehicles and/or rubber tracked skid steer machines will be allowed prior to infill placement if the tire / track ground pressure is less than 5 psi.
 3. Equipment operators shall inspect equipment rubber tires or tracks for sharp protrusions from foreign matter or tire/track damage, embedded rocks, or other foreign materials protruding from tires/track prior to driving on the synthetic turf. Equipment travel paths driven on synthetic turf shall be as straight as possible with no sharp turns, sudden stops or quick starts.
 4. Damage caused by having equipment on the engineered synthetic turf (i.e., tears, rips, punctures, wrinkles, ripples, movement, etc.) shall be the responsibility of the installer to repair.
- C. Post installation, no equipment shall be allowed on the HydroTurf until HydroBinder Infill is fully cured for 28 days:
1. Driving should be limited and only in areas where the subgrade under the HydroTurf is well-compacted, firm and unyielding.
 2. Drivability tire / track (ground) pressures should be limited to less than 35 psi. Rubber tire and/or tracked vehicles or equipment only.
 3. On slopes flatter than 10%, allowable ground pressures may only be increased with the written approval of the Engineer.
- D. Any activity that may be identified during the course of construction by the Engineer, the District's representative, or construction quality assurance personnel as being a possible danger to the integrity of the HydroTurf CS system will be prohibited regardless of any prior approval.

3.06 REPAIR AND TIE-IN PROCEDURES

- A. Engineered Turf Component
1. When Repairs and Tie-Ins of Engineered Turf occur, the construction quality assurance personnel must observe the following:
 - a. Repairs to Engineered Turf are completed by using a 4-in overlapped heat-bonded seam;
 - b. All tie-in seams along flatter slopes (i.e. 15% or less) with length greater than 25 feet will use an approved fusion welding machine so that consistent pressure is achieved throughout the seam; and
 - c. A hand-held heat gun or leister with hand pressure will be used in smaller/concentrated areas. Passing trial seams using the hand-held heat gun shall be performed prior to production seaming. Trial seams shall be performed as outlined in the HydroTurf Installation Guidelines (most recent revision).

2. Geosynthetics Installer may also demonstrate techniques and practices as follows:
 - a. Field demonstration and approval by the District's representative is required before incorporating any alternative technique.

3.07 INSTALLATION ACCEPTANCE

- A. The Geosynthetics Installer retains all ownership and responsibility for the HydroTurf CS system until acceptance by the District.
 1. After HydroTurf CS components are deployed, seamed, has passed required testing successfully, and any repairs are made;
 - a. The completed installation will be inspected by the District's representative and the geosynthetics installer's construction quality control supervisor;
 - b. Damage and/or defects found during this inspection will be repaired by the geosynthetics installer; and
 - c. The installation will not be accepted until it meets the requirements of these specifications and Florida, Federal or Local Regulations.
- B. Installation of the HydroTurf CS system will be accepted by the Engineer only when the following has been completed:
 1. The installation is complete;
 2. Seams have been observed and documented by the construction quality assurance personnel and accepted by the Engineer;
 3. Required independent testing laboratory and field tests have been completed, reviewed and approved;
 4. Required geosynthetics installer supplied documentation has been received, reviewed and approved; and
 5. As built record drawings have been completed and verified by the Engineer.

END OF SECTION

**SECTION 02663
PIPE PRESSURE TESTING**

PART 1 - GENERAL (NOT USED)

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

A. Pressure and Leakage Tests of Pressure Piping

1. General: The Contractor shall perform hydrostatic pressure and leakage tests on all pressure piping. Tests shall be made between valves and shall not exceed 2,000-feet. Each side of all valves shall be pressure tested. Multiple sections of main may be tested simultaneously providing there are non-pressurized sections in between each pressure-tested section.
2. Standard: AWWA C600, Section 4, with the exceptions required herein and the exception that the Contractor shall furnish all gauges, meters, pressure pumps, and other equipment needed to test the lines.
3. Hydrostatic Pressure Test
 - a. Test Pressure: Pressure test at 50% above the normal working pressure, but not less than 10-psi, unless otherwise noted on the Drawings.
 - b. Test Duration: Duration is 2-hours. If during the test, the integrity of the tested line is in question, the District may require a 6-hour pressure test.
 - c. Air Release: Corporation cocks at least 3/4-inch in diameter, pipe riser, and angle globe valves shall be provided at each dead-end to bleed air from the line.
4. Hydrostatic Leakage Test
 - a. General: Following the pressure test, the Contractor shall perform the leakage test. The line shall be filled with water and all air removed for the test. The Contractor shall provide a pump to maintain the test pressure for the entire test period.
 - b. Test Pressure: Maximum operating pressure as determined by the District but not less than 10-psi unless otherwise noted.
 - c. Test duration: 2-hours.
 - d. Allowable leakage:

$$L = \frac{SD(P)^{0.5}}{148,000}$$

148,000

L = Allowable leakage (gallons per hour)

S = Length of pipe tested (feet)

D = Nominal diameter of pipe (inches)

P = Average test pressure maintained (psig)

- e. Visible Leakage: All leaks evident at the surface shall be repaired and leakage eliminated regardless of the measured total leakage.
 - f. Leakage Measurement: The amount of water required to maintain the test pressure is the leakage.
- B. Wire Continuity Check: The Contractor shall perform a continuity check of the 10-gauge locating wire for the entire length of the main by performing a continuity test at each valve test station box.

END OF SECTION

**SECTION 02931
RIPRAP**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The work specified in this section shall consist of the placing of all riprap, including geotextile layer and bedding stone where indicated on the Drawings.

1.02 WORK INCLUDED

- A. The Contractor shall furnish all materials, equipment, tools and labor necessary for the placing of the riprap including geotextile layer and bedding stone as shown on the Drawings.

1.03 REFERENCE SPECIFICATION

- A. Florida Department of Transportation (FDOT) "Standard Specifications for Road and Bridge Construction", 2017 edition".

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Riprap: Riprap shall be Rubble Riprap (Bank and Shore Protection) meeting the requirements of Section 530-2.1.3 FDOT Specifications.
- B. Bedding Stone: Provide Bedding Stone meeting the requirements of Section 530-2.1.4 FDOT Specifications.
- C. Geotextile Fabric: Provide Geotextile Fabric meeting the requirements of Geotextile Fabric Type D-2 per Section 514-3.4 and Section 985 FDOT Specifications. Geotextile fabric shall be Mirafi FW404 or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Construction methods shall be in accordance with the details shown on all the Drawings, and Section 530-3 FDOT Specifications.

END OF SECTION

**SECTION 03100
CONCRETE FORMWORK**

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and cut, remove, repair or otherwise modify parts of existing concrete structures or appurtenances as shown on the Drawings and as specified herein. Work under this Section shall also include bonding new concrete to existing concrete.
- B. Secure to forms as required or set for embedment as required, all miscellaneous metal items, sleeves, reglets, anchor bolts, inserts and other items furnished under other Sections and required to be cast into concrete, or approved in advance by the Engineer.

1.02 RELATED WORK

- A. Concrete Reinforcement is included in Section 03200.
- B. Concrete Joints and Joint Accessories are included in Section 03150.
- C. Cast-in-Place Concrete is included in Section 03300.
- D. Grout is included in Section 03600.

1.03 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings, and product data showing materials of construction and details of installation for:
 - 1. Form release agent
 - 2. Form ties
 - 3. Form Savers

1.04 SAMPLES

- A. Demonstrate to the Engineer on a designated area of the concrete substructure exterior surface that the form release agent will not adversely affect concrete surfaces to be painted, coated or otherwise finished and will not affect the forming materials.
- B. Certificates
 - 1. Certify that form release agent is suitable for use in contact with potable water after 30 days (non-toxic and free of taste and odor).

1.05 REFERENCE STANDARDS

- A. American Concrete Institute (ACI)
 - 1. ACI 301 – Standard Specification for Structural Concrete

2. ACI 318 – Building Code Requirements for Reinforced Concrete
 3. ACI 347 – Formwork for Concrete
- B. American Plywood Association (APA)
1. Material grades and designations as specified
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 SYSTEM DESCRIPTION

- A. General: Architectural Concrete is wall, slab, beam or column concrete which will have surfaces exposed to view in the finished work. It includes similar exposed surfaces in water containment structures from the top of walls to 2-ft below the normal water surface in open tanks and basins.
- B. Formwork shall be designed and erected in accordance with the requirements of ACI 301 and ACI 318 and as recommended in ACI 347 and shall comply with all applicable regulations and codes. The design shall consider any special requirements due to the use of plasticized and/or retarded set concrete.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The usage of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configurations desired.

2.02 MATERIALS

- A. Forms for cast in place concrete shall be made of wood, metal, or other approved material. Construct wood forms of sound lumber or plywood of suitable dimensions and free from knotholes and loose knots. Where used for exposed surfaces, dress and match boards. Sand plywood smooth and fit adjacent panels with tight joints. Metal forms may be used when approved by the Engineer and shall be of an appropriate type for the class of work involved. All forms shall be designed and constructed to provide a flat, uniform concrete surface requiring minimal finishing or repairs.
- B. Wall Forms
1. Forms for all exposed exterior and interior concrete walls shall be "Plyform" exterior grade plywood panels manufactured in compliance with the APA and bearing the trademark of that group, or equal acceptable to the Engineer. Provide B grade or better veneer on all faces to be placed against concrete during forming. The class of material and grades of interior plies shall be of sufficient strength and stiffness to provide a flat, uniform concrete surface requiring minimal finishing and grinding.
 2. All joints or gaps in forms shall be taped, gasketed, plugged, and/or caulked with an approved material so that the joint will remain watertight and will withstand placing pressures without bulging.

- C. Rustication strips shall be at the location and shall conform to the details shown on the Drawings. Moldings for chamfers and rustications shall be milled and planed smooth. Rustications and corner strips shall be of a nonabsorbent material, compatible with the form surface and fully sealed on all sides to prohibit the loss of paste or water between the two surfaces.
- D. Form Release Agent
1. Coat all forming surfaces in contact with concrete using an effective, non-staining, non-residual, water based, bond-breaking form coating unless otherwise noted. Form release agents used in potable water containment structures shall be suitable for use in contact with potable water and shall be non-toxic and free of taste or odor and meet the requirements of NSF/ANSI Standard 61. Form release agent shall be Farm Fresh by Unitex or approved equal.
- E. Form Ties
1. Form ties encased in concrete other than those specified in the following paragraphs shall be designed so that, after removal of the projecting part, no metal shall remain within 1 1/2 in of the face of the concrete. The part of the tie to be removed shall be at least 1/2 in diameter or be provided with a wood or metal cone at least 1/2 in diameter and 1 1/2 in long. Form ties in concrete exposed to view shall be the cone washer type.
 2. Form ties for exposed exterior and interior walls shall be as specified in the preceding paragraph except that the cones shall be of approved wood or plastic.
 3. Flat bar ties for panel forms, is used, shall have plastic or rubber inserts having a minimum depth of 1-1/2-in and sufficient dimensions to permit proper patching of the tie hole.
 4. Ties for liquid containment structures shall have an integral waterstop that is tightly welded to the tie.
 5. Common wire shall not be used for form ties.
 6. Alternate form ties consisting of tapered through-bolts at least 1-in in diameter at smallest end or through-bolts that utilize a removable tapered sleeve of the same minimum size may be used at the Contractor's option. Obtain Engineer's acceptance of system and spacing of ties prior to ordering or purchase of forming. Clean, fill and seal form tie hole with non-shrink cement grout. A vinyl plug shall be inserted into the hole to serve as a waterstop. The Contractor shall be responsible for water-tightness of the form ties and any repairs needed.
- F. Form Savers
1. Form savers shall be Lenton Form Saver or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Forms shall be used for all cast-in-place concrete including sides of footings. Forms shall be constructed and placed so that the resulting concrete will be of the shape, lines, dimensions and appearance indicated on the drawings.
- B. Forms for walls shall have removable panels at the bottom for cleaning, inspection and joint surface preparation. Forms for walls of considerable height shall have closable intermediate inspection ports. Tremies and hoppers for placing concrete shall be used to allow concrete inspection, to prevent segregation and to prevent the accumulation of hardened concrete on the forms above the fresh concrete.
- C. Molding, bevels, or other types of chamfer strips shall be placed to produce block outs, rustications, or chamfers as shown on the Drawings or as specified herein. Chamfer strips shall be provided at horizontal and vertical projecting corners to produce a $\frac{3}{4}$ -in chamfer. Rectangular or trapezoidal moldings shall be placed in locations requiring sealants where specified or shown on the Drawings. Sizes of moldings shall conform to the sealants manufacturer's recommendations.
- D. Forms shall be sufficiently rigid to withstand construction loads and vibration and to prevent displacement or sagging between supports. Construct forms so that the concrete will not be damaged by their removal. The contractor shall be entirely responsible for the adequacy of the forming system
- E. Before form material is re-used, all surfaces to be in contact with concrete shall be thoroughly cleaned, all damaged places repaired, all projecting nails withdrawn and all protrusions smoothed. Reuse of wooden forms for other than rough finish will be permitted only if a "like new" condition of the form is maintained.

3.02 FORM TOLERANCES

- A. Forms shall be surfaced, designed and constructed in accordance with the recommendations of ACI 347 and shall meet the following additional requirements for the specified finishes.
 - 1. Formed Surface Exposed to View: Edges of all form panels in contact with concrete shall be flush within 1/16-in and forms for plane surfaces shall be such that the concrete will be plane within 3/16-in in 4-ft. Forms shall be tight to prevent the passage of mortar, water and grout. The maximum deviation of the finish wall surface at any point shall not exceed $\frac{1}{4}$ -in from the intended surface as shown on the Drawings. Form panels shall be arranged symmetrically and in an orderly manner to minimize the number of seams.
 - 2. Formed surfaces not exposed to view or buried shall meet requirements of Class "C" Surface in ACI 347.
 - 3. Formed rough surfaces including mass concrete, pipe encasement, electrical duct encasement and other similar installations shall have no minimum requirements for surface smoothness and surface deflections. The overall dimensions of the concrete shall be plus or minus 1-in.

3.03 FORM PREPARATION

- A. Wood forms in contact with the concrete shall be coated with an effective release agent prior to form installation.
- B. Steel forms shall be thoroughly cleaned and mill scale and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface for all forms, except those utilized for surfaces receiving a rough finish. All forms shall have the contact surfaces coated with a release agent.

3.04 REMOVAL OF FORMS

- A. The Contractor shall be responsible for all damage resulting from removal of forms. Forms and shoring for structural slabs or beams shall remain in place in accordance with ACI 301 and ACI 347. Form removal shall conform to the requirements specified in Section 03300 and a curing compound applied.

3.05 INSPECTION

- A. The Engineer on site shall be notified when the forms are complete and ready for inspection at least 6 hours prior to the proposed concrete placement.
- B. Failure of the forms to comply with the requirements specified herein or to produce concrete complying with the requirements of Section 03300 shall be grounds for rejection of that portion of the concrete work. Rejected work shall be repaired or replaced as directed by the Engineer at no additional cost to the District. Such repair or replacement shall be subject to the requirements to this Section and approval of the Engineer.

END OF SECTION

**SECTION 03150
CONCRETE JOINTS AND JOINT ACCESORIES**

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install accessories for concrete joints as shown on the Drawings and as specified herein

1.02 RELATED WORK

- A. Concrete Formwork is included in Section 03100.
- B. Concrete Reinforcement is included in Section 03200.
- C. Cast-In-Place Concrete is included in Section 03300.
- D. Concrete Finishes are included in Section 03350.
- E. Grout is included in Section 03600.

1.03 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data. Submittals shall include at least the following:
 - 1. Standard Waterstops: Product data including catalogue cut, technical data, storage requirements, splicing methods and conformity to ASTM standards.
 - 2. Special Waterstops: Product data including catalogue cut, technical data, location of use, storage requirements, splicing methods, installation instructions and conformity to ASTM standards.
 - 3. Premolded joint fillers: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.
 - 4. Bond breaker: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.
 - 5. Expansion joint dowels: Product data on the complete assembly including dowels, coatings, lubricants, spacers, sleeves, expansion caps, installation requirements and conformity to ASTM standards.
 - 6. Compressible joint filler: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.
 - 7. Bonding agents: Product data including catalogue cut, technical data, storage requirements, product life, application requirements and conformity to ASTM standards.

B. Certifications

1. Certification that all materials used within the joint system is compatible with each other.
2. Certifications that materials used in the construction of joints are suitable for use in contact with potable water 30 days after installation.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A675 – Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
2. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
3. ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
4. ASTM D1751 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction. (Nonextruding and Resilient Bituminous Types).
5. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

B. U.S. Army Corps of Engineers (CRD)

1. CRD C572 – Specification for Polyvinylchloride Waterstops.

C. Federal Specifications

1. FS SS-S-210A - Sealing Compound for Expansion Joints.

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. All materials used together in a given joint (bond breakers, backer rods, joint fillers, sealants, etc.) shall be compatible with one another. Coordinate selection of suppliers and produce to ensure compatibility. Under no circumstances shall asphaltic bond breakers or joint fillers be used in joints receiving sealant.
- C. All chemical sealant type waterstops shall be products specifically manufactured for the purpose for which they will be used and the products shall have been successfully used on similar structures for more than five years.

2.02 MATERIALS

A. Standard Waterstops

1. PVC Waterstops - The waterstop shall be made by extruding elastomeric plastic compound with virgin polyvinylchloride as the basic resins. The compound shall contain no reprocessed materials. Minimum tensile strength of waterstop shall be 1750 psi. The waterstop shall conform to CRD-C572. The waterstop shall be Greenstreak Group, Inc. model No. 679 or approved equal for construction joints. The waterstop shall be Greenstreak Group Inc. model No.732 or approved equal for control joints and Greenstreak Group Inc. Model No. 738 for expansion joints. Provide grommets or pre-punched holes spaced at 12 inches on center along length of waterstop.
2. Factory Fabrications: Provide factory made waterstop fabrications for all changes of direction, transitions, and intersections, leaving only straight butt joints of sufficient length for splicing in the field.

B. Special Waterstops

1. Retrofit Waterstop - The waterstop shall be made by extruding elastomeric plastic compound with virgin polyvinylchloride as the basic resins. The compound shall contain no reprocessed materials. Minimum tensile strength of waterstop shall be 1750 psi. The waterstop shall conform to CRD-C572. Waterstops shall be style581 for locations shown on the Drawings by Greenstreak Plastic Products, St. Louis, MO or equal. All hardware shall be SS type 316.
2. Hydrophillic Waterstop (Swelling) – Hydrotite as manufactured by Sika Greenstreak, or approved equal.
3. Preformed adhesive waterstops - The waterstop shall be a rope type preformed plastic waterstop meeting the requirements of Federal Specification SS-S-210A. The rope shall have a cross-section of approximately one square inch unless otherwise specified or shown on the Drawings. The waterstop shall be Synko-Flex waterstop as manufactured by Synko-Flex Products of Houston, TX, Lockstop by Greenstreak Group Inc., or approved equal. Primer for the material shall be as recommended by the waterstop manufacturer.

C. Premolded Joint Filler

1. Premolded joint filler - Structures. Self-expanding cork, premolded joint filler shall conform to ASTM D1752, Type III. The thickness shall be 3/4-in unless shown otherwise on the Drawings.
2. Premolded joint filler - sidewalk and roadway concrete pavements or where fiber joint filler is specifically noted on the Drawings. The joint filler shall be asphalt-impregnated fiber board conforming to ASTM D1751. Thickness shall be 3/4-in unless otherwise shown on the Drawings.

D. Bond Breaker

1. Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape which will satisfactorily adhere to the premolded joint filler or concrete surface as required. The tape shall be the same width as the joint.
 2. Except where tape is specifically called for on the drawings, bond breaker for concrete shall be either bond breaker tape or a nonstaining type bond prevention coating such as Williams Tilt-up Compound by Williams Distributors Inc.; Silcoseal 77, by SCA Construction Supply Division, Superior Concrete Accessories or equal.
- E. Expansion Joint Dowels
1. Dowels shall be smooth steel conforming to ASTM A675, Grade 70. Dowels must be straight and clean, free of loose flaky rust and loose scale. Dowels may be sheared to length provided deformation from true shape caused by shearing does not exceed 0.04-in on the diameter of the dowel and extends no more than 0.04-in from the end. Bars shall be coated with a bond breaker on the expansion end of the dowel. Expansion caps shall be provided on the expansion end. Caps shall allow for at least 1-1/2-in of expansion.
 2. Dowel Bar Sleeves: Provide Greenstreak two component Speed Dowel System, to accept 1" diameter x 12" long slip dowels. The Greenstreak Group, Inc. Speed Dowel System is comprised of a reusable base and a plastic sleeve. Both pieces shall be manufactured from polypropylene plastic.
- F. Bonding Agent
1. Epoxy bonding agent shall be a two-component, solvent-free, moisture insensitive, epoxy resin material conforming to ASTM C881, Type II. The bonding agent shall be Sikadur 32 Hi-Mod by Sika Corporation of Lyndhurst, N.J.; Concesive Liquid (LPL) by Master Builders of Cleveland, OH or equal. Acrylic may be used if approved by the Engineer.
- G. Compressible Joint Filler
1. The joint filler shall be a non-extruded watertight strip material use to fill expansion joints between structures. The material shall be capable of being compressed at least 40 percent for 70 hours at 68 degrees F and subsequently recovering at least 20 percent of its original thickness in the first 1/2 hour after unloading. Compressible Joint filler shall be Evasote 380 E.S.P, by E-Poxy Industries, Inc., Ravena, NY, Sikaflex 1a by Sika or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Standards Waterstops

1. Install waterstops for all joints where indicated on the Drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided. Provide factory made waterstop fabrications for all changes in

direction, intersections and transitions leaving only straight butt joints splices for the field.

2. Horizontal waterstops in slabs shall be clamped in position by the bulkhead (unless previously set in concrete).
3. Waterstops shall be installed so that half of the width will be embedded on each side of the joint. Care shall be exercised to ensure that the waterstop is completely embedded in void-free concrete.
4. Waterstops shall be terminated 3-in below the exposed top of walls. Expansion joint waterstop center bulbs shall be plugged with foam rubber, 1-in deep, at point of termination.

B. Special Waterstops

1. Install special waterstops at joints where specifically noted on the Drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided. Provide factory made waterstop fabrications for all changes in direction, intersections and transitions leaving only straight butt joints splices for the field.
2. Each piece of the waterstop shall be of maximum practicable length to provide a minimum number of connections or splices. Connections and splices shall conform to the manufacturer's recommendations and as specified herein.
3. Waterstops shall be terminated 3-in below the exposed top of walls.

C. Construction Joints

1. Make construction joints only at locations shown on the Drawings or as approved by the Engineer. Any additional or relocation of construction joints proposed by the Contractor, must be submitted to the Engineer for written approval.
2. Additional or relocated joints should be located where they least impair strength of the member. In general, locate joints within the middle third of spans of slabs, beams and girders. However, if a beam intersects a girder at the joint, offset the joint a distance equal to twice the width of the member being connected. Locate joints in walls and columns at the underside of floors, slabs, beams or girders and at tops of footings or floor slabs. Do not locate joints between beams, girders, column capitals, or drop panels and the slabs above them. Do not locate joints between brackets or haunches and walls or columns supporting them.
3. All joints shall be perpendicular to main reinforcement. Continue reinforcing steel through the joint as indicated on the Drawings. When joints in beams are allowed, provide a shear key and inclined dowels as approved by the Engineer.
4. Provide sealant grooves for joint sealant where indicated on the Drawings.
5. At all construction joints and at concrete joints designated on the Drawings to be "roughened", uniformly roughen the surface of the concrete to a full amplitude (distance between high and low points or side to side) of

approximately 1/4-in to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by water-blasting or sandblasting and prepare for bonding.

6. Provide waterstops in all wall and slab construction joints in liquid containment structures and at other locations shown on the Drawings.
7. Keyways shall not be used in construction joints unless specifically shown on the Drawings or approved by the Engineer.

D. Expansion Joints

1. Do not extend through expansion joints, reinforcement or other embedded metal items that are continuously bonded to concrete on each side of joint.
2. Position premolded joint filler material accurately. Secure the joint filler against displacement during concrete placement and compaction. Place joint filler over the face of the joint, allowing for sealant grooves as detailed on the Drawings. Tape all joint filler splices to prevent intrusion of mortar. Seal expansion joints as shown on the Drawings.
3. Expansion joints shall be 3/4-in in width unless otherwise noted on the Drawings.
4. Where indicated on Drawings, install smooth dowels at right angles to expansion joints. Align dowels accurately with finished surface. Rigidly hold in place and support during concrete placement. Unless otherwise shown on the Drawings, apply oil or grease to one end of all dowels through expansion joints. Provide plastic expansion caps on the lubricated ends of expansion dowels.
5. Provide center bulb type waterstops in all wall and slab expansion joints in liquid containment structures and at other locations shown on the Drawings.

E. Control Joints

1. Provide sealant grooves, sealants and waterstops at control joints in slabs on grade or walls as detailed. Provide waterstops at all wall and slab control joints in water containment structures and at other locations shown on the Drawings.
2. Control joints may be sawed if specifically approved by the Engineer. If control joint grooves are sawed, properly time the saw cutting with the time of the concrete set. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw. Complete cutting before shrinkage stresses have developed sufficiently to induce cracking. No reinforcing shall be cut during sawcutting.
3. Extend every other bar of reinforcing steel through control joints or as indicated on the Drawings. Where specifically noted on the Drawings, coat the concrete surface with a bond breaker prior to placing new concrete against it. Avoid coating reinforcement or waterstops with bond breaker at these locations.

END OF SECTION

**SECTION 03200
CONCRETE REINFORCEMENT**

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install all concrete reinforcement complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Concrete Formwork is included in Section 03100.
- B. Cast-in-place Concrete is included in Section 03300.

1.03 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:
 - 1. Reinforcing steel. Placement drawings shall conform to the recommendations of ACI 315. All reinforcement in a concrete placement shall be included on a single placement drawing or cross referenced to the pertinent main placement drawing. The main drawing shall include the additional reinforcement (around openings, at corners, etc) shown on the standard detail sheets. Bars to have special coatings and/or to be of special steel or special yield strength are to be clearly identified. For all cast-in-place concrete tanks, retaining walls, building stem walls, wall sections shall be included in the drawings.
 - 2. Bar bending details. The bars shall be referenced to the same identification marks shown on the placement drawings.
 - 3. Schedule of all placements to contain synthetic reinforcing fibers. The amount of fibers per cubic yard to be used for each of the placements shall be noted on the schedule. The name of the manufacturer of the fibers and the product data shall be included with the submittal.
- B. Submit Test Reports, in accordance with Section 01300, of each of the following items.
 - 1. Certified copy of mill test on each steel proposed for use showing the physical properties of the steel and the chemical analysis.
 - 2. Welder's certification. The certification shall be in accordance with AWS D1.4 when welding of reinforcement is required.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 2. ASTM A184 - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
 3. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
 4. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
 5. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
 6. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 7. ASTM A616 - Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
 8. ASTM A617 - Standard Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
 9. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 10. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
 11. ASTM A775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 12. ASTM A884 - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
 13. ASTM A934 - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
- B. American Concrete Institute (ACI)
1. ACI 301 - Standard Specification for Structural Concrete
 2. ACI 315 - Details and Detailing of Concrete Reinforcement.
 3. ACI 318 - Building Code Requirements for Structural Concrete
 4. ACI SP-66 - ACI Detailing Manual
- C. Concrete Reinforcing Steel Institute (CRSI)
1. Manual of Standard Practice
- D. American Welding Society (AWS)
1. AWS D1.4 - Structural Welding Code Reinforcing Steel
- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. Provide services of a manufacturer's representative, with at least 2 years experience in the use of the reinforcing fibers for a preconstruction meeting and assistance during the first placement of the material.

1.06 DELIVERY, HANDLING AND STORAGE

- A. Reinforcing steel shall be substantially free from mill scale, rust, dirt, grease, or other foreign matter.
- B. Reinforcing steel shall be shipped and stored with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted Placing Drawings.
- C. Reinforcing steel shall be stored off the ground and kept free from dirt, oil, or other injurious contaminants

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials shall be new, of domestic manufacture and shall comply with the following material specifications.
- B. Deformed Concrete Reinforcing Bars: ASTM A615, Grade 60 deformed bars.
- C. Concrete Reinforcing Bars required on the Drawings to be Welded: ASTM A706.
- D. Welded Steel Wire Fabric: ASTM A185. Provide in flat sheets.
- E. Welded Deformed Steel Wire Fabric: ASTM A497.
- F. Welded Plain Bar Mats: ASTM A704 and ASTM A615 Grade 60 plain bars.
- G. Fabricated Deformed Steel Bar Mats: ASTM A184 and ASTM A615 Grade 60 deformed bars.
- H. The following alternate materials are allowed:
 - 1. ASTM A615 Grade 60 may be used for ASTM A706 provided the following requirements are satisfied:
 - I. The actual yield strength of the reinforcing steel based on mill tests shall not exceed the specified yield strength by more than 18,000 psi. Retests shall not exceed this value by more than an additional 3000 psi.
 - J. The ratio of the actual ultimate tensile strength to the actual tensile yield strength of the reinforcement shall not be less than 1.25.
 - K. The carbon equivalency (CE) of bars shall be 0.55 or less.
 - L. Reinforcing Steel Accessories
 - 1. Plastic Protected Bar Supports: CRSI Bar Support Specifications, Class 1 - Maximum Protection.

2. Stainless Steel Protected Bar Supports: CRSI Bar Support Specifications, Class 2 - Moderate Protection.
 3. Precast Concrete Block Bar Supports: CRSI Bar Support Specifications, Precast Blocks. Blocks shall have equal or greater strength than the surrounding concrete.
 4. Steel Protected Bar Supports: #4 Steel Chairs with plastic or rubber tips.
- M. Tie Wire
1. Tie Wires for Reinforcement shall be 16-gauge or heavier, black annealed wire or stranded wire.
- N. Mechanical reinforcing steel butt splices shall be positive connecting taper threaded type employing a hexagonal coupler such as Lenton rebar splices as manufactured by Erico Products Inc., Solon, OH or equal. They shall meet all ACI 318 Building Code requirements. Bar ends must be taper threaded with coupler manufacturer's bar threader to ensure proper taper and thread engagement. Bar couplers shall be torqued to manufacturer's recommended value.
1. Unless otherwise noted on the Drawings, mechanical tension splices shall be designed to produce a splice strength in tension or compression of not less than 125 percent of the ASTM specified minimum yield strength of the rebar.
 2. Compression type mechanical splices shall provide concentric bearing from one bar to the other bar and shall be capable of developing the ultimate strength of the rebar in compression.
- O. Fiber Reinforcement
1. Synthetic reinforcing fiber for concrete shall be 100 percent polypropylene collated, fibrillated fibers as manufactured by Propex Concrete Systems Chattanooga, TN - Propex or equal. Fiber length and quantity for the concrete mix shall be in strict compliance with the manufacturer's recommendations as approved by the Engineer.

2.02 FABRICATION

- A. Fabrication of reinforcement shall be in compliance with the CRSI Manual of Standard Practice.
- B. Bars shall be cold bent. Bars shall not be straightened or rebent.
- C. Bars shall be bent around revolving collar having a diameter of not less than that recommended by the ACI 318.
- D. Bar ends that are to be butt spliced, placed through limited diameter holes in metal, or threaded, shall have the applicable end(s) saw-cut. Such ends shall terminate in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Surface condition, bending, spacing and tolerances of placement of reinforcement shall comply with the CRSI Manual of Standard Practice. The Contractor shall be solely responsible for providing and adequate number of bars and maintaining the spacing and clearances shown on the Drawings.
- B. Except as otherwise indicated on the Drawings, the minimum concrete cover of reinforcement shall be as follows:
 - 1. Concrete cast against and permanently exposed to earth: 3-in
 - 2. Concrete exposed to soil, water, sewage, sludge and/or weather: 2-in (Including bottom cover of slabs over water or sewage)
 - 3. Concrete not exposed to soil, water, sewage, sludge and/or weather:
 - a. Slabs (top and bottom cover), walls, joists, shells and folded plate members – 3/4 in.
 - b. Beams and columns (principal reinforcement, ties, spirals and stirrups) – 1-1/2 in.
- C. Reinforcement which will be exposed for a considerable length of time after being placed shall be coated with a heavy coat of neat cement slurry.
- D. No reinforcing steel bars shall be welded either during fabrication or erection unless specifically shown on the Drawings or specified herein, or unless prior written approval has been obtained from the Engineer. All bars that have been welded, including tack welds, without such approval shall be immediately removed from the work. When welding of reinforcement is approved or called for, it shall comply with AWS D1.4.
- E. Reinforcing steel interfering with the location of other reinforcing steel, conduits or embedded items, may be moved within the specified tolerances or one bar diameter, whichever is greater. Greater displacement of bars to avoid interference shall only be made with the approval of the Engineer. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without the prior approval of the Engineer.
- F. Securely support and tie reinforcing steel to prevent movement during concrete placement. Secure dowels in place before placing concrete.
- G. Reinforcing steel bars shall not be field bent except where shown on the Drawings or specifically authorized in writing by the Engineer. If authorized, bars shall be cold-bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. If the reinforcing steel is damaged, replace, Cadweld or otherwise repair as directed by the Engineer. Do not bend reinforcement after it is embedded in concrete unless specifically shown otherwise on the Drawings.

3.02 REINFORCEMENT AROUND OPENINGS

- A. Unless specific additional reinforcement around openings is shown on the Drawings, provide additional reinforcing steel on each side of the opening equivalent to one half

of the cross-sectional area of the reinforcing steel interrupted by an opening. The bars shall have sufficient length to develop bond at each end beyond the opening or penetration.

3.03 SPLICING OF REINFORCEMENT

- A. Splices designated as compression splices on the Drawings, unless otherwise noted, shall be 30 bar diameters, but not less than 12-in. The lap splice length for column vertical bars shall be based on the bar size in the column above.
- B. Tension lap splices shall be provided at all laps in compliance with ACI 318. Splices in adjacent bars shall be staggered. Class A splices may be used when 50 percent or less of the bars are spliced within the required lap length. Class B splices shall be used at all other locations.
- C. Splicing of reinforcing steel in concrete elements noted to be "tension members" on the Drawings shall be avoided whenever possible. However, if required for constructability, splices in the reinforcement subject to direct tension shall be welded to develop, in tension, at least 125 percent of the specified yield strength of the bar. Splices in adjacent bars shall be offset the distance of a Class B splice.
- D. Install wire fabric in as long lengths as practicable. Wire fabric from rolls shall be rolled flat and firmly held in place. Splices in welded wire fabric shall be lapped in accordance with the requirements of ACI-318 but not less than 12-in. The spliced fabrics shall be tied together with wire ties spaced not more than 24-in on center and laced with wire of the same diameter as the welded wire fabric. Do not position laps midway between supporting beams, or directly over beams of continuous structures. Offset splices in adjacent widths to prevent continuous splices.
- E. Mechanical reinforcing steel splicers shall be used only where shown on the Drawings. Splices in adjacent bars shall be offset by at least 30 bar diameters. Mechanical reinforcing splices are only to be used for special splice and dowel conditions approved by the Engineer.

3.04 ACCESSORIES

- A. Determine, provide and install accessories such as chairs, chair bars and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.
- B. Use precast concrete blocks where the reinforcing steel is to be supported over soil.
- C. Stainless steel bar supports or steel chairs with stainless steel tips shall be used where the chairs are set on forms for a concrete surface that will be exposed to weather, high humidity, or liquid (including bottom of slabs over liquid containing areas). Use of galvanized or plastic tipped metal chairs is permissible in all other locations unless otherwise noted on the Drawings or specified herein.
- D. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

3.05 INSPECTION

- A. In no case shall any reinforcing steel be covered with concrete until the installation of the reinforcement, including the size, spacing and position of the reinforcement has been observed by the Engineer and the Engineer's release to proceed with the concreting has been obtained. The Engineer shall be given ample prior notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the Engineer has finished his/her observations of the reinforcing steel.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor and materials required and install cast-in-place concrete complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Concrete Formwork is included in Section 03100.
- B. Concrete Reinforcement is included in Section 03200.
- C. Concrete Joints and Joint Accessories are included in Section 03150.
- D. Concrete Finishes are included in Section 03350.
- E. Grout is included in Section 03600.
- F. Modifications and Repair to Concrete are included in section 03740.

1.03 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data including the following:
 - 1. Sources of cement, pozzolan and aggregates.
 - 2. Material Safety Data Sheets (MSDS) for all concrete components and admixtures.
 - 3. Air-entraining admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.
 - 4. Water-reducing admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.
 - 5. High-range water-reducing admixture (plasticizer). Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range and conformity to ASTM standards. Identify proposed locations of use.
 - 6. Concrete mix for each formulation of concrete proposed for use including constituent quantities per cubic yard, water-cementitious materials ratio, concrete slump, type and manufacturer of cement. Provide either a. or b. below for each mix proposed.

- A. Standard deviation data for each proposed concrete mix based on statistical records.
 - B. The curve of water-cementitious materials ratio versus concrete cylinder strength for each formulation of concrete proposed based on laboratory tests. The cylinder strength shall be the average of the 28 day cylinder strength test results for each mix. Provide results of 7 and 14 day tests if available.
7. Sheet curing material. Product data including catalogue cut, technical data and conformity to ASTM standard.
 8. Liquid curing compound. Product data including catalogue cut, technical data, storage requirements, product life, application rate and conformity to ASTM standards. Identify proposed locations of use.
- B. Samples
 1. Fine and coarse aggregates if requested by the Engineer.
- C. Test Reports
 1. Fine aggregates – sieve analysis, physical properties, and deleterious substance.
 2. Coarse aggregates – sieve analysis, physical properties, and deleterious substances.
 3. Cements – chemical analysis and physical properties for each type.
 4. Pozzolans – chemical analysis and physical properties.
 5. Proposed concrete mixes – compressive strength, slump and air content.
 - D. Certifications
 1. Certify admixtures used in the same concrete mix are compatible with each other and the aggregates.
 2. Certify admixtures are suitable for use in contact with potable water after 30 days of concrete curing.
 3. Certify curing compound is suitable for use in contact with potable water after 30 days (non-toxic and free of taste or odor).

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 1. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 2. ASTM C33 - Standard Specification for Concrete Aggregates.
 3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

5. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
 6. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete
 7. ASTM C150 - Standard Specification for Portland Cement
 8. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete
 9. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 10. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 11. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 12. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 13. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
 14. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
 15. ASTM C1017 - Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete.
- B. American Concrete Institute (ACI).
1. ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete.
 2. ACI 305 - Hot Weather Concreting.
 3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
 4. ACI 318 - Building Code Requirements for Structural Concrete.
 5. ACI 350 - Environmental Engineering Concrete Structures.
 6. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.
- C. QUALITY ASSURANCE
1. Reinforced concrete shall comply with ACI 318, the recommendations of ACI 350R and other stated requirements, codes and standards. The most stringent requirement of the codes, standards and this Section shall apply when conflicts exist.
 2. Only one source of cement and aggregates shall be used on any one structure. Concrete shall be uniform in color and appearance.
 3. Well in advance of placing concrete, discuss with the Engineer the sources of individual materials and batched concrete proposed for use. Discuss placement methods, waterstops and curing. Propose methods of hot and cold weather concreting as required. Prior to the placement of any concrete containing a high-range water-reducing admixture (plasticizer), the Contractor,

accompanied by the plasticizer manufacturer, shall discuss the properties and techniques of batching and placing plasticized concrete.

4. If, during the progress of the work, it is impossible to secure concrete of the required workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the desired properties. All changes so ordered shall be made at the Contractor's expense.
 5. If, during the progress of the work, the materials from the sources originally accepted change in characteristics, the Contractor shall, at his/her expense, make new acceptance tests of aggregates and establish new design mixes.
 6. Testing of the following materials shall be furnished by Contractor to verify conformity with this Specification Section and the stated ASTM Standards.
 - A. Fine aggregates for conformity with ASTM C33 - sieve analysis, physical properties, and deleterious substances.
 - B. Coarse aggregates for conformity with ASTM C33 - sieve analysis, physical properties, and deleterious substances.
 - C. Cements for conformity with ASTM C150 - chemical analysis and physical properties.
 - D. Pozzolans for conformity with ASTM C618 - chemical analysis and physical properties.
 - E. Proposed concrete mix designs - compressive strength, slump and air content.
- D. Field testing and inspection services will be provided by the District. The cost of such work, except as specifically stated otherwise, shall be paid by the District. Testing of the following items shall be by the District to verify conformity with this Specification Section.
1. Concrete placements - compressive strength (cylinders), compressive strength (cores), slump, and air content.
 2. Other materials or products that may come under question.
- E. All materials incorporated in the work shall conform to accepted samples.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Cement: Store in weather-tight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set.
- B. Aggregate: Arrange and use stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding 3-ft in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregate.
- C. Sand: Arrange and use stockpiles to avoid contamination. Allow sand to drain to uniform moisture content before using. Do not use frozen or partially frozen aggregates.

- D. Admixtures: Store in closed containers to avoid contamination, evaporation or damage. Provide suitable agitating equipment to assure uniform dispersion of ingredients in admixture solutions which tend to separate. Protect liquid admixtures from freezing and other temperature changes which could adversely affect their characteristics.
- E. Pozzolan: Store in weather-tight buildings, bins or silos to provide protection from dampness and contamination.
- F. Sheet Curing Materials: Store in weather-tight buildings or off the ground and under cover.
- G. Liquid Curing Compounds: Store in closed containers.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Cement: U.S. made Portland cement complying with ASTM C150. Air entraining cements shall not be used. Cement brand shall be subject to approval by the Engineer and one brand shall be used throughout the work.

2.02 MATERIALS

- A. Materials shall comply with this Section and any applicable State or local requirements.
- B. Cement: The following cement type(s) shall be used:
 - 1. All Classes – Type I/II or Type II
- C. Fine Aggregate: Washed inert natural sand conforming to the requirements of ASTM C33.
- D. Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33. Grading requirements shall be as listed in ASTM C33 Table 2 for the specified coarse aggregate size number. Limits of Deleterious Substances and Physical Property Requirements shall be as listed in ASTM C33 Table 3 for severe weather regions. Size numbers for the concrete mixes shall be as shown in Table 1 herein.
- E. Water: Potable water free from injurious amounts of oils, acids, alkalis, salts, organic matter, or other deleterious substances.
- F. Admixtures: Admixtures shall be free of chlorides and alkalis (except for those attributable to water). When it is required to use more than one admixture in a concrete mix, the admixtures shall be from the same manufacturer. Admixtures shall be compatible with the concrete mix including other admixtures and shall be suitable for use in contact with potable water after 30 days of concrete curing.
 - 1. Air-Entraining Admixture: The admixture shall comply with ASTM C260. Proportioning and mixing shall be in accordance with manufacturer's recommendations.

2. Water-Reducing Agent: The admixture shall comply with ASTM C494, Type A. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
 3. High-Range Water-Reducer (Plasticizer): The admixture shall comply with ASTM C494, Type F and shall result in non-segregating plasticized concrete with little bleeding and with the physical properties of low water/cement ratio concrete. The treated concrete shall be capable of maintaining its plastic state in excess of 2 hours. Proportioning and mixing shall be in accordance with manufacturer's recommendations. Where walls are 14" thick or less and the wall height exceeds 12 ft a mix including a plasticizer must be used.
 4. Admixtures causing retarded or accelerated setting of concrete shall not be used without written approval from the Engineer. When allowed, the admixtures shall be retarding or accelerating water reducing or high range water reducing admixtures.
- G. Pozzolan (Fly Ash): Pozzolan shall be Class C or Class F fly ash complying with ASTM C618 except the Loss on Ignition (LOI) shall be limited to 3 percent maximum.
- H. Sheet Curing Materials. Waterproof paper, polyethylene film or white burlap-polyethylene sheeting all complying with ASTM C171.
- I. Liquid Curing Compound. Liquid membrane-forming curing compound shall comply with the requirements of ASTM C309, Type 1-D (clear or translucent with fugitive dye) and shall contain no wax, paraffin, or oil. Curing compound shall be approved for use in contact with potable water after 30 days (non-toxic and free of taste or odor). Curing compound shall comply with Federal, State and local VOC limits.

2.03 MIXES

- A. Development of mix designs and testing shall be by an independent testing laboratory acceptable to the Engineer engaged by and at the expense of the Contractor.
- B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce concrete having proper placability, durability, strength, appearance and other required properties. Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing excessive free water to collect on the surface.
- C. The design mix shall be based on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if such data is not available, be developed by a testing laboratory, acceptable to the Engineer, engaged by and at the expense of the Contractor. Acceptance of mixes based on standard deviation shall be based on the modification factors for standard deviation tests contained in ACI 318. The water content of the concrete mix, determined by laboratory testing, shall be based on a curve showing the relation between water cementitious ratio and 7 and 28 day compressive strengths of concrete made using the proposed materials. The curves shall be determined by four or more points, each representing an average value of at least three test specimens at each age. The curves shall have a range of values sufficient to

yield the desired data, including the specified design strengths as modified below, without extrapolation. The water content of the concrete mixes to be used, as determined from the curve, shall correspond to strengths 16 percent greater than the specified design strengths. The resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content as specified in Table 1.

- D. Compression Tests: Provide testing of the proposed concrete mix or mixes to demonstrate compliance with the specified design strength requirements in conformity with the above paragraph.
- E. Entrained air, as measured by ASTM C231, shall be as shown in Table 1.
 - 1. If the air-entraining agent proposed for use in the mix requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in the admixture submittal.
- F. Slump of the concrete as measured by ASTM C143, shall be as shown in Table 1. If a high-range water-reducer (plasticizer) is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from 5 to 8-in.
- G. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

TABLE 1
CONCRETE MIX REQUIREMENTS

Class	Design Strength (1)	Cement (2)	Fine Aggregate (2)	Coarse Aggregate (3)	Cementitious Content (4)
A	2500	C150 Type II	C33	57	440 min.
B	3000	C150 Type II	C33	57	480 min.
C	4000	C150 Type II	C33	57	560 min.
D	5000	C150 Type II	C33	57	600 min.

Class	W/cm Ratio (5)	Fly Ash	AE Range (6)	WR (7)	HRWR (8)	Slump Range Inches
A	0.63 max.	--	3.5 to 5	Yes	*	1-4
B	0.54 max.	--	3.5 to 5	Yes	*	1-3
C	0.44 max.	25% max	3.5 to 5	Yes	*	3-5
D	0.40 max.	--	3.5 to 5	Yes	*	3-5

NOTES:

(1) Minimum compressive strength in psi at 28 days

(2) ASTM designation

(3) Size Number in ASTM C33

(4) Cementitious content in lbs/cu yd

(5) W/Cm is Water-Cementitious ratio by weight

(6) AE is percent air-entrainment

(7) WR is water-reducer admixture

(8) HRWR is high-range water-reducer admixture

* HRWR used at contractor's option except where walls are 14" thick or less and the wall height exceeds 12 ft a mix including a plasticizer must be used.

PART 3 - EXECUTION

3.01 MEASURING MATERIALS

- A. Concrete shall be composed of portland cement, fine aggregate, coarse aggregate, water and admixtures as specified and shall be produced by a plant acceptable to the Engineer. All constituents, including admixtures, shall be batched at the plant except a high-range water-reducer may also be added in the field.
- B. Measure materials for batching concrete by weighing in conformity with and within the tolerances given in ASTM C94 except as otherwise specified. Scales shall have been certified by the local Sealer of Weights and Measures within 1 year of use.
- C. Measure the amount of free water in fine aggregates within 0.3 percent with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record the number of gallons of water as-batched on printed batching tickets.
- D. Admixtures shall be dispensed either manually using calibrated containers or measuring tanks, or by means of an automatic dispenser approved by the manufacturer of the specific admixture.
 - 1. Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.
 - 2. Inject multiple admixtures separately during the batching sequence.

3.02 MIXING AND TRANSPORTING

- A. Batch plants shall have a current NRMCA Certification or equal.
- B. Concrete shall be ready-mixed concrete produced by equipment acceptable to the Engineer. No hand-mixing will be permitted. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.
- C. Ready-mix concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.
- D. Keep the water tank valve on each transit truck locked at all times. Any addition of water above the appropriate W/Cm ratio must be directed by the Engineer. Added water shall be incorporated by additional mixing of at least 35 revolutions. All added water shall be metered and the amount of water added shall be shown on each delivery ticket.
- E. All central plant and rolling stock equipment and methods shall comply with ACI 318 and ASTM C94.
- F. Select equipment of size and design to ensure continuous flow of concrete at the delivery end. Metal or metal-lined non-aluminum discharge chutes shall be used and shall have slopes not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20-ft long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.

- G. Retempering (mixing with or without additional cement, aggregate, or water) of concrete or mortar which has reached initial set will not be permitted.
- H. Handle concrete from mixer to placement as quickly as practicable while providing concrete of required quality in the placement area. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms.
- I. Furnish a delivery ticket for ready mixed concrete to the Engineer as each truck arrives. Each ticket shall provide a printed record of the weight of cement and each aggregate as batched individually. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Clearly indicate the weight of fine and coarse aggregate, cement and water in each batch, the quantity delivered, the time any water is added, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of the truck mixer.
- J. Temperature and Mixing Time Control
 - 1. In cold weather, do not allow the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms to drop below 40 degrees F.
 - 2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees F.
 - 3. In hot weather, cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees F. If necessary, substitute well-crushed ice for all or part of the mixing water.
 - 4. The maximum time interval between the addition of mixing water and/or cement to the batch and the placing of concrete in the forms shall not exceed the values shown in Table 2.

TABLE 2

MAXIMUM TIME TO DISCHARGE OF CONCRETE

<u>Air or Concrete Temperature (whichever is higher)</u>	<u>Maximum Time</u>
80 to 90 Degree F (27 to 32 Degree C).....	45 minutes
70 to 79 Degree F (21 to 26 Degree C).....	60 minutes
40 to 69 Degree F (5 to 20 Degree C).....	.90 minutes

If an approved high-range water-reducer (plasticizer) is used to produce plasticized concrete, the maximum time interval shall not exceed 90 minutes.

3.03 CONCRETE APPARANCE

- A. Concrete mix showing either poor cohesion or poor coating of the coarse aggregate with paste shall be remixed. If this does not correct the condition, the concrete shall be rejected. If the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finishability are observed, changes in the concrete mix shall be obtained only by adjusting one or more of the following:
 - 1. The gradation of aggregate.
 - 2. The proportion of fine and coarse aggregate.
 - 3. The percentage of entrained air, within the allowable limits.
- B. Concrete for the work shall provide a homogenous structure which, when hardened, will have the required strength, durability and appearance. Mixtures and workmanship shall be such that concrete surfaces, when exposed, will require no finishing. When concrete surfaces are stripped, the concrete, when viewed in good lighting from 10-ft away, shall be pleasing in appearance, and at 20-ft shall show no visible defects.

3.04 PLACING AND COMPACTING

- A. Placing
 - 1. Verify that all formwork completely encloses concrete to be placed and is securely braced prior to concrete placement. Remove ice, excess water, dirt and other foreign materials from forms. Confirm that reinforcement and other embedded items are securely in place. Have a competent workman at the location of the placement who can assure that reinforcing steel and embedded items remain in designated locations while concrete is being placed. Sprinkle semi-porous subgrades or forms to eliminate suction of water from the mix. Seal extremely porous subgrades in an approved manner.
 - 2. Deposit concrete as near its final position as possible to avoid segregation due to rehandling or flowing. Place concrete continuously at a rate which ensures the concrete is being integrated with fresh plastic concrete. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials or on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.
 - 3. Pumping of concrete will be permitted. Use a mix design and aggregate sizes suitable for pumping and submit for approval.
 - 4. Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only when made of galvanized metal or concrete and if prior approval has been obtained.
 - 5. Do not place concrete for supported elements until concrete previously placed in the supporting element (columns, slabs and/or walls) has reached adequate strength.

6. Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms with a suitable tool to bring the full surface of the mortar against the form. Prevent the formation of excessive surface voids.
7. Slabs
 - A. After suitable bulkheads, screeds and jointing materials have been positioned, the concrete shall be placed continuously between construction joints beginning at a bulkhead, edge form, or corner. Each batch shall be placed into the edge of the previously placed concrete to avoid stone pockets and segregation.
 - B. Avoid delays in casting. If there is a delay in casting, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously placed to avoid cold joints. Concrete shall then be brought to correct level and struck off with a straightedge. Bullfloats or darbies shall be used to smooth the surface, leaving it free of humps or hollows.
 - C. Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow 1 hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep the top surface of the wall moist so as to prevent cold joints.
8. Formed Concrete
 - A. Place concrete in forms using tremie tubes and taking care to prevent segregation. Bottom of tremie tubes shall preferably be in contact with the concrete already placed. Do not permit concrete to drop freely more than 4-ft. Place concrete for walls in 12 to 24-in lifts, keeping the surface horizontal. If plasticized concrete is used, the maximum lift thickness may be increased to 4-ft.
9. Underwater concreting shall be performed in conformity with the recommendations of ACI 304R. The tremie system shall be used to place underwater concrete. Tremie pipes shall be in the range of 8 to 12-in in diameter and be spaced at not more than 16-ft on centers nor more than 8-ft from an end form. Where concrete is being placed around a pipe, there shall be at least one tremie pipe on each side of each pipe. Where the tremie system is not practical, direct pumped concrete for underwater placement may be used subject to approval of the system including details by the Engineer.
 - B. Compacting
 1. Consolidate concrete by vibration, puddling, spading, rodding or forking so that concrete is thoroughly worked around reinforcement, embedded items and openings and into corners of forms. Puddling, spading, etc, shall be continuously performed along with vibration of the placement to eliminate air or stone pockets which may cause honeycombing, pitting or planes of weakness.

2. All concrete shall be placed and compacted with mechanical vibrators. The number, type and size of the units shall be approved by the Engineer in advance of placing operations. No concrete shall be ordered until sufficient approved vibrators (including standby units in working order) are on the job.
3. A minimum frequency of 7000 rpm is required for mechanical vibrators. Insert vibrators and withdraw at points from 18 to 30-in apart. At each insertion, vibrate sufficiently to consolidate concrete, generally from 5 to 15 seconds. Do not over vibrate so as to segregate. Keep a spare vibrator on the site during concrete placing operations.
4. Concrete Slabs: Concrete for slabs less than 8-in thick shall be consolidated with vibrating screeds; slabs 8 to 12-in thick shall be compacted with internal vibrators and (optionally) with vibrating screeds. Vibrators shall always be placed into concrete vertically and shall not be laid horizontally or laid over.
5. Walls and Columns: Internal vibrators (rather than form vibrators) shall be used unless otherwise approved by the Engineer. In general, for each vibrator needed to melt down the batch at the point of discharge, one or more additional vibrators must be used to densify, homogenize and perfect the surface. The vibrators shall be inserted vertically at regular intervals, through the fresh concrete and slightly into the previous lift, if any.
6. Amount of Vibration: Vibrators are to be used to consolidate properly placed concrete but shall not be used to move or transport concrete in the forms. Vibration shall continue until:
 - A. Frequency returns to normal.
 - B. Surface appears liquefied, flattened and glistening.
 - C. Trapped air ceases to rise.
 - D. Coarse aggregate has blended into surface, but has not disappeared.

3.05 CURING AND PROTECTION

- A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.
- B. Curing Methods
 1. Curing Methods for Concrete Surfaces: Cure concrete to retain moisture and maintain specified temperature at the surface for a minimum of 7 days after placement. Curing methods to be used are as follows:
 - A. Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling or covered with saturated burlap. Begin wet cure as soon as concrete attains an initial set and maintain wet cure 24 hours a day.
 - B. Sheet Material Curing: Cover entire surface with sheet material. Securely anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.
 - C. Liquid Membrane Curing: Apply over the entire concrete surface except for surfaces to receive additional concrete. Curing compound

shall NOT be placed on any concrete surface where additional concrete is to be placed, where concrete sealers or surface coatings are to be used, or where the concrete finish requires an integral floor product. Curing compound shall be applied as soon as the free water on the surface has disappeared and no water sheen is visible, but not after the concrete is dry or when the curing compound can be absorbed into the concrete. Application shall be in compliance with the manufacturer's recommendations.

2. Specified applications of curing methods.
 - A. Slabs for Water Containment Structures: Water curing only.
 - B. Slabs on Grade and Footings (not used to contain water): Water curing, sheet material curing or liquid membrane curing.
 - C. Structural Slabs (other than water containment): Water curing or liquid membrane curing.
 - D. Horizontal Surfaces which will Receive Additional Concrete, Coatings, Grout or Other Material that Requires Bond to the substrate: Water curing.
 - E. Formed Surfaces: None if nonabsorbent forms are left in place 7 days. Water cure if absorbent forms are used. Sheet cured or liquid membrane cured if forms are removed prior to 7 days. Exposed horizontal surfaces of formed walls or columns shall be water cured for 7 days or until next placement of concrete is made.
 - F. Surfaces of Concrete Joints: Water cured or sheet material cured.
 - G. Finished surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing.
 - H. Cold Weather Concreting:
3. "Cold weather" is defined as a period when for more than 3 successive days, the average daily outdoor temperature drops below 40 degrees F. The average daily temperature shall be calculated as the average of the highest and the lowest temperature during the period from midnight to midnight.
4. Cold weather concreting shall conform to ACI 306.1 and the additional requirements specified herein. Temperatures at the concrete placement shall be recorded at 12 hour intervals (minimum).
5. Discuss a cold weather work plan with the Engineer. The discussion shall encompass the methods and procedures proposed for use during cold weather including the production, transportation, placement, protection, curing and temperature monitoring of the concrete. The procedures to be implemented upon abrupt changes in weather conditions or equipment failures shall also be discussed. Cold weather concreting shall not begin until the work plan is acceptable to the Engineer.
6. During periods of cold weather, concrete shall be protected to provide continuous warm, moist curing (with supplementary heat when required) for a total of at least 350 degree-days of curing.

- A. Degree-days are defined as the total number of 24 hour periods multiplied by the weighted average daily air temperature at the surface of the concrete (eg: 5 days at an average 70 degrees F = 350 degree-days).
 - B. To calculate the weighted average daily air temperature, sum hourly measurements of the air temperature in the shade at the surface of the concrete taking any measurement less than 50 degrees F as 0 degrees F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.
- 7. Salt, manure or other chemicals shall not be used for protection.
 - 8. The protection period for concrete being water cured shall not be terminated during cold weather until at least 24 hours after water curing has been terminated.
- C. Hot Weather Concreting
- 1. "Hot weather" is defined as any combination of high air temperatures, low relative humidity and wind velocity which produces a rate of evaporation estimated in accordance with ACI 305R, approaching or exceeding 0.2 lbs/sqft/hr).
 - 2. Concrete placed during hot weather, shall be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 305R and the additional requirements specified herein.
 - A. Temperature of concrete being placed shall not exceed 90 degrees F and every effort shall be made to maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall be such that it will cause no difficulties from loss of slump, flash set or cold joints.
 - B. All necessary precautions shall be taken to promptly deliver, to promptly place the concrete upon its arrival at the job and to provide vibration immediately after placement.
 - c. The Engineer may direct the Contractor to immediately cover plastic concrete with sheet material.
 - 3. Discuss with the Engineer a work plan describing the methods and procedures proposed to use for concrete placement and curing during hot weather periods. Hot weather concreting shall not begin until the work plan is acceptable to the Engineer.

3.06 REMOVAL OF FORMS

- A. Except as otherwise specifically authorized by the Engineer, forms shall not be removed before the concrete has attained a strength of at least 70 percent of its specified design strength for beams and slabs and at least 30 percent of its specified design strength for walls and vertical surfaces, nor before reaching the following number of day-degrees of curing (whichever is the longer)

Table 3
Minimum Time to Form Removal

<u>Forms for</u>	<u>Degree Days</u>
Beams and slabs	500
Walls and vertical surfaces	100

(See definition of degree-days in Paragraph 3.05D above).

- B. Shores shall not be removed until the concrete has attained at least 70 percent of its specified design strength and also sufficient strength to support safely its own weight and construction live loads.

3.07 INSPECTION AND FIELD TESTING

- A. The batching, mixing, transporting, placing and curing of concrete shall be subject to the inspection of the Engineer at all times. The Contractor shall advise the Engineer of his/her readiness to proceed at least 24 hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing steel and the alignment, cleanliness and tightness of formwork. No placement shall be made without the inspection and acceptance of the Engineer.
- B. Sets of field control cylinder specimens will be taken by the Engineer (or inspector) during the progress of the work, in compliance with ASTM C31. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be less than one set per day, nor less than one set for each 150 cu yds of concrete nor less than one set for each 5,000 sq ft of surface area for slabs or walls.
 1. A "set" of test cylinders consists of four cylinders: one to be tested at 7 days and two to be tested and their strengths averaged at 28 days. The fourth may be used for a special test at 3 days or to verify strength after 28 days if 28 day test results are low.
 2. When the average 28 day compressive strength of the cylinders in any set falls below the specified design strength or below proportional minimum 7 day strengths (where proper relation between seven and 28 day strengths have been established by tests), proportions, water content, or temperature conditions shall be changed to achieve the required strengths.
- C. Cooperate in the making of tests by allowing free access to the work for the selection of samples, providing an insulated closed curing box for specimens, affording protection to the specimens against injury or loss through the operations and furnish material and labor required for the purpose of taking concrete cylinder samples. All shipping of specimens will be paid for by the District. Curing boxes shall be acceptable to the Engineer.
- D. Slump tests will be made in the field immediately prior to placing the concrete. Such tests shall be made in accordance with ASTM C143. If the slump is greater the specified range, the concrete shall be rejected.

- E. Air Content: Test for air content shall be made on fresh concrete samples. Air content for concrete made of ordinary aggregates having low absorption shall be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173.
- F. The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. The results of tests on such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work.
- G. Cooperate in obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding and such incidental equipment as may be required. Repair all core holes. The work of cutting and testing the cores will be at the expense of the District.
- H. See Specification Section 03900 for Leak Testing.

3.08 FAILURE TO MEET REQUIREMENTS

- A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, the Engineer shall have the right to require changes in proportions outlined to apply to the remainder of the work. Furthermore, the Engineer shall have the right to require additional curing on those portions of the structure represented by the test specimens which failed. The cost of such additional curing shall be at the Contractor's expense. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the Engineer shall have the right to require strengthening or replacement of those portions of the structure which fail to develop the required strength. The cost of all such core borings and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be entirely at the expense of the Contractor. In such cases of failure to meet strength requirements the Contractor and Engineer shall confer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94. The "purchaser" referred to in ASTM C94 is the Contractor in this Section.
- B. When the tests on control specimens of concrete fall below the specified strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39. In the case of cores not indicating adequate strength, the Engineer, in addition to other recourses, may require, at the Contractor's expense, load tests on any one of the slabs, beams, piles, caps, and columns in which such concrete was used. Tests need not be made until concrete has aged 60 days.
- C. Should the strength of test cylinders fall below 60 percent of the required minimum 28 day strength, the concrete shall be rejected and shall be removed and replaced.

3.09 PATCHING AND REPAIRS

- A. It is the intent of this Section to require quality work including adequate forming, proper mixture and placement of concrete and curing so completed concrete surfaces will require no patching.
- B. Defective concrete and honeycombed areas as determined by the Engineer shall be repaired as specified by the Engineer.
- C. As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed; recesses left by the removal of form ties shall be filled; and surface defects which do not impair structural strength shall be repaired. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to approval of the Engineer.
- D. Immediately after removal of forms remove plugs and break off metal ties as required by Section 03100. Promptly fill holes upon stripping as follows: Moisten the hole with water, followed by a 1/16-in brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1 to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer the grout into the hole until dense, and an excess of paste appears on the surface in the form of a spiderweb. Trowel smooth with heavy pressure. Avoid burnishing.
- E. When patching exposed surfaces the same source of cement and sand as used in the parent concrete shall be employed. Adjust color if necessary by addition of proper amounts of white cement. Rub lightly with a fine Carborundum stone at an age of 1 to 5 days if necessary to bring the surface down with the parent concrete. Exercise care to avoid damaging or staining the virgin skin of the surrounding parent concrete. Wash thoroughly to remove all rubbed matter.

3.10 SCHEDULE

- A. The following (Table 4) are the general applications for the various concrete classes and design strengths:

Table 4
Concrete Schedule Design Strength

<u>Class</u>	<u>(psi)</u>	<u>Description</u>
A	2,500	Concrete fill and duct encasement
B	3,000	Concrete overlay slabs and pavements
C	4,000	Walls, slabs on grade, suspended slab and beam systems, columns, grade beams and all other structural concrete.
D	5,000	Prestressed concrete

END OF SECTION

**SECTION 03350
CONCRETE FINISHES**

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and finish cast-in-place concrete surfaces as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Concrete Formwork is included in Section 03100.
- B. Cast-In-Place Concrete is included in Section 03300.
- C. Grout is included in Section 03600

1.03 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:
 - 1. Concrete sealer. Confirmation that the sealer is compatible with additionally applied coatings shall also be submitted.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C33 – Standard Specification for Concrete Aggregates.
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. Finishes
 - 1. For concrete which will receive additional applied finishes or materials, the surface finish specified is required for the proper application of the specified manufacturer's products. Where alternate products are approved for use, determine if changes in finishes are required and provide the proper finishes to receive these products.
 - 2. Changes in finishes made to accommodate products different from those specified shall be performed at no additional cost to the District. Submit the proposed new finishes and their construction methods to the Engineer for approval.
 - 3. Services of Manufacturer's Representative

- A. Make available at no extra cost to the District, upon 72 hours notification, the services of a qualified field representative of the manufacturer of curing compound, sealer or hardener to instruct the user on the proper application of the product under prevailing job conditions.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Chemical hardener shall be Lapidolith by Sonneborn; Hornolith by A.C. Horn; Penalith by W.R. Meadows or equal fluosilicate base material.
- B. Concrete sealer shall be "MasterKure CC 180 WB", by Master Builders Solutions, Shakopee, MN or equal.

PART 3 - EXECUTION

3.01 FORMED SURFACES

- A. Forms shall not be removed before the requirements of Section 03300, have been satisfied.
- B. Exercise care to prevent damaging edges or obliterating the lines of chamfers, rustications or corners when removing the forms or performing any other work adjacent thereto.
- C. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.
 - 1. Rough-Form Finish
 - A. Immediately after stripping forms and before concrete has changed color, carefully remove all fins and projections.
 - B. Promptly fill holes left by tie cones and defects as specified in Section 03300.
- D. Rubbed Finish
 - 1. Immediately upon stripping forms and before concrete has changed color, carefully remove all fins. While the wall is still damp apply a thin coat of medium consistency neat cement slurry by means of bristle brushes to provide a bonding coat within all pits, air holes or blemishes in the parent concrete. Avoid coating large areas with the slurry at one time.
 - 2. Before the slurry has dried or changed color, apply a dry (almost crumbly) grout proportioned by volume and consisting of 1 part cement to 1-1/2 parts of clean masonry sand having a fineness modulus of approximately 2.3 and complying with the gradation requirements of ASTM C33 for such a material. Grout shall be uniformly applied by means of damp pads of coarse burlap approximately 6-in square used as a float. Scrub grout into the pits and air holes to provide a dense mortar in all imperfections.
 - 3. Allow the mortar to partially harden for 1 or 2 hours depending upon the weather. If the air is hot and dry, keep the wall damp during this period using

a fine, fog spray. When the grout has hardened sufficiently so it can be scraped from the surface with the edge of a steel trowel without damaging the grout in the small pits or holes, cut off all that can be removed with a trowel. (Note: Grout allowed to remain on the wall too long will harden and will be difficult to remove.)

4. Allow the surface to dry thoroughly and rub it vigorously with clean dry burlap to completely remove any dried grout. No visible film of grout shall remain after this rubbing. The entire cleaning operation for any area must be completed the day it is started. Do not leave grout on surfaces overnight. Allow sufficient time for grout to dry after it has been cutoff with the trowel so it can be wiped off clean with the burlap.
 5. On the day following the repair of pits, air holes and blemishes, the walls shall again be wiped off clean with dry, used pieces of burlap containing old hardened mortar which will act as a mild abrasive. After this treatment, there shall be no built-up film remaining on the parent surface. If, however, such a film is present, a fine abrasive stone shall be used to remove all such material without breaking through the surface film of the original concrete. Such scrubbing shall be light and sufficient only to remove excess material without changing the texture of the concrete.
 6. A thorough wash-down with stiff bristle brushes shall follow the final bagging or stoning operation. No extraneous materials shall remain on the surface of the wall. The wall shall be sprayed with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after the application of the repair grout.
 7. It is the intent of this finish to provide a surface that is uniform in appearance with no blemishes, imperfections, discolorations, etc.
- E. Abrasive Blast Finish
1. Coordinate with Rubbed Finish application. Do not begin until Rubbed Finish operation is complete or before concrete has reached minimum 7-day strength. The Rubbed Finish application may be deleted by the Engineer if the unfinished concrete surface is of superior quality. Apply the abrasive blast finish only where indicated on Drawings.
 2. Prepare a sample area of minimum 4-ft high by 16-ft wide Blast Finish as directed by Engineer on a portion of new wall construction which will not be exposed in the final work. Sample area shall contain a variety of finishes obtained with different nozzles, nozzle pressures, grit materials and blasting techniques for selection by Engineer. Final accepted sample shall remain exposed until completion of all Blast Finish operations.
 3. Blast finish operation shall meet all regulatory agency requirements. Blast Finish contractor shall be responsible for obtaining all required permits and/or licenses.
 4. Perform abrasive blast finishing in as continuous an operation as possible, utilizing the same work crew to maintain continuity of finish on each surface or

area of work. Maintain patterns or variances in depths of blast as present on the accepted sample.

5. Use an abrasive grit of proper type and gradation as well as equipment and technique to expose aggregate and surrounding matrix surfaces as follows:
6. Medium: Generally expose coarse aggregate - 1/4-in to 3/8-in reveal.
7. Abrasive blast corners and edge of patterns carefully, using back-up boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure and blasting techniques required to match Architect's samples.
8. Upon completion of the Blast Finish operation, thoroughly flush finished surfaces with clean clear water to remove residual dust and grit. Allow to air dry until curing of concrete is complete.
9. After the concrete has cured for a minimum of 28 days, apply a clear acrylic sealer as directed by manufacturer.

3.02 FLOORS AND SLABS

A. Floated Finish

1. Machine Floating

- A. Screed floors and slabs with straightedges to the established grades shown on the Drawings. Immediately after final screeding, a dry cement/sand shake in the proportion of two sacks of portland cement to 350 lbs of coarse natural concrete sand shall be sprinkled evenly over the surface at the rate of approximately 500 lbs /1,000 sq ft of floor. Do not sprinkle neat, dry cement on the surface.
- B. The application of the cement/sand shake may be eliminated at the discretion of the Engineer if the base slab concrete exhibits adequate fattiness and homogeneity and the need is not indicated. When the concrete has hardened sufficiently to support the weight of a power float without its digging into or disrupting the level surface, thoroughly float the shake into the surface with a heavy revolving disc type power compacting machine capable of providing a 200 lb compaction force distributed over a 24-in diameter disc.
- C. Start floating along walls and around columns and then move systematically across the surface leaving a matte finish.
- D. The compacting machine shall be the "Kelly Power Float with Compaction Control" as manufactured by Kelley Industries of SSP Construction Equipment Inc., Pomona, CA or equal. Troweling machines equipped with float (shoe) blades that are slipped over the trowel blades may be used for floating. Floating with a troweling machine equipped with normal trowel blades will not be permitted. The use of any floating or troweling machine which has a water attachment for wetting the concrete surface during finishing will not be permitted.

2. Hand Floating

- A. In lieu of power floating, small areas may be compacted by hand floating. The dry cement/sand shake previously specified shall be used unless specifically eliminated by the Engineer. Screed the floors and slabs with straightedges to the established grades shown on the Drawings. While the concrete is still green, but sufficiently hardened to support a finisher and kneeboards with no more than 1/4-in indentation, wood float to a true, even plane with no coarse aggregate visible. Use sufficient pressure on the wood floats to bring moisture to the surface.
3. Finishing Tolerances
- A. Level floors and slabs to a tolerance of plus or minus 1/8-in when checked with a 10-ft straightedge placed anywhere on the slab in any direction. Where drains occur, pitch floors to drains such that there are no low spots left undrained. Failure to meet either of the above requirements shall be cause for removal, grinding, or other correction as directed by the Engineer.
4. Broom Finish
- A. Screed slabs with straightedges to the established grades indicated on the Drawings. When the concrete has stiffened sufficiently to maintain small surface indentations, draw a stiff bristle broom lightly across the surface in the direction of drainage, or, in the case of walks and stairs, perpendicular to the direction of traffic to provide a non-slip surface.
- B. Steel Trowel Finish
- 1. Finish concrete as specified in Paragraph 3.04 and 3.05. Then, hand steel trowel to a perfectly smooth hard even finish free from high or low spots or other defects.
- C. Concrete Sealer
- 1. Prepare and seal surfaces indicated on the room finish schedule to receive a sealer as follows:
 - A. Finish concrete as specified in the preceding paragraphs and in accordance with the Schedule in Paragraph 3.05 below.
 - B. Newly Placed Concrete: Surface must be sound and properly finished. Surface is application-ready when it is damp but not wet and can no longer be marred by walking workmen.
 - C. Newly-Cured Bare Concrete: Level any spots gouged out by trades. Remove all dirt, dust, droppage, oil, grease, asphalt and foreign matter. Cleanse with caustics and detergents as required. Rinse thoroughly and allow to dry so that surface is no more than damp, and not wet.
 - D. Aged Concrete: Restore surface soundness by patching, grouting, filling cracks and holes, etc. Surface must also be free of any dust, dirt and other foreign matter. Use power tools and/or strippers to remove any incompatible sealers or coatings. Cleanse as required, following the procedure indicated under cured concrete.

- E. Methods: Apply sealer so as to form a continuous, uniform film by spray, soft-bristle pushbroom, long-nap roller or lambswool applicator. Ordinary garden-type sprayers, using neoprene hose, are recommended for best results.
- F. Applications: For curing only, apply first coat evenly and uniformly as soon as possible after final finishing at the rate of 200 to 400 sq ft per gallon. Apply second coat when all trades are completed and structure is ready for occupancy at the rate of 400 to 600 sq ft per gallon.
- G. To meet guarantee and to seal and dustproof, two coats are required. For sealing new concrete, both coats shall be applied full-strength. On aged concrete, when renovating, dustproofing and sealing, the first coat should be thinned 10 to 15 percent with reducer per manufacturer's directions.

3.03 CONCRETE RECEIVING CHEMICAL HARDENER

- A. After 28 days, minimum, concrete cure, apply chemical hardener in three applications to a minimum total coverage of the undiluted chemical of 100 sq ft per gallon and in accordance with manufacturer's recommendations as reviewed.

3.04 APPROVAL OF FINISHES

- A. All concrete surfaces, when finished, will be inspected by the Engineer.
- B. Surfaces which, in the opinion of the Engineer, are unsatisfactory shall be refinished or reworked.
- C. After finishing horizontal surfaces, regardless of the finishing procedure specified, the concrete shall be cured in compliance with Section 03300 unless otherwise directed by the Engineer.

3.05 SCHEDULE OF FINISHES

- A. Concrete shall be finished as specified either to remain as natural concrete to receive an additional applied finish or material under another section.
- B. Concrete for the following conditions shall be finished as noted on the Drawings and as further specified herein:
 1. Concrete to Receive Dampproofing: Rough-form finish. See Paragraph 3.01D above.
 2. Concrete Not Exposed to View and Not Scheduled to Receive an Additional Applied Finish or Material: Rough-form finish. See Paragraph 3.01D above.
 3. Exterior Vertical Concrete Above Grade Exposed to View: Rubbed finish. See Paragraph 3.01E above.
 4. Interior Vertical Concrete Exposed to View Except in Water Containment Areas: Rubbed finish. See Paragraph 3.01E above.
 5. Vertical Concrete in Water Containment Areas. Rubbed finish on exposed surfaces and extending to two feet below normal operating water level:

Rough-form finish on remainder of submerged areas. See Paragraphs 3.01E and 3.01D above.

6. Interior and Exterior Underside of Concrete Exposed to View: Rubbed finish. See Paragraph 3.01E above.
7. Exterior surfaces exposed to view and indicated to have an abrasive blast finish. See Paragraph 3.01F above.
8. Interior or Exterior Horizontal Concrete not Requiring Floor Hardener or Sealer: Floated finish. See Paragraph 3.02A above.
9. Concrete for Exterior Walks, Interior and Exterior Stairs: Broomed finish perpendicular to direction of traffic. See Paragraph 3.02B above.
10. Concrete Slabs On Which Process Liquids Flow or In Contact with Sludge: Steel trowel finish. See Paragraph 3.02C above.
11. Concrete to Receive Hardener: See Paragraph 3.03 above.
12. Concrete to Receive Floor Sealer: See Paragraph 3.02D above.
13. Concrete tank bottoms to be covered with grout: See Section 03600.

END OF SECTION

SECTION 03600 GROUT

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install grout complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Formwork is included in Section 03100.
- B. Concrete Reinforcement is included in Section 03200.
- C. Concrete Joints and Joint Accessories are included in Section 03350.
- D. Cast-in-Place Concrete is included in Section 03300.

1.03 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:
 - 1. Commercially manufactured nonshrink cementitious grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature consideration, conformity to required ASTM standards and Material Safety Data Sheet.
 - 2. Commercially manufactured nonshrink epoxy grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards and Material Safety Data Sheet.
 - 3. Cement grout. The submittal shall include the type and brand of the cement, the gradation of the fine aggregate, product data on any proposed admixtures and the proposed mix of the grout.
 - 4. Concrete grout. The submittal shall include data as required for concrete as delineated in Section 03300 and for fiber reinforcement as delineated in Section 03 20 00. This includes the mix design, constituent quantities per cubic yard and the water/cement ratio.
- B. Laboratory Test Reports
 - 1. Submit laboratory test data is required under Section 03300 for concrete to be used as concrete grout.
- C. Certifications

1. Certify that commercially manufactured grout products and concrete grout admixtures are suitable for use in contact with potable water after 30 days curing.

D. Qualifications

1. Grout manufacturers shall submit documentation that they have at least 10 years experience in the production and use of the proposed grouts which they will supply.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts and Monolithic Surfacing and Polymer Concretes
2. ASTM C579 - Standard Test Method for Compressive Strength of Chemical Resistant Mortars, Grouts and Monolithic Surfacing and Polymer Concretes
3. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
4. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

B. U.S. Army Corps of Engineers Standard (CRD)

1. CRD C-621 - Corps of Engineers Specification for Nonshrink Grout

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Grout manufacturer shall have a minimum of 10 years experience in the production and use of the type of grout proposed for the work.

B. Pre-installation Conference

1. Well in advance of grouting, hold a pre-installation meeting to review the requirements for surface preparation, mixing, placing and curing procedures for each product proposed for use. Parties concerned with grouting shall be notified of the meeting at least 10 days prior to its scheduled date.

C. Services of Manufacturer's Representative

1. A qualified field technician of the nonshrink grout manufacturer, specifically trained in the installation of the products, shall attend the pre-installation conference and shall be present for the initial installation of each type of nonshrink grout. Additional services shall also be provided, as required, to correct installation problems.

D. Field Testing

1. All field testing and inspection services required shall be provided by the District. The Contractor shall assist in the sampling of materials and shall provide any ladders, platforms, etc, for access to the work. The methods of testing shall comply in detail with the applicable ASTM Standards.
2. The field testing of Concrete Grout shall be as specified for concrete in Section 03300.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers and printed instructions.
- B. Store materials in full compliance with the manufacturer's recommendations. Total storage time from date of manufacture to date of installation shall be limited to 6 months or the manufacturer's recommended storage time, whichever is less.
- C. Material which becomes damp or otherwise unacceptable shall be immediately removed from the site and replaced with acceptable material at no additional expense to the District.
- D. Nonshrink cement-based grouts shall be delivered as preblended, prepackaged mixes requiring only the addition of water.
- E. Nonshrink epoxy grouts shall be delivered as premeasured, prepackaged, three component systems requiring only blending as directed by the manufacturer.

1.07 DEFINITIONS

- A. Nonshrink Grout: A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state and bonds to a clean base plate.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The use of a manufacturer's name and product or catalog number is for the purpose of establishing the standard of quality desired.
- B. Like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

2.02 MATERIALS

A. Nonshrink Cementitious Grout

1. Nonshrink cementitious grouts shall meet or exceed the requirements of ASTM C1107, Grades B or C and CRD C-621. Grouts shall be portland cement based, contain a pre-proportioned blend of selected aggregates and shrinkage compensating agents and shall require only the addition of water. Nonshrink cementitious grouts shall not contain expansive cement or metallic particles.

The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827.

- A. General purpose nonshrink cementitious grout shall conform to the standards stated above and shall be SikaGrout 212 by Sika Corp.; Set Grout by Master Builders, Inc.; Gilco Construction Grout by Gifford Hill & Co.; Euco NS by the Euclid Chemical Co.; NBEC Grout by U.S. Grout Corp. or equal.
- B. Flowable (Precision) nonshrink cementitious grout shall conform to the standards stated above and shall be Masterflow 928 by Master Builders, Inc.; Hi-Flow Grout by the Euclid Chemical Co.; SikaGrout 212 by Sika Corp. ; Supreme Grout by Gifford Hill & Co. ; Five Star Grout by U.S. Grout Corp. or equal.

B. Nonshrink Epoxy Grout

- 1. Nonshrink epoxy-based grout shall be a pre-proportioned, three component, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a compressive strength of 14,000 psi in 7 days when tested in conformity with ASTM D695 and have a maximum thermal expansion of 30×10^{-6} when tested in conformity with ASTM C531. The grout shall be Ceilcote 648 CP by Master Builders Inc.; Five Star Epoxy Grout by U.S. Grout Corp.; Sikadur 42 Grout-Pak by Sika Corp.; High Strength Epoxy Grout by the Euclid Chemical Co. or equal.

C. Cement Grout

- 1. Cement grouts shall be a mixture of one part portland cement conforming to ASTM C150, Types I, II, or III and 1 to 2 parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout but not to the degree that it will allow the grout to flow.

D. Concrete Grout

- 1. Concrete grout shall conform to the requirements of Section 03300 except as specified herein. It shall be proportioned with cement, coarse and fine aggregates, water, water reducer and air entraining agent to produce a mix having an average strength of 2900 psi at 28 days, or 2500 psi nominal strength. Coarse aggregate size shall be 1/2-in maximum. Slump should not exceed 5-in and should be as low as practical yet still retain sufficient workability.
- 2. Synthetic reinforcing fibers as specified in Section 03200 shall be added to the concrete grout mix at the rate of 1.5 lbs of fibers per cubic yard of grout. Fibers shall be added from the manufacturer's premeasured bags and according to the manufacturer's recommendations in a manner which will ensure complete dispersion of the fiber bundles as single monofilaments within the concrete grout.

E. Water

1. Potable water, free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Grout shall be placed over cured concrete which has attained its full design strength unless otherwise approved by the Engineer.
- B. Concrete surfaces to receive grout shall be clean and sound; free of ice, frost, dirt, grease, oil, curing compounds, laitance and paints and free of all loose material or foreign matter which may effect the bond or performance of the grout.
- C. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to a minimum of ¼" amplitude or provide a raked finish in order to ensure bond of the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.
 1. Air compressors used to clean surfaces in contact with grout shall be the oilless type or equipped with an oil trap in the air line to prevent oil from being blown onto the surface.
- D. Remove all loose rust, oil or other deleterious substances from metal embedments or bottom of baseplates prior to the installation of the grout.
- E. Concrete surfaces shall be washed clean and then kept moist for at least 24 hours prior to the placement of cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, flooding the surface, or other method acceptable to the Engineer. Upon completion of the 24 hour period, visible water shall be removed from the surface prior to grouting. The use of an adhesive bonding agent in lieu of surface saturation shall only be used when approved by the Engineer for each specific location of grout installation.
- F. Epoxy-based grouts do not require the saturation of the concrete substrate. Surfaces in contact with epoxy grout shall be completely dry before grouting.
- G. Construct grout forms or other leakproof containment as required. Forms shall be lined or coated with release agents recommended by the grout manufacturer. Forms shall be of adequate strength, securely anchored in place and shored to resist the forces imposed by the grout and its placement.
- H. Forms for epoxy grout shall be designed to allow the formation of a hydraulic head and shall have chamfer strips built into forms.
- I. Level and align the structural or equipment bearing plates in accordance with the structural requirements and the recommendations of the equipment manufacturer.
- J. Equipment shall be supported during alignment and installation of grout by shims, wedges, blocks or other approved means. The shims, wedges and blocking devices shall be prevented from bonding to the grout by appropriate bond breaking coatings and removed after grouting unless otherwise approved by the Engineer.

3.02 INSTALLATION – GENERAL

- A. Mix, apply and cure products in strict compliance with the manufacturer's recommendations and this Section.
- B. Have sufficient manpower and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.
- C. Maintain temperatures of the foundation plate, supporting concrete, and grout between 40 and 90 degrees F during grouting and for at least 24 hours thereafter or as recommended by the grout manufacturer, whichever is longer. Take precautions to minimize differential heating or cooling of baseplates and grout during the curing period.
- D. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperatures and/or the temperature of the materials in contact with the grout are outside of the 60 and 90 degrees F range.
- E. Install grout in a manner which will preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or control joint.
- F. Reflect all existing underlying expansion, control and construction joints through the grout.

3.03 INSTALLATION - CEMENT GROUTS AND NONSHRINK CEMENTITIOUS GROUTS

- A. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel or admixtures without prior approval by the Engineer.
- B. Avoid mixing by hand. Mixing in a mortar mixer (with moving blades) is recommended. Pre-wet the mixer and empty excess water. Add premeasured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.
- C. Placements greater than 3-in in depth shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.
- D. Place grout into the designated areas in a manner which will avoid segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Placement should proceed in a manner which will ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
- E. Place grout rapidly and continuously to avoid cold joints. Do not place cement grouts in layers. Do not add additional water to the mix (retemper) after initial stiffening.

- F. Just before the grout reaches its final set, cut back the grout to the substrate at a 45 degree angle from the lower edge of bearing plate unless otherwise approved by the Engineer. Finish this surface with a wood float (brush) finish.
- G. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer. Saturate the grout surface by use of wet burlap, soaker hoses, ponding or other approved means. Provide sunshades as necessary. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

3.04 INSTALLATION - NONSHRINK EPOXY GROUTS

- A. Mix in accordance with the procedures recommended by the manufacturer. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not overmix. Mix full batches only to maintain proper proportions of resin, hardener and aggregate.
- B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 or above 90 degrees F.
- C. Place grout into the designated areas in a manner which will avoid trapping air. Placement methods shall ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
- D. Minimize "shoulder" length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.
- E. Finish grout by puddling to cover all aggregate and provide a smooth finish. Break bubbles and smooth the top surface of the grout in conformity with the manufacturer's recommendations.
- F. Epoxy grouts are self curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placing, or longer if recommended by the manufacturer.

3.05 INSTALLATION - CONCRETE GROUT

- A. Screed underlying concrete to the grade shown on the Drawings. Prepare the surface according to 3.01B. Protect and keep the surface clean until placement of concrete grout.
- B. Remove the debris and clean the surface by sweeping and vacuuming of all dirt and other foreign materials. Wash the tank slab using a strong jet of water. Flushing of debris into tank drain lines will not be permitted.
- C. Saturate the concrete surface for at least 24 hours prior to placement of the concrete grout. Saturation may be maintained by ponding, by the use of soaker hoses, or by other methods acceptable to the Engineer. Remove excess water just prior to placement of the concrete grout. Place a cement slurry immediately ahead of the concrete grout so that the slurry is moist when the grout is placed. Work the slurry over the surface

with a broom until it is coated with approximately 1/16 to 1/8-in thick cement paste. (A bonding grout composed of 1 part portland cement, 1.5 parts fine sand, an approved bonding admixture and water, mixed to achieve the consistency of thick paint, may be substituted for the cement slurry.)

- D. Place concrete grout to final grade using the scraper mechanism as a guide for surface elevation and to ensure high and low spots are eliminated. Unless specifically approved by the equipment manufacturer, mechanical scraper mechanisms shall not be used as a finishing machine or screed.
- E. Provide grout control joints as indicated on the Drawings.
- F. Finish and cure the concrete grout as specified for cast-in-place concrete.

3.06 SCHEDULE

- A. The following list indicates where the particular types of grout are to be used:
- B. General purpose nonshrink cementitious grout: Use at all locations where non shrink grout is called for on the plans except for base plates greater in area than 3-ft wide by 3-ft long and except for the setting of anchor rods, anchor bolts or reinforcing steel in concrete.
- C. Flowable nonshrink cementitious grout: Use under all base plates greater in area than 3-ft by 3-ft. Use at all locations indicated to receive flowable nonshrink grout by the Drawings. The Contractor, at his/her option and convenience, may also substitute flowable nonshrink grout for general purpose nonshrink cementitious grout..
- D. Nonshrink epoxy grout: Use for the setting of anchor rods, anchor bolts and reinforcing steel in concrete and for all locations specifically indicated to receive epoxy grout.
- E. Cement grout: Cement grout may be used for grouting of incidental base plates for structural and miscellaneous steel such as post base plates for platforms, base plates for beams, etc. It shall not be used when nonshrink grout is specifically called for on the Drawings or for grouting of primary structural steel members such as columns and girders.
- F. Concrete grout: Use for overlaying the base concrete under scraper mechanisms of clarifiers to allow more control in placing the surface grade.

END OF SECTION

**SECTION 03740
MODIFICATIONS AND REPAIR TO CONCRETE**

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and cut, remove, repair or otherwise modify parts of existing concrete structures or appurtenances as shown on the Drawings and as specified herein. Work under this Section shall also include bonding new concrete to existing concrete.

1.02 RELATED WORK

- A. Concrete Formwork is included in Section 03100.
- B. Concrete Reinforcement is included in Section 03200.
- C. Concrete Joints and Accessories are included in Section 03150.
- D. Cast-in-Place Concrete is included in Section 03300.
- E. Concrete Finishes are included in Section 03350.
- F. Grout is included in Section 03600.

1.03 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, a schedule of Demolition and the detailed methods of demolition to be used at each location.
- B. Submit manufacturer's technical literature on all product brands proposed for use, to the Engineer for review. The submittal shall include the manufacturer's installation and/or application instructions.
- C. When substitutions for acceptable brands of materials specified herein are proposed, submit brochures and technical data of the proposed substitutions to the Engineer for approval before delivery to the project.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C881 – Standards Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - 2. ASTM C882 – Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
 - 3. ASTM C883 – Standard Test Method for Effective Shrinkage of Epoxy-Resin Systems Used with Concrete.
 - 4. ASTM D570 – Standard Test Method for Water Absorption of Plastics

5. ASTM D638 – Standard Test Method for Tensile Properties of Plastics.
 6. ASTM D695 – Standard Test Method for Compressive Properties of Rigid Plastics.
 7. ASTM D732 – Standard Test Method for Shear Strength of Plastics by Punch Tool.
 8. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. No existing structure or concrete shall be shifted, cut, removed, or otherwise altered until authorization is given by the Engineer.
- B. When removing materials or portions of existing structures and when making openings in existing structures, all precautions shall be taken and all necessary barriers, shoring and bracing and other protective devices shall be erected to prevent damage to the structures beyond the limits necessary for the new work, protect personnel, control dust and to prevent damage to the structures or contents by falling or flying debris. Unless otherwise permitted, shown or specified, line drilling will be required in cutting existing concrete.
- C. **Manufacturer Qualifications:** The manufacturer of the specified products shall have a minimum of 10 years experience in the manufacture of such products and shall have an ongoing program of training, certifying and technically supporting the Contractor's personnel.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver the specified products in original, unopened containers with the manufacturer's name, labels, product identification and batch numbers.
- B. Store and condition the specified product as recommended by the manufacturer.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General
 1. Materials shall comply with this Section and any state or local regulations.
- B. Epoxy Bonding Agent
 1. General
 - A. The epoxy bonding agent shall be a two-component, solvent-free, asbestos-free moisture insensitive epoxy resin material used to bond plastic concrete to hardened concrete complying with the requirements

of ASTM C881, Type II and the additional requirements specified herein.

2. Material

A. Properties of the cured material

- I. Compressive Strength (ASTM D695): 8500 psi minimum at 28 days.
- II. Tensile Strength (ASTM D638): 4000 psi minimum at 14 days.
- III. Flexural Strength (ASTM D790 - Modulus of Rupture): 6,300 psi minimum at 14 days.
- IV. Shear Strength (ASTM D732): 5000 psi minimum at 14 days.
- V. Water Absorption (ASTM D570 - 2 hour boil): One percent maximum at 14 days.
- VI. Bond Strength (ASTM C882) Hardened to Plastic: 1500 psi minimum at 14 days moist cure.
- VII. Effective Shrinkage (ASTM C883): Passes Test.
- VIII. Color: Gray.

3. Approved manufacturers include: Sika Corporation, Lyndhurst, NJ - Sikadur 32, Hi-Mod; Master Builder's, Cleveland, OH - Concrecive Liquid (LPL) or equal.

C. Epoxy Paste

1. General

- A. Epoxy Paste shall be a two-component, solvent-free, asbestos free, moisture insensitive epoxy resin material used to bond dissimilar materials to concrete and shall comply with the requirements of ASTM C881, Type I, Grade 3 and the additional requirements specified herein. It may also be used to patch existing surfaces where the glue line is 1/8-in or less.

2. Material

A. Properties of the cured material:

- I. Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
- II. Tensile Strength (ASTM D638): 3,000 psi minimum at 14 days. Elongation at Break - 0.3 percent minimum.
- III. Flexural Strength (ASTM D790 - Modulus of Rupture): 3,700 psi minimum at 14 days.
- IV. Shear Strength (ASTM D732): 2,800 psi minimum at 14 days.
- V. Water Absorption (ASTM D570): 1.0 percent maximum at 7 days.
- VI. Bond Strength (ASTM C882): 2,000 psi at 14 days moist cure.
- VII. Color: Concrete grey.

3. Approved manufacturer's include:

- A. Sika Corporation, Lyndhurst, N.J. - Sikadur Hi-mod LV 32; Master Builders, Inc., Cleveland, OH - Concrecive 1438 or equal.
 - B. Overhead applications: Sika Corporation, Lyndhurst, NJ - Sikadur Hi-mod LV 31; Master Builders, Inc., Cleveland, OH - Concrecive 1438 or equal.
- D. Repair Mortar
 - 1. General
 - A. Repair mortal shall be a two-component, polymer modified, cement based, fast-setting, trowel grade, structural repair mortar suitable for use on horizontal, vertical and overhead surfaces prepackaged product specifically formulated for the repair of concrete surface defects.
 - 2. Material
 - A. Properties of the cured material:
 - I. Compressive Strength (2 hours 50 percent RH) – 150 psi minimum
 - II. Compressive Strength (28 days 50 percent RH) – 150 psi minimum
 - III. Bond Strength (pull off method) – 100 percent concrete substrate failure
 - IV. This system shall conform with ANSI/NSF standards for surface contact with potable water.
 - 3. Approved manufacturer's include:
 - A. Sika Corporation, Lyndhurst, N.J. – SikaTop 122 PLUS or equal.
 - B. Overhead applications: Sika Corporation, Lyndhurst, N.J. – SikaTop 123 PLUS or equal.
- E. Non-Shrink Precision Cement Grout, Non-Shrink Cement Grout, Non-Shrink Epoxy Grout and Polymer Modified mortar are included in Section 03600 GROUT.
- F. Adhesive Capsule type anchor system shall be equal to the HVA adhesive Anchoring System by Hilti Fastening Systems, Tulsa, OK. The capsule shall consist of a sealed glass capsule containing premeasured amounts of polyester or vinylester resin, quartz sand aggregate and a hardener contained in a separate vial within the capsule. Where the adhesive anchor is under sustained tensile loading (i.e. vertically installed anchors) the anchor system shall be Hilti HIT RE-500 SD by Hilti Fastening Systems, Tulsa, OK.
- G. Acrylic Latex Bonding Agents shall not be used for this project.
- H. Crack Repair Epoxy Adhesive
 - 1. General
 - A. Crack Repair Epoxy Adhesive shall be a two-component, solvent-free, moisture insensitive epoxy resin material suitable for crack grouting by

injection or gravity feed. It shall be formulated for the specific size of opening or crack being injected.

- B. All concrete surfaces containing potable water or water to be treated for potable use that are repaired by the epoxy adhesive injection system shall be coated with an acceptable epoxy coating system that conforms with ANSI/NSF standards for surface contact with potable water.

2. Material

A. Properties of the cured material

- I. Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
- II. Tensile Strength (ASTM D638): 5,300 psi minimum at 14 days. Elongation at Break - 2 to 5 percent.
- III. Flexural Strength (ASTM D790 - Modulus of Rupture): 12,000 psi minimum at 14 days (gravity); 4,600 psi minimum at 14 days (injection)
- IV. Shear Strength (ASTM D732): 3,700 psi minimum at 14 days.
- V. Water Absorption (ASTM D570 - 2 hour boil): 1.5 percent maximum at 7 days.
- VI. Bond Strength (ASTM C882): 2,000 psi at 2 days dry; 1,400 psi at 14 days dry plus 12 days moist.
- VII. Effective Shrinkage (ASTM 883): Passes Test.

3. Approved manufacturer's include:

- A. For standard applications: Sika Corporation, Lyndhurst, NJ - Sikadur Hi-Mod; Master Builders Inc., Cleveland, OH - Concessive 1380 or equal.
- B. For very thin applications; Sika Corporation, Lyndhurst, NJ - Sikadur Hi-Mod LV; Master Builders Inc., Cleveland, OH - Concessive 1468 or equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Cut, repair, reuse, demolish, excavate or otherwise modify parts of the existing structures or appurtenances, as indicated on the Drawings, specified herein, or necessary to permit completion of the Work. Finishes, joints, reinforcements, sealants, etc, are specified in respective Sections. All work shall comply with other requirements of this of Section and as shown on the Drawings.
- B. All commercial products specified in this Section shall be stored, mixed and applied in strict compliance with the manufacturer's recommendations.
- C. In all cases where concrete is repaired in the vicinity of an expansion joint or control joint the repairs shall be made to preserve the isolation between components on either side of the joint.

- D. When drilling holes for dowels/bolts at new or existing concrete, drilling shall stop if rebar is encountered. As approved by the Engineer, the hole location shall be relocated to avoid rebar. Rebar shall not be cut without prior approval by the Engineer. Where possible, rebar locations shall be identified prior to drilling using "rebar locators" so that drilled hole locations may be adjusted to avoid rebar interference.

3.02 CONCRETE REMOVAL

- A. Concrete designated to be removed to specific limits as shown on the Drawings or directed by the Engineer, shall be done by line drilling at limits followed by chipping or jack-hammering as appropriate in areas where concrete is to be taken out. Remove concrete in such a manner that surrounding concrete or existing reinforcing to be left in place and existing in place equipment is not damaged. Sawcutting at limits of concrete to be removed shall only be done if indicated on the Drawings, or after obtaining written approval from the Engineer.
- B. Where existing reinforcing is exposed due to saw cutting/core drilling and no new material is to be placed on the sawcut surface, a coating or surface treatment of epoxy paste shall be applied to the entire cut surface to a thickness of 1/4-in.
- C. In all cases where the joint between new concrete or grout and existing concrete will be exposed in the finished work, except as otherwise shown or specified, the edge of concrete removal shall be a 1-in deep saw cut on each exposed surface of the existing concrete.
- D. Concrete specified to be left in place which is damaged shall be repaired by approved means to the satisfaction of the Engineer.
- E. The Engineer may from time to time direct the Contractor to make additional repairs to existing concrete. These repairs shall be made as specified or by such other methods as may be appropriate.

3.03 SURFACE PREPARATION

- A. Connection surfaces shall be prepared as specified below for concrete areas requiring patching, repairs or modifications as shown on the Drawings, specified herein, or as directed by the Engineer.
- B. Remove all deteriorated materials, dirt, oil, grease, and all other bond inhibiting materials from the surface by dry mechanical means, i.e. - sandblasting, grinding, etc, as approved by the Engineer. Be sure the areas are not less than 1/2-in in depth. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded into parent concrete, subject to the Engineer's final inspection.
- C. If reinforcing steel is exposed, it must be mechanically cleaned to remove all contaminants, rust, etc, as approved by the Engineer. If half of the diameter of the reinforcing steel is exposed, chip out behind the steel. The distance chipped behind the steel shall be a minimum of 1/2-in. Reinforcing to be saved shall not be damaged during the demolition operation.
- D. Reinforcing from existing demolished concrete which is shown to be incorporated in new concrete shall be cleaned by mechanical means to remove all loose material and

products of corrosion before proceeding with the repair. It shall be cut, bent or lapped to new reinforcing as shown on the Drawings and provided with a minimum cover all around as specified on the contract drawings or 2-in.

- E. The following are specific concrete surface preparation "methods" are to be used where called for on the Drawings, specified herein or as directed by the Engineer. All installation of anchors shall be according to the manufacturer's recommendations.
1. Method A: After the existing concrete surface at connection has been roughened and cleaned, thoroughly moisten the existing surface with water. Brush on a 1/16-in layer of cement and water mixed to the consistency of a heavy paste. Immediately after application of cement paste, place new concrete or grout mixture as detailed on the Drawings.
 2. Method B: After the existing concrete surface has been roughened and cleaned, apply epoxy bonding agent at connection surface. The field preparation and application of the epoxy bonding agent shall comply strictly with the manufacturer's recommendations. Place new concrete or grout mixture to limits shown on the Drawings within time constraints recommended by the manufacturer to ensure bond.
 3. Method C: Drill a hole 1/4-in larger than the diameter of the dowel. The hole shall be blown clear of loose particles and dust just prior to installing epoxy. The drilled hole shall first be filled with epoxy paste, and then dowels/bolts shall be buttered with paste then inserted by tapping. Unless otherwise shown on the Drawings, deformed bars shall be drilled and set to a depth of ten bar diameters and smooth bars shall be drilled and set to a depth of fifteen bar diameters. If not noted on the Drawings, the Engineer will provide details regarding the size and spacing of dowels.
 4. Method D: Combination of Method B and C.
 5. Method E: Capsule anchor system shall be set in existing concrete by drilling holes to the required depth to develop the full tensile and shear strengths of the anchor material being used. The anchor bolts system shall be installed per the manufacturer's recommendation in holes sized as required. The anchor stud bolt, rebar or other embedment item shall be tipped with a double 45 degree chamfered point, securely fastened into the chuck of all rotary percussion hammer drill and drilled into the capsule filled hole.

3.04 GROUTING

- A. Grouting shall be as specified in Section 03600.

3.05 CRACK REPAIR

- A. Cracks on horizontal surfaces shall be repaired by gravity feeding crack sealant into cracks per manufacturer's recommendations. If cracks are less than 1/16-in in thickness they shall be pressure injected.

- B. Cracks on vertical surfaces shall be repaired by pressure injecting crack sealant through valves sealed to surface with crack repair epoxy adhesive per manufacturer's recommendations.

END OF SECTION

**SECTION 05500
MISCELLANEOUS METAL**

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and cut, remove, repair or otherwise modify parts of existing concrete structures or appurtenances as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Concrete joint accessories are included in Section 03150.

1.03 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:

- 1. Shop drawings, showing sizes of members, method of assembly, anchorage and connection to other members.

- B. Samples

- 1. Submit samples as requested by the Engineer during the course of construction.

- C. Design Data

- 1. Submit calculations sealed by a professional engineer registered in the State of Florida or submit load tables and test data demonstrating that the railing and their attachments will resist the loads specified in the 2017 Florida Building Code at the post spacing provided.

- 2. Submit manufacturer's load and deflection tables for grating.

- D. Test Reports

- 1. Certified copy of mill test reports on each aluminum proposed for use showing the physical properties and chemical analysis.

- E. Certificates

- 1. Submit certification that the railing system is in compliance with OSHA requirements and the 2017 Florida Building Code.

- 2. Certify that welders have been qualified under AWS, within the previous 12 months, to perform the welds required under this Section.

1.04 REFERENCE STANDARDS

- A. Aluminum Association (AA)

1. ABH-21 Aluminum Brazing Handbook
 2. ASD-1 Aluminum Standards and Data
 3. DAF-45 Designation System for Aluminum Finishes
 4. SAA-46 Standards for Anodized Architectural Aluminum
- B. American Society for Testing and Materials (ASTM)
1. ASTM A36 – Standard Specification for Carbon Structural Steel.
 2. ASTM A48 – Standard Specification for Gray Iron Castings.
 3. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 4. ASTM A108 – Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
 5. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 6. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 7. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
 8. ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes.
 9. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 Psi Tensile Strength.
 10. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 11. ASTM A366 - Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
 12. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 13. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 14. ASTM A536 - Standard Specification for Ductile Iron Castings.
 15. ASTM A570 - Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.
 16. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 17. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
 18. ASTM B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

19. ASTM F593 – Standard Specification for Stainless Steel Bolts, Hex Caps Screws, and Studs.
 20. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- C. American Iron and Steel Institute (AISI).
1. Specification for Structural Steel Buildings.
- D. American Welding Society (AWS)
1. AWS D1.1 - Structural Welding Code Steel.
 2. AWS D1.2 - Structural Welding Code Aluminum.
 3. AWS D1.6 - Structural Welding Code Stainless Steel.
- E. Occupational Safety and Health Administration (OSHA)
- F. 2017 Florida Building Code. (FBC)
- G. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. The work of this Section shall be completely coordinated with the work of other Sections. Verify, at the site, both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.
- B. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.
- C. All welding shall be performed by qualified welders and shall conform to the applicable AWS welding code. Welding of steel shall conform to AWS D1.1 and welding of aluminum shall conform to AWS D1.2.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.
- B. Repair items which have become damaged or corroded to the satisfaction of the Engineer prior to incorporating them into the work.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance and manufacturer's service.

2.02 MATERIALS

A. Unless otherwise noted, materials for miscellaneous metals shall conform to the following standards:

1. Structural Steel
 - A. W Shapes: ASTM A992, Gr.50
 - B. M Shapes: ASTM A36
 - C. S, C and MC Shapes: ASTM A36
 - D. L Shapes: ASTM A36
 - E. Plates, rods and Bars: ASTM A36
2. HSS Rectangular Shapes: ASTM A500, Grade B, 42 ksi
3. HSS Round Shapes: ASTM A500, Grade B, 35 ksi
4. Welded and Seamless Steel Pipe: ASTM A501 or ASTM A53,
5. Type E or S, Grade B Schedule 40. Use standard malleable iron fittings, galvanized for exterior work
6. Steel Sheets: ASTM A366
7. Gray Iron Castings: ASTM A48, Class 35
8. Ductile Iron Castings: ASTM A536, Grade 65-45-12
9. Aluminum Extruded Pipe: ASTM B429, Alloy 6063 T6
10. Aluminum Extruded Shapes: ASTM B221, Alloy 6061 T6
11. Aluminum Sheet and Plate: ASTM B209, Alloy 6061 T6
12. Stainless Steel Plates, Sheets, and Structural Shapes
 - A. Exterior, Submerged or Industrial Use: ASTM A240, Type 316 (Type 316L for welded)
 - B. Interior and Architectural Use: ASTM A240, Type 304
13. Stainless Steel Bolts, Nuts, and Washers: ASTM A276, Type 316
14. Carbon Steel Bolts and Studs: ASTM A307, Grade A or ASTM F1154, Gr. 36 (galvanized unless noted otherwise)
15. High Strength Steel Bolts, Nuts and washers: ASTM A325 (mechanically Galvanized per ASTM B695, Class 50, where noted)
 - a. Elevated Temperature Exposure: Type I
 - B. General Application: Type I or Type II
16. Galvanizing: ASTM A123 Zn w/0.5
17. Percent minimum Ni

18. Galvanizing, hardware ASTM A153, Zn w/0.5
19. percent minimum

2.03 ANCHORS, BOLTS AND FASTENING

- A. Furnish anchors, bolts, fasteners, etc., as necessary for installation of the work of this section or as specified for securing the work of other sections.
- B. Anchor bolt material shall be ASTM F1154, Grade 36, or ASTM A307, Grade A standard headed bolts with heavy hex nuts, Grade A washers, hot-dipped galvanized, unless noted otherwise on drawings.
- C. Unless otherwise noted, bolts for the connection of carbon steel or iron shall be steel bolts; bolts for the connection of galvanized steel or iron shall be galvanized steel or stainless steel bolts; and bolts for the connection of aluminum or stainless steel shall be stainless steel bolts.
- D. Unless otherwise noted, expansion anchors shall be zinc plated carbon steel wedge type anchors complete with nuts and washers. Type 316 stainless steel, wedge type anchors shall be used where they will be submerged or exposed to the weather or where stainless steel wedge type anchors are required. When the length or embedment of the bolt is not noted on the Drawings, provide length sufficient to place the wedge and expansion sleeve portion of the bolt at least 1-in behind the concrete reinforcing steel. Expansion anchors shall be Hilti, Kwick-bolt III; ITW Ramset; Redhead trubolt, or equal.
- E. Unless otherwise noted, adhesive anchors shall be a two-component chemical resin anchoring system. Capsules shall be self-contained, exactly premeasured amounts of polyester or vinyl ester resin, aggregate and hardener. Stud assemblies shall consist of a stainless steel type 316 all-thread anchor rod with nut and washer. Provide manufacturer's recommended installation tools for installing anchor components. Install anchors in full compliance with the manufacturer's recommendations. Adhesive anchor system shall be Hilti, HIT-RE 500-SD; Simpson Strong Tie, SET-XP Epoxy-Tie or Acrylic Tie; or approved equal.
- F. Anchors used in masonry construction shall be as indicated in Section 2.03.C above where anchors are installed into solid grouted cells. Additional, Hilti, HIY-HY150 MAX adhesive anchoring system, or approved equal, may also be used in grouted masonry construction. When fastening to hollow concrete block or brick, adhesive anchors shall be a three-part stud, screen and chemical dispenser anchoring system. Adhesive cartridges shall contain premeasured amounts of resin and hardener which are mixed and deposited in a screen tube by a dispenser. Stud assemblies shall consist of a stainless steel type 316 all-thread anchor rod with nut and washer. Anchors shall be Hilti, HIT HY-20 System or approved equal.
- G. Automatic end welded headed anchor studs shall be flux ended studs made from cold drawn steel, ASTM A108 Grades C-1010 through C-1020. Headed anchor studs shall be Nelson, H4L Headed Concrete Anchors or equal.
- H. Machine bolts and nuts shall conform to Federal Specification FF-B-575C. Bolts and nuts shall be hexagon type. Bolts, nuts, screws, washers and related appurtenances shall be Type 316 stainless steel.

- I. Connection bolts for wood members shall be ASTM A307, galvanized where specified.
- J. Toggle bolts shall be Hilti, Toggler Bolt or equal.

2.04 METAL GRATING

- A. Grating shall have rectangular, 3/16-in thick, bearing bars spaced 1-3/16-in on center with cross bars spaced at 4-in on center. All grating panels shall be banded with a bar the same size as the bearing bars.
 - 1. Grating shall not exceed the fabricator's maximum recommended span, and meet or exceed the following load and deflection criteria for the maximum span length at the opening being covered by the grating.
 - A. The grating shall produce a deflection of 1/360 of the span or less under a uniform live load of 100 lbs/sq ft on the maximum span.
 - B. The grating shall produce a deflection of 1/360 of the span or less under a concentrated live load of 300 lbs applied at the mid point of the maximum span.
 - 2. Openings 2-in or greater in diameter/dimension and grating edges shall be banded with a bar of the same depth and thickness as the bearing bars. Cut bearing bars or cross bars shall be welded to the banding bar.
 - 3. Provide trench grating with symmetrical cross bar arrangement.
 - 4. Grating clamps, nuts, bolts, washers and other fastening devices for grating and grating supports shall be Type 316 stainless steel. All grating shall be anchored to the supporting system using saddle clips.
- B. Aluminum grating material shall be aluminum alloy 6063-T6 with a mill finish. Cross bars shall be attached to the bearing bars with interlocked swaged joints. The grating shall be Type BS by IKG Borden, Houston, TX; Type 19 SG-4 by Ohio Gratings, Inc., Canton, OH; Type 19S4 by Seidelhuber Metal Products, San Carlos, CA or equal.
- C. Metal frames and supports for grating shall be of the same material as the grating unless otherwise shown on the Drawings. Where aluminum supports are used, they shall be fabricated from aluminum alloy 6061-T6.

2.05 RAILINGS

- A. Guardrails and railing systems shall comply with the requirements of OSHA and the FBC and shall be custom pre-engineered, mechanically fastened or welded pipe aluminum railing systems. Mechanically fastened railing system shall be TUFrail as provided by Thomson Fabrication Company or equal.
- B. Rails and posts shall be 6061-T6, 6063-T6 or 6105-T5. Splice and reinforcing sleeves, brackets, end caps, toeboards, etc, shall be aluminum alloy 6061-T6, 6063-T6 or 6105-T5 alloy. Cast fittings shall be aluminum alloy No. 214. Railing system fastening hardware shall be Type 316 stainless steel. After welding, aluminum shall be anodized. All railing, posts, toeboards and exposed aluminum shall be anodized with a clear architectural Class I satin finish providing a minimum coating thickness of 0.7 mils and

a minimum coating weight of 32 milligrams per square inch in compliance with AA M10C22A41.

- C. Railings shall be 2 rail welded railing systems, as shown on the Drawings, fabricated with 1-1/2-in nominal diameter pipe. Posts shall be Schedule 80 pipe, and railing shall be Schedule 40 pipe, minimum. Posts and top rails shall be continuous. The top surface of the top railing at all points, including corners and terminations, shall be smooth and shall not be interrupted by projected fittings or posts. Spacing of posts shall not exceed 5-ft on center and shall be uniformly spaced except as otherwise shown on the Drawings. Posts will be required on each side of structure expansion joints. All railing posts shall be vertical.
- D. Welds shall be circumferential welds ground smooth and even to produce a railing that is neat in appearance and structurally sound. Welding methods shall be in conformity with AWS standards for the materials being joined. All rail to post connections shall be coped and fastened by continuous welds. There shall be no burrs, sharp edges or protrusions on any weld on any part of the handrail system. After fabrication, the welds and surrounding area shall be cleaned and hand buffed to blend with the adjacent finish. All mechanical fasteners shall be unobtrusively located in countersunk holes with the top flush with the surface of the rail. Bends in the railing shall be as indicated by the Drawings. No distortion of the circular railing shape will be allowed. Bends and terminal sections shall be made without the use of fittings. Corner bends shall be mitered and welded bends.
- E. Railing shall be assembled in sections as long as practical but shall not be greater than 24-ft in length. A field splice shall be used when an assembled section is to be attached to another section. Field splices shall be used in all railing panels that cross over structure expansion joints.
 - 1. Field splices shall use internal splice sleeves located within 8-in of railing posts. The sleeve shall be welded to the rail on one side and fastened with a set screw to the rail on other side. The field splice shall be detailed to take the differential expansion between the railing system and the supporting structure.
 - 2. When the field splice occurs in a railing panel crossing a structure expansion joint, the sleeve shall be welded to the rail on one side and be free to slide in the rail on other side. The field splice shall be detailed to take the same movement as the structure expansion joint.
- F. The bases or supports for railing posts and handrail shall be the types indicated on the Drawings.
 - 1. Where non-removable railing is set in concrete, the posts shall be placed in 2-1/2-in diameter formed concrete openings and firmly caulked with a nonsulphur compound, hydraulic cement equal to Por-Rok by Minwax Construction Products Division Sterling Drug, Montvale, NJ. Collars shall be placed around the post bases and fastened in place with set screws on the side of the post away from the walkway. Posts shall be placed with the centerline 4-in from the edge of the concrete except that posts shall be set at the centerline of concrete curbs.

2. Aluminum railing posts, which may collect condensation, shall have a 3/16-in drain hole drilled immediately above the concrete encased area, the base flange, or supporting socket on the side away from the walking area. The bottom of the rail post between the drain hole and the bottom of the post shall be filled with an inert material such as a compressed closed cell neoprene rod.
- G. Toeboards shall be provided on all railing adjacent to a drop in elevation of 4-ft or more. Toeboards are not required on the inclined portion of stairway railings or where concrete or steel curbs, 4-in or more in height, are present. Toeboards shall be 4-in high channels of the same material as the railing. The channels shall have a minimum thickness of 1/8-in and have flanges of not less than 3/4-in nor more than 1-1/2-in in width. Toeboards shall be positioned with a maximum clearance of 1/4-in from the floor and fastened to railing posts with 1/4-in stainless steel U-bolts, with J-bolts at corner posts and with clip angles and two 1/4-in stainless steel expansion bolts at walls. Toeboards shall not be welded to the posts. Connection to post shall allow expansion and contracting movements.
- H. All railings shall be properly protected by paper, or by an approved coating or by both against scratching, splashes or mortar, paint, or other defacements during transportation and erection and until adjacent work by other trades has been completed. After protective materials are removed, the surfaces shall be made clean and free from stains, marks, or defects of any kind.
- I. Aluminum shapes, including mounting brackets, in contact with concrete or a different type of metal shall be separated by a 1/32" neoprene gasket or provided with a heavy coating of protective zinc chromate for separation of dissimilar materials.
- J. Safety gates, for railing openings, shall be fabricated of matching pipe and rail material and configuration. The gates shall be self-closing gates with approved stop, latch and stainless steel closure spring and hinges.
- K. Barrier chains, for railing openings, shall be fabricated of stainless steel chains. Chain shall be 1/4-in stainless steel links, with eleven links per foot as manufactured by Eastern Chain Works, Inc., NY; Lawrence Metal Products, Inc. or equal. Chains shall be fastened to the handrail posts at the elevation of each rail. One end of each chain shall be connected to one post with a 1/4-in diameter stainless steel eye bolt and the other end shall be connected to the other post by means of a heavy chromium plated bronze swivel eye slide harness snap and a similar eye bolt.

2.06 ACCESS HATCHES

- A. Access hatches shall have single or double leaf doors as indicated by the Drawings. The doors shall be 1/4-in aluminum diamond pattern plate with welded stiffeners, as necessary, to withstand a live load of 300 lbs/sq ft with a maximum deflection of 1/150th of the span. Hatches shall have a 1/4-in aluminum channel frame with a perimeter anchor flange or strap anchors for concrete embedment around the perimeter. Where hatch is supported by steel framing members, these members shall be modified as needed to support the hatch chosen. This includes the addition of angles, tube members, etc. Unless otherwise noted on the Drawings, use pivot torsion bars for counterbalance or spring operators for easy operation along with automatic door hold

open. Hardware shall be durable and corrosion resistant with Type 316 stainless steel hardware used throughout. Provide removable lock handle. Finish shall be the factory mill finish for aluminum doors and frames with bituminous coating on the exterior of the frames in contact with concrete. Hatches shall be watertight and have a 1-1/2-in drainage coupling to the channel frame. Access hatches shall be Types as indicated on the Drawings by Bilco Company, New Haven, CT or equal.

2.07 MISCELLANEOUS ALUMINUM

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Welding shall be on the unexposed side as much as possible in order to prevent pitting or discoloration of the aluminum exposed surface. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous aluminum items shall include: beams, angles, closure angles, grates, hatches, floor plates, stop plates, stair nosings, and any other miscellaneous aluminum called for on the Drawings and not otherwise specified.
- D. Angle frames for hatches, beams, grates, etc, shall be complete with welded strap anchors attached.
- E. Aluminum diamond plate and floor plate shall have a minimum thickness of 3/8-in. Frames and supports shall be of aluminum construction. Fastening devices and hardware shall be Type 304 stainless steel. Plates shall have a mill finish.
- F. Stair treads for aluminum stairs shall have abrasive non-slip nosing as approved.
- G. Aluminum nosing at concrete stairs shall be Wooster Products, Inc.; Alumogrit Treads, Type 116; similar by Barry Pattern and Foundry Co.; Andco or equal. Furnish with wing type anchors and flat head stainless steel machine screws, 12-in on center. Nosing shall also be used at concrete ladder openings. Nosing shall a single piece for each step extending to within 3-in at each side of stair or full ladder width. Set nosing flush with stair tread finish at concrete stairs. Furnish treads with heavy duty protective tape cover.
- H. Miscellaneous aluminum items shall have a cleaned and degreased mill finish.

2.08 MISCELLANEOUS STEEL

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from

defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.

- B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous steel items shall include: beams, angles, lintels, metal stairs, support brackets, base plates for other than structural steel or equipment, closure angles, bridge crane rails, monorail hoist beams, holddown straps and lugs, door frames, splice plates, subframing at roof openings and any other miscellaneous steel called for on the Drawings and not otherwise specified.
- D. Structural steel angle and channel door frames shall be shop coated with primer. Frames shall be fabricated with not less than three anchors on each jamb.
- E. Steel pipe pieces for sleeves, lifting attachments and other functions shall be Schedule 40 pipe unless otherwise shown on the Drawings. Wall and floor sleeves, of steel pipe, shall have welded circumferential steel waterstops at mid-length.
- F. Lintels, relief angles or other steel supporting masonry or embedded in masonry shall be shop coated with primer.
- G. All steel finish work shall be thoroughly cleaned, by effective means, of all loose mill scale, rust and foreign matter and shall be given one shop coat of primer compatible with the finish coat after fabrication but before shipment. Paint shall be omitted within 3-in of proposed field welds. Paint shall be applied to dry surfaces and shall be thoroughly and evenly spread and well worked into joints and other open spaces.
- H. Galvanizing, where required, shall be the hot-dip zinc process after fabrication. Coating shall be not less than 2 oz/sq ft of surface.

2.09 MISCELLANEOUS STAINLESS STEEL

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B.
- C. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and

smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.

- D. Miscellaneous stainless steel items shall include: beams, angles, bar racks and any other miscellaneous stainless steel called for on the Drawings and not otherwise specified.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install all items except those to be embedded in concrete or other masonry which shall be installed under Division 3 and Division 4 respectively. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown. Fastening to wood plugs in masonry will not be permitted.
- B. Abrasions in the shop primer shall be touched up immediately after erection. Areas left unprimed for welding shall be painted with primer after welding.
- C. Zinc coating which has been burned by welding, abraded, or otherwise damaged shall be cleaned and repaired after installation. The damage area shall be thoroughly cleaned by wire brushing and all traces of welding flux and loose or cracked zinc coating removed prior to painting. The cleaned area shall be painted with two coats of zinc oxide-zinc dust paint conforming to the requirements of Military Specifications MIL-P-15145. The paint shall be properly compounded with a suitable vehicle in the ratio of one part zinc oxide to four parts zinc dust by weight.
- D. Specialty products shall be installed in accordance with the manufacturer's recommendations.
- E. Expansion bolts shall be checked for tightness a minimum of 24 hours after initial installation.
- F. Install adhesive capsule anchors using manufacture's recommended drive units and adapters and in compliance with the manufacturer's recommendations.
- G. Headed anchor studs shall be welded in accordance with manufacturer's recommendations.
- H. All railings shall be erected to line and plumb with tightly fitted joints proving smooth transitions. For mechanically fastened systems provide gaps between connecting members no greater than 1/8" unless at designated expansion joints.
- I. All steel surfaces that come into contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.
- J. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.

- K. Where aluminum contacts masonry or concrete, apply a heavy coat of approved alkali resistant paint to the masonry or concrete.
- L. Where aluminum contacts wood, apply two coats of aluminum metal and masonry paint to the wood.
- M. Between aluminum grating, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4-in thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.

END OF SECTION

**SECTION 11201
FABRICATED ALUMINUM SLIDE GATES**

PART 1 - GENERAL

1.01 SCOPE

- A. The work covered by this section includes furnishing all labor, materials, equipment and incidentals as shown on the Drawings, specified herein and required to supply and install fabricated aluminum slide gates, electric motor actuator and all appropriate appurtenances in full conformance with the Contract Drawings and as specified herein.
- B. Gates and operators shall be supplied with all the necessary parts and accessories indicated on the Drawings, specified herein or otherwise required for a complete, properly operating installation.

1.02 DESIGN REQUIREMENTS

A. Gate Manufacturer Qualifications

- 1. Manufacturer of fabricated aluminum slide gates shall have a minimum of 10 years of experience in the production of substantially similar size and type equipment in the United States, and shall show evidence of satisfactory operation in at least 25 project installations. Fabricated aluminum slide gates and operators shall be the products of a manufacturer regularly engaged in the production of fabricated gates. The gate manufacturer's plant fabricating the gates shall be ISO 9001 certified.
- 2. The gate manufacturer shall assume unit responsibility for all items specified in this section. Unit responsibility shall require that all items be products of, or warranted by, the manufacturer. The slide gate manufacturer shall be responsible for all coordination between components and provide all submittals, installation and start-up assistance and certifications on the equipment as a unit.
- 3. Slide gate and appurtenances shall be the product of one manufacturer.
- 4. The manufacturer shall provide written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications.

1.03 SUBMITTALS

- A. Shop Drawings: Submit for approval the following in accordance with Section 01300 - Submittals. Shop drawings for fabricated slide gates shall be prepared and assembled by the approved manufacturer. Shop drawings prepared and assembled by manufacturer's sales representatives, fabrication shops or other than the listed manufacturers will not be accepted. Submittals for fabricated slide gates shall include the following:
 - 1. Certified fabrication, assembly and installation drawings and diagrams. Shop drawings shall include a complete description of all materials including the

material thickness of all structural components of the frame and slide. Installation drawings showing all details of construction, details required for installation, dimensions and anchor bolt locations.

2. Provide the maximum bending stress and deflection of the slide under the maximum design head for each slide gate.
 3. Manufacturer's literature, illustrations, specifications and engineering data.
 4. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
 5. Wiring diagrams for electric motor actuators.
 6. Submittals shall clearly identify the location, method of installation and type of operator to be provided.
- B. Field Test Results: Submit a written report giving the results of the field tests required.
- C. Operation and Maintenance Manuals
1. Submit complete manuals including copies of all approved Shop Drawings, test reports, maintenance data and schedules, description of operation, and spare parts information and a lubricant specification for the type and grade necessary to meet the requirements of the equipment.
 2. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01730, Operating and Maintenance Data.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Fabricated slide gates shall be stored and protected in accordance with the requirements of Section 01600 of these Specifications, in addition to the following.
- B. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- C. Finished surfaces of all exposed openings shall be protected by wooden blanks, strongly built and securely bolted thereto.
- D. Each box, crate or package shall be properly marked to show its net weight in addition to its contents.
- E. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete in ample time to not delay the Work.
- F. Handle and protect slide gates and appurtenances properly during delivery, storage and installation in a manner to prevent damage of any nature, in strict accordance with manufacturer's recommendations. Slide gates that are distorted or otherwise damaged will not be acceptable. Protect all bolt threads and ends from damage.
- G. Store all mechanical equipment in covered storage off the ground and prevent condensation.

1.05 QUALITY ASSURANCE

- A. The manufacturer shall provide written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications.
- B. The gate manufacturer shall provide unit responsibility for all items specified in this section. Unit responsibility shall require that all items be products of, or warranted by, the gate manufacturer. The gate manufacturer shall be responsible for all coordination between components and provide all submittals, installation and start-up assistance, and certification on the equipment as a unit.

1.06 WARRANTY AND GUARANTEES

- A. The Contractor shall provide a warranty against defective materials and workmanship in accordance with the requirements of Section 01730 of these Specifications. The Contractor shall warrant trouble-free operation for a period of not less than one year, which shall commence from the date of final written acceptance by the District. The equipment shall be warranted during the one year period to be free from defects in workmanship, design and materials, specifically including leakage and sticking due to corrosion. If any part of the equipment should fail during the warranty period, it shall be replaced at no expense to the District.
- B. The manufacturer's warranty period shall run concurrently with the Contractor's warranty period regardless of when the equipment was shipped. No exception to this provision shall be allowed.
- C. In addition to the one year Contractor's warranty period, the fabricated gate manufacturer shall warrant each fabricated gate being supplied to the District against defects in workmanship and materials for a minimum period of 24 months from the date of Final Acceptance by the District, under normal use, operation, and service, up to a maximum of 36 months from the date of delivery to the job site. This warranty shall be held in effect regardless of pre-commissioning conditions in a typical indoor or outdoor environment as long as the fabricated gates have not been abused or disassembled.
- D. The fabricated gate manufacturer shall also provide factory-authorized service and parts stock either within the state of Florida or at other locations within the United States available to ship to the job site within 24 hours of notification by the District. The factory-authorized service center's location and the telephone number shall be indicated in the shop drawing submittal and the O&M manuals for the gates

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Fabricated aluminum slide gates shall be:
 - 1. Waterman Industries Model A-250-1.
 - 2. Or Engineer approved equal.

2.02 FABRICATED ALUMINUM SLIDE GATE

A. The gate shall be constructed of the following materials unless noted otherwise:

Component:	Material:
Frames, Rails, Cover Slides, Yokes	Aluminum - ASTM B-209 and B-211 Alloy 6061 T-6
Fasteners and Anchor Bolts	Stainless Steel - ASTM F-593 and 594, Type 304CW or 316CW
Stems	Stainless Steel - ASTM A-276, Type 304 or 316
Flushbottom Seals	Rubber - ASTM D-2000 BC 615/625 Grade BE 625
Seats and Slides	Ultra High Molecular Weight Polyethylene (UHMW)
Finish	Mill finish on all aluminum and stainless steel surfaces

- A. The gate frame shall be a rigid unit composed of aluminum guide rails with UHMW seats upstream and downstream. These shall form a tight seal between the frame and the slide (disc). Gate shall meet AWWA C562 leakage requirements. This tight seal shall provide an allowable leakage rate of no more than 0.1 gallons per minute (GPM) per peripheral foot of perimeter opening for seating heads and 0.1 GPM per peripheral foot for unseating heads. Stainless steel retainer bars, cross bars and head rails (for self-contained gate only) shall be provided. The clear opening shall be the same size as the waterway, unless otherwise specified. The guides shall be of sufficient length to support two-thirds of the height of the slide when in the full open position.
- B. The slide cover (disc) shall be aluminum plate reinforced with structural shapes welded to the plate. The slide cover shall not deflect more than 1/720th of the span of the gate under the maximum head. The stem connection shall be either the clevis type, with structural members welded to the slide and a bolt to act as a pivot pin, or a threaded and bolted (or keyed) thrust nut supported in a welded nut pocket. The clevis or pocket and yoke of the gate shall be capable of taking, without damage, at least twice the rated thrust output of the operator at 40 pounds pull.
- C. Gates shall be furnished with a flush seal arrangement. A resilient seal with a minimum width of exposed face of 3/4" shall be securely attached to the frame along the invert, and shall extend to the depth of the guide groove.
- D. All welds for gate and frame fabrication shall be performed by welders with AWS certification. All welds shall be continuous. No stitch welding shall be allowed.
- E. The fabricated aluminum slide gate shall be 48", able to withstand 15 feet of seating head and 8 feet of unseating head.

2.03 ELECTRIC MOTOR ACTUATORS

- A. General: Electric motor actuators shall comply with the fabricated aluminum slide gate of these Specifications. Electric motor actuators shall be provided by the fabricated aluminum slide gate manufacturer with the slide gate as a complete assembly.
- B. Approved Manufacturers: AUMA Actuators, Inc. of Canonsburg, PA or Engineer approved equal.
- C. Equipment Requirements: The actuators shall be suitable for use on a 460 volt 3 phase 60 Hz power supply and must include motor, reversing starters, local controls and

terminals for remote control and indication housed within a self contained, sealed enclosure. Set-up of the actuator shall be carried out without the removal of any covers. Actuator calibration shall be by integral pushbuttons and selector switch. No separate special commissioning tools shall be required. In addition, provision shall be made for the protection of configured actuator settings by means of a password.

- D. Actuator Sizing: The actuator shall be sized to guarantee valve closure at the specified torque and/or thrust requirement as indicated by the valve manufacturer or supplier. The actuator must be adequately sized to provide the torque required to operate the slide gate at 90% of the nominal voltage with the option of operation at up to -30% undervoltage conditions. The operating speed shall provide valve closing and opening at approximately 12 inches per minute for slide gates or sluice gates.
- E. Environmental: Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from -13°F to +158°F (-25°C to +70°C), up to 100% relative humidity.
- F. Enclosure: Actuators shall be 0-ring sealed, watertight to NEMA 4X/6 and submersible to IP 68-8 (26 feet for 96 hours)) in accordance with EN 60529. During submersion it must be possible to operate the actuator at least 10 times. Enclosure must allow for temporary site storage without the need for electrical supply connection. All external fasteners shall be of stainless steel. Gear case shall be cast iron. In order to prevent condensation, a heater must be installed inside the actuator, suitable for continuous operation. Actuator must provide an alarm signal in case of failure of anti-condensation heater.
- G. Motor: The electric motor shall be Class F insulated, with a duty rating of at least 15 minutes at 104°F (40°C) ambient temperature at an average load of at least 35% of rated actuator torque. Motor shall be specifically designed and built by the actuator manufacturer for electric actuator service characterized by high starting torque, low stall torque and low inertia. Commercially available motors shall not be acceptable. Electrical disconnection of the motor shall be by means of a plug and socket and motor removal shall be possible without loss of lubricant. The actuator must include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel regardless of the connection sequence of the power supply.
- H. Motor Protection: The following criteria shall be provided for motor protection:
 - 1. The motor shall be de-energized without damage in the event of a stall condition when attempting to move a jammed valve
 - 2. The motor shall be de-energized in the event of an overtorque condition
 - 3. Thermal devices (one for each phase of power) shall be imbedded in the motor windings to de-energize the motor in case of overheating.
 - 4. Lost phase protection.
- I. Gearing: The actuator gearing shall be totally enclosed in a grease-filled cast iron gearcase suitable for operation in any orientation. Actuator gearing shall be hardened steel with alloy bronze worm wheel. The design should permit the opening of the

gearcase for inspection or disassembly without releasing the stem thrust or taking the valve out of service. Where required per application, electric actuators can be provided with worm gearboxes. The worm gearboxes shall be supplied with full 360° bronze worm wheels.

- J. Manual operator shall be provided on each electrical actuator. Manual operation shall be by side mounted handwheel which shall not rotate during motor operation. Handwheel declutch mechanism shall include an output contact to indicate actuator manual operation. Manual operation shall utilize the actuator worm shaft/worm wheel to maintain self-locking gearing and to facilitate changeover from motor to manual operation when the actuator is under load. Actuator designs that bypass electric actuator worm gears when declutched are unacceptable. The declutching from motor operation shall be at the motor shaft to minimize declutching effort. The amount of force required to declutch the actuator shall be the same regardless of the size of the actuator. Designs that break the valve load at the worm and worm gear are unacceptable. Return from manual to electric mode of operation will be automatic upon motor operation. A seized or inoperable motor shall not prevent manual operation.
- K. Drive nut and thrust base assembly: For multi-turn rising stem applications, the drive nut shall be installed in a detachable thrust base. The design shall allow actuator removal from the thrust base, leaving the thrust base attached to the valve to retain valve position. Thrust bearings shall be lubricated by means of an easily accessible grease fitting.
- L. Actuator status indication: Six contacts shall be provided. The contacts shall have a minimum rating of 5A, 250VAC.
 - 1. one contact dedicated for collective fault (phase failure, motor protection tripped, torque fault) or one of eight other fault groups
 - 2. Five additional indication contacts selectable from a list of at least 45 parameters including, but not limited to: end position CLOSED, end position OPEN, selector switch in REMOTE mode, torque fault in CLOSED direction, and torque fault in OPEN direction.
- M. Local indication: The actuator shall include a digital position indicator with a display from fully open to fully close in 1% increments. Six indicating lights shall be included. Five of which are programmable local indicating lights to indicate functions including, but not limited to: end position CLOSED, end position OPEN, fault, selector switch in REMOTE and actuator moving. The sixth light shall indicate Bluetooth® interface connectivity.
- N. Controls: All actuators shall be furnished with integral motor controls consisting of reversing starters, control transformer, automatic phase correction, monitor relay (to signal fault conditions such as thermal switch trip, torque switch tripped in mid-travel, wrong phase sequence or phase failure) and be capable of mounting up to 330ft from the valve/vault.
- O. Remote position and torque feedback: Actuator shall provide a 4 to 20 mA analog position feedback signal. Actuator shall provide a 4 to 20 mA analog torque feedback

- signal corresponding to required valve torque for diagnostics and preventive maintenance.
- P. Starter and transformer: The starter shall be suitable for up to 60 starts per hour for open/close service.
- Q. Controls and Control Mode Selector: The actuator shall include local Open/Stop/Close/Reset pushbuttons and a Local/Off/Remote selector switch lockable in any of the three positions. The Reset pushbutton shall be provided to facilitate actuator commissioning. It shall be possible to select maintained or non-maintained control independently for either the local or remote modes. It shall be possible to program the output direction of the actuator (clockwise or counterclockwise to close) without removal of any covers. It shall be possible to re-orient local pushbutton controls in 90° increments
- R. The following electrical actuator control capabilities for control by contact closure/discrete signals must be available:
1. Input remote control signals for:
 - a. open/stop/close (maintained contacts) or emergency
 - b. open/close 'push to run' (momentary)
 - c. programmable emergency input for fail to any intermediate or end of travel positions when required.
 2. Programmable electronic torque switch bypass initialized in end and intermediate positions. Settable from 0-5 seconds.
 3. Separate open and close direction pulse timer (stepping mode) circuits capable of initializing at any position (open, close or intermediate).
 4. It shall be possible to reverse valve travel without the necessity of stopping the actuator. The starter contactors shall be protected from excessive current surges during travel reversal by an automatic time delay on energization of the contactor coils.
 5. The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses of up to 1.1 kV.
- S. The following electrical actuator control capabilities for analog signal input must be available:
- T. The following electrical actuator monitoring capabilities shall be provided:
1. Liquid Crystal Display (LCD) – minimum four lines back-lit for setting menu showing status indication and diagnostic information.
 2. Retrievable (lifetime and re-settable) data logs including:
 - a. motor run time
 - b. total number of cycles
 - c. number of torque trips in each direction of travel
 - d. number of limit switch trips at each end of travel

- e. total torque trip faults
 - f. motor thermal overloads.
3. Diagnostic capability, which will store and enable download of historical actuator operation, torque data to permit analysis of actuator, valve in-service performance and status signals according to NAMUR recommendation NE 107 via local display. Data download shall be carried out without removing any covers and all shall be available locally at the actuator or accessible via laptop computer.
 4. Actuator controls shall have a real time clock for event recording to support asset management functions and life cycle analysis.
- U. Wiring and terminals: Internal wiring shall be tropical grade insulated stranded cable of appropriate size for the control and main power. All external wiring shall terminate in a removable double-sealed plug and socket connection, which allows easy disconnection of all power and control voltages. Actuators furnished without plug and socket terminal connections must have power and control disconnect switches for ease of maintenance and safety

2.04 ANCHORS AND BOLTING HARDWARE

- A. Anchors and bolting hardware shall be provided by the gate manufacturer for mounting the gates and appurtenances to 8-inch thick precast walls or bolting hardware to mount the gates to wall mounted brackets.
1. Quantity, size and location of anchors and bolting hardware shall be determined by the gate manufacturer.
 2. Epoxy-type anchors shall be provided.
 3. Anchors and bolting hardware shall be Type 316 stainless steel.
 4. Anchors shall be of ample length and diameter to safely withstand all forces expected to be created by operation of the gate, with a minimum safety factor of 1.5. The minimum diameter for anchors shall be 1/2-inch.
 5. All bolts and nuts for slide gates shall have hexagonal heads. Anchors shall be furnished with two nuts each to attach gates to concrete.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Slide gates and appurtenances shall be installed as shown on the Drawings and/or specified herein, and in strict accordance with the manufacturer's installation instructions.
- B. Gates and appurtenances shall be installed with sufficient clearance for proper operation of any external mechanisms, and with sufficient clearance to dismantle the gate for maintenance.

- C. Gates shall be installed so that frame members and anchor bolts do not rest upon or contact steel reinforcing bars. Anchor bolts shall be set using a template.
- D. All anchors shall be set in accordance with approved manufacturer's drawings. All bolts shall be tightened and all items requiring lubrication, including pivot pins, shall be lubricated. Anti-seize thread lubricant shall be liberally applied to the threaded portion of stainless steel anchor bolts during the installation and tightening of nuts. Excess lubricant shall be thoroughly removed following final tightening.
- E. Slide gate frames and plates shall be checked, prior to installation, for projections or warpage that would promote excessive leakage. Defective gates and plates shall be removed and replaced.
- F. Each fabricated slide gate shall be carefully installed and adjusted for proper operation. Each gate shall be adjusted so that it does not bind or leak in excess of specified requirements. Slide gate frames shall be installed in a true vertical plane, square and plumb, with 90 degree corners to the lines and elevations shown and accurately aligned and adjusted for correct operation. Frames shall be internally braced and adequately supported during concrete placement and/or installation. Care shall be taken to avoid warping the gate frames and to maintain tolerances between seating faces.
- G. Any voids between the gate frame and existing concrete walls shall be filled with non-shrink grout as shown on the installation drawings and in accordance with the manufacturer's recommendations.
- H. The actuator shall be accurately set and plumbed and shall be in proper alignment with the gate and stem before the actuator is grouted in place. Operating stems shall be installed in proper alignment and shall not bind in the lift nut or stem guides.
- I. Limit switches for electric actuators shall be adjusted following a complete installation of the slide gate in strict accordance with the actuator manufacturer's written installation instructions.

3.02 INSPECTION AND FIELD TESTING

- A. Following installation, operating tests will be performed to demonstrate to the District and the Engineer that all slide gates will perform in a satisfactory manner and that all items of equipment are in full compliance with this Section. The Contractor shall make, at Contractor's expense, all necessary modifications, changes and/or adjustments required to ensure satisfactory operation.
- B. After Contractor and Engineer have mutually agreed that the equipment installation is complete and ready for continuous operation, Contractor and a qualified field service representative of the manufacturer shall conduct a functional field test and a leakage test of each slide gate in the presence of Engineer.
 - 1. Functional Tests: Each slide gate with appurtenances shall be field tested. Tests shall demonstrate to Engineer that each part and all parts together function in the manner intended. All necessary testing equipment and manpower shall be provided by Contractor at his expense.

2. Each gate shall be operated through at least two complete open/close cycles to confirm that it operates without sticking, binding, scraping, or distorting. The effort to open and close manual operators shall be measured using a torque wrench or other similar measuring device, and shall not exceed the maximum operating effort specified above.
 3. Electric motor actuators shall function smoothly and without interruption.
- C. Deficient equipment will be rejected. If gates, operators and appurtenances do not meet the specified requirements after corrective measures have been attempted by the Contractor, the equipment shall be removed and replaced with equipment that satisfies the conditions specified and tested to verify compliance. Replacement and retesting of defective equipment shall be made at no additional cost to the District.

3.03 MANUFACTURER'S REPRESENTATIVE SERVICES

- A. The Contractor shall provide the services of a trained, competent, qualified and experienced factory-employed field representative during inspection, testing and start-up of the equipment and for instruction of the District's personnel in the proper operation and maintenance of the equipment. Factory personnel are required for this start-up and training. Manufacturer's sales representatives are not deemed acceptable to provide the start-up service. The factory representative shall have a complete and full knowledge and experience in the installation, start-up procedures, and proper operation and maintenance of the slide gates. The services of the factory technician shall be provided as follows:
1. Two (2) separate trips and a total of two (2) 8-hour days of service to inspect and certify the installation prior to startup, conduct check-out and start-up services, and instruct the District's operation and maintenance personnel in proper operation and maintenance of the equipment.
 - a. One, 8-hour day during the installation phase of the slide gate and electric actuator equipment for consultation to the Contractor,
 - b. One, 8-hour day to inspect the final installation and supervise the Contractor's personnel to check-out of the completed installations, perform initial start-up of the slide gate and electric actuator equipment and perform the functional testing of the slide gate systems. A portion of the day will be to instruct the District's personnel in the proper operation and maintenance of the slide gate and electric motor actuator equipment in accordance with a training schedule approved by the District.
 2. Upon completion of his work, the manufacturer's field service technician shall submit to the Engineer, a written report for the fabricated slide gate installed, as a result of his inspection, adjustments, corrections, repairs, start-up and testing. The report shall include descriptions of the inspection, adjustments, corrections and repairs made, testing and start-up, and training of the District's personnel. The report shall also include a notarized certification signed by the manufacturer's field service technician that each installed fabricated slide gate:

- a. Has been installed and lubricated per manufacturer's requirements.
 - b. Has been accurately aligned, set and leveled and proper clearances set.
 - c. Is free from undue stress imposed by mounting bolts or setting.
 - d. Each fabricated slide gate has been tested and is in conformance with nominal operating parameters and leakage requirements. Test procedures and results shall be included in the report.
 - e. Each fabricated slide gate is ready for permanent operation on a continuous basis, is free from any known defects and that nothing in the installation will render the manufacturer's warranty null and void.
3. The Contractor's attention is directed to the fact that the services specified for the manufacturer's field service technician represent an absolute minimum acceptable level of service, and are not intended to limit the responsibilities of the Contractor to comply with all requirements of the Contract Documents. The Contractor shall procure, at no additional cost to the District, all services required, including additional or extended visits to the jobsite by manufacturer's representatives, to comply with said requirements.
- B. Electric Motor Actuator: Each electric actuator will be provided with a commissioning kit consisting of a wiring diagram and installation and operation manual. No special commissioning tools or parts will be required for start-up. In order to prevent loss of screws during commissioning or maintenance, all covers shall be fixed with captive screws. In order to minimize the amount of spare parts required, parts such as covers, plug and sockets, parts must be interchangeable throughout all model sizes.
 - C. Each electric motor actuator shall be performance tested. Test documentation shall be provided indicating the following:
 1. torque sensing tripping points in both the open and closed directions of travel.
 2. current at the maximum torque tripping point.
 3. actuator output speed.
 4. high voltage test.
- 3.04 CLEANING
- A. Prior to acceptance of the work of this Section, thoroughly clean all installed materials and related areas in accordance with the requirements of Section 01710 of these Specifications.

END OF SECTION

**SECTION 11261
ANGLED LINE SHAFT AXIAL FLOW PUMPS**

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required to install and test, and make ready for operation two (2) angled line shaft, single stage axial flow impeller pumps, with motors, discharge flap gates, and controls as shown in the Contract Documents and as specified herein.
- B. All necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in this Section or not shall be furnished and installed as required for an installation incorporating the highest standards for this type of service. Also included shall be supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation and maintenance of the equipment.

1.02 RELATED WORK

- A. Concrete work and the installation of anchor bolts are included in Sections 03300 and 05500; however, anchor bolts for these units as recommended by the pump manufacturer shall be furnished by the Contractor under this Section.
- B. Electrical and Motors as specified herein and in Section 16100.
- C. Instrumentation and control work as shown on the Drawings and specified herein and in Section 16100.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings and product data. Shop drawings must be approved by the Engineer prior to manufacture of the pump(s). Submittals shall include the following:
 - 1. Certified by the Manufacturer, dimensional drawings of each item of equipment and auxiliary apparatus to be furnished.
 - 2. Certified by the Manufacturer, installation and cross-sectional drawings including pump support and mounting bolt plans and details complete with all dimensions and written description of procedure for the installation and mounting the pump(s).
 - 3. Schematic electrical wiring diagram and other data as required for complete pump installation if a change from the wiring diagram shown on the Drawings is proposed.
 - 4. Literature and drawings describing the equipment in sufficient detail, including parts list and materials of construction, to indicate full conformance with the detail specifications.

5. Total weight of pumping unit and of the motor.
- B. Design Data
1. Manufacturer's certified rating curves, to satisfy the specified design conditions, showing pump characteristics of discharge, anticipated field head, brake horsepower, bowl efficiency and guaranteed net positive suction head required (NPSHR). Curves shall show the full recommended range of performance and include shut-off head. This information shall be prepared specifically for the pump proposed. Catalog sheets showing a family of curves will not be acceptable.
- C. Test Reports
1. Certified motor test data.
 2. Tabulated data for the drive motors including rated Hp, full load rpm, power factor and efficiency curves at 1/2, 3/4 and full load, service factor and kW input, including when the pump is at its design point.
 3. A schedule of the date of shop testing and delivery of the equipment to the job site.
 4. Description of pump factory test procedures, equipment and results, including but not limited to, performance curves.
- D. Operation and Maintenance Data
1. Complete operating and maintenance instructions shall be furnished for all equipment included under this Section as provided in Section 01730. The maintenance instructions shall include troubleshooting data and full preventative maintenance schedules and complete replacement parts lists with ordering information.

1.04 REFERENCE STANDARDS

- A. Design, manufacturing and assembly of elements of the equipment specified herein shall be in accordance with, the following:
1. American Institute of Steel Construction (AISC)
 2. American Iron and Steel Institute (AISI)
 3. American Society of Mechanical Engineers (ASME)
 4. American National Standards Institute (ANSI)
 5. American Society for Testing Materials (ASTM)
 6. American Water Works Association (AWWA)
 7. American Welding Society (AWS)
 8. American Bearing Manufacturers Association (ABMA)

9. Hydraulic Institute Standards for Centrifugal, Rotary and Reciprocating Pumps; Hydraulic Institute, Vertical Pump Standards; and Hydraulic Institute Test Standards, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests – 14.6
 10. Institute of Electrical and Electronics Engineers (IEEE)
 11. National Electrical Code (NEC)
 12. National Electrical Manufacturers Association (NEMA)
 13. Occupational Safety and Health Administration (OSHA)
 14. Society for Protective Coatings (SSPC)
 15. Underwriters Laboratories (UL)
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. To assure unity of responsibility, the motors, supporting sole plates, discharge head, shafting and column pipe assembly shall be furnished by the pump manufacturer. The Contractor and manufacturer shall assume responsibility for the satisfactory installation and operation of the entire pumping system including pumps, motors, sole plates and associated items, as specified. The person or persons responsible for carrying out the pump installation shall be a licensed Contractor in the State of Florida.
- B. The equipment specified herein is intended to be standard pumping equipment of proven ability as manufactured by concerns having extensive experience in the production of such equipment similar to the applications stated in Paragraphs 1.01 and 1.06. Units specified herein shall be furnished by a single manufacturer. The equipment furnished shall be designed, constructed and installed to operate satisfactorily when installed as shown on the Drawings.
- C. Pumps shall be manufactured in accordance with the Hydraulic Institute Standards, except where otherwise specified herein.
- D. The pump manufacturer shall be fully responsible for the design, arrangement, and operation of all connected rotating components, including supporting pump mounting pad(s), if any, of the assembled pumping unit mounted as shown on the Drawings, to ensure that neither harmful nor damaging vibrations occur at any speed within the specified operating range.
- E. The supplied pump shall be manufactured such that the NPSHR in the manufacturer's allowable operating region is not more than 80% of the NPSHA.

1.06 SYSTEM DESCRIPTION

- A. The pumps will pump surface water from a drainage canal to an adjacent drainage canal. The pumps may be started and stopped either locally or by remote signal. The

pumps will be controlled and powered by a pump station control panel specified herein. Other system controls and instrumentation related to pump operation shall be furnished and installed per the Drawings including a level transmitter in the drainage canal with instrumentation to shut down the pump on low water level with an operator selected (ex. 60-seconds) time delay.

- B. The pumps will be controlled based on the water level at the pump suction.

1.07 DELIVERY STORAGE AND HANDLING

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the unit and equipment are ready for operation.
- B. All equipment and parts must be properly protected against any damage during shipment. Store the equipment in accordance with manufacturer's recommendations.
- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- D. The finished surfaces of all exposed flanges shall be protected by wooden or equivalent blank flanges, strongly built and securely bolted thereto.
- E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- F. No shipment shall be made until approved by the Engineer in writing.

1.08 MAINTENANCE

- A. All spare parts shall be properly protected for long periods of storage and packed in containers that are clearly identified with indelible markings as to contents.

1.09 WARRANTY

- A. Provide warranty and guarantee for all equipment and work in accordance with Section 01740.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The pumping units shall be Model NW320x30 as manufactured by MWI Pumps (33rd NW 2nd Street, Deerfield Beach, FL 33441); no exceptions. The pumping units shall all be supplied by one manufacturer and shall be complete including pumps, motors, belts, pulleys, and appurtenances such as, but not limited to lifting inlet screen, mounting pads, connecting flanges, and hardware.
- B. The pumps and motors shall be designed and built for 24-hour continuous service at any and all points within the required range of operation, without overheating, without cavitation and without excessive vibration or strain. All parts shall be so designed and proportioned as to have liberal strength, stability and stiffness and to be

especially constructed to meet the specified requirements. Ample room and facilities shall be provided for inspection, repairs and adjustment.

- C. All necessary mounting bolts, nuts and washers shall be furnished and shall be Type 316 stainless steel.
- D. Each major piece of equipment shall be furnished with a stainless steel nameplate (with embossed data) securely mounted to the body of the equipment. As a minimum, the nameplate for the pumps shall include the manufacturer's name and model number, serial number, rated flow capacity, head, speed and all other pertinent data. As a minimum, nameplates for motors shall include the manufacturer's name and model number, serial number, horsepower, speed, input voltage, amps, number of cycles and power and service factors.

2.02 CONDITIONS OF OPERATION

- A. The pumps must be able to be operated individually or operated simultaneously as installed in the drainage canal and mounted in the configuration shown on the drawings.
- B. Each pump shall be designed for the conditions of service as shown in **Table 11261-A**. All pumps shall have a rising head capacity curve for stable pump operation from the minimum head operating point to the shut-off head.

2.03 PUMP CONSTRUCTION

- A. Pump bowl assembly shall be manufactured from corrosion resistant ASTM A242 "COR-TEN". The suction bell shall be bolted to the discharge bowl with heavy flanges accurately machine faced and drilled. Both the intake bell and the pump bowl shall have straightening vanes. Intake bell diameter shall be 1 ½ times the impeller diameter and shall be constructed to minimize vortex tendencies by maintaining equal pressure and velocities across the bell entrance.
- B. The impeller hub shall be manufactured from ASTM A242 "COR-TEN" steel. The hub shall be bored with a taper and keyed for positive locking to the pump shaft and shall be equipped with propeller pulling nuts for easy removal. The impeller shall have three blades manufactured from ASTM A242 "COR-TEN" steel. The impeller blades shall be formed with rounded leading edges and tapered trailing edges and have smooth contours for hydraulic efficiency. Blades shall be chamfered both sides at the root for full penetration welding to the hub. The periphery of the blades shall be machined for a close running fit with the impeller casing. After manufacturing, the complete impeller shall be statically balanced.
- C. Pump discharge column and discharge elbow shall be manufactured from ASTM A242 "COR-TEN" steel. The elbow shall be long radius type with centerline radius not less than 1 times the nominal pipe diameter. Discharge flanges shall be ASTM A242 "COR-TEN" steel and shall safely withstand all operating heads without distortion or leakage.

- D. The pump shaft shall be of sufficient diameter to transmit full load torque and to prevent vibration according to the ASME code for transmission shafting. The shaft shall be manufactured from pump quality (PSQ) cold rolled AISI 1045 steel. At areas in contact with seals or bearings, the shaft shall have hardened nickel-chrome-boron shaft sleeves with a 6-8 RMS finish and a Rockwell "C" hardness.
- E. A line shaft enclosing tube shall be provided between the discharge bowl and the pump thrust bearing housing. The tube shall be ASTM A53 Schedule 80 pipe and sealed at both ends with lip seals to prevent leakage of lubricant and entrance of water or foreign material.
- F. Bronze bearings shall be provided in the shaft enclosing tube. Bearings shall be of the threaded coupling type. Bearings shall be oiled from the top of the tube by means of a one gallon steel oil reservoir which will keep the tube constantly filled, thereby continually covering the contact surfaces of the bearings.
- G. The pump mounting pad shall be manufactured from ASTM A36 steel. It shall be of adequate thickness and strength to prevent excessive vibration and deflection. It shall have mounting holes for anchorage of the complete pump assembly.
- H. Pump and pipe welding shall be continuous and full penetration inside and out. All flanges shall be welded inside and out. All slag shall be removed and undercutting shall not exceed 15% of the material thickness.
- I. The pump parts shall be cleaned by sandblasting according to method SSPC-SP10 "Bare White Metal" before applying two coats of 4-8 mils DFT each Sherwin Williams Dura-Plate 235 or approved equal.
- J. All machine bolts, nuts, and cap screws shall be 304 stainless steel of the hex nut head type. Hardware or parts requiring special tools or wrenches shall not be used.

2.04 PUMP DRIVE MOTOR AND EQUIPMENT

- A. The pump shall be driven by means of a squirrel cage induction motor suitable for driving the pump continuously over the entire pumping range without overload or without operating in the service factor. Motor horsepower shall be as specified in Table 11261-A. The motor shall be furnished with thrust bearings having ample capacity to carry the full weight of all rotating parts and hydraulic forces developed by continuous pump operation. The pump drive motor manufacturer shall be Lincoln Electric or approved equal.
- B. The pump electric motor shall be furnished by the pump manufacturer. The pump electric motor and belt and pulley shall be assembled and mounted by the pump manufacturer. The electric motor shall be rated 50 HP at 1800 rpm with a 1.15 service factor with motor space heater and internal t-stat. The pump electric motor shall be rated 460 volts, 3-phase, 60 hertz. The pump electric motor shall have Totally Enclosed Fan Cooled (TEFC) hostile duty enclosures with stainless steel nameplates.
- C. The pump manufacturer shall provide the necessary belts and pulleys for the pump drive. A belt guard shall be included.

2.05 DISCHARGE PIPING

- A. Discharge Flap Gate: The pump manufacturer shall supply a discharge flap gate. The flap gate shall be manufactured from ASTM A242 “COR-TEN” or ASTM A36 and ASTM A53 steel. Flap Gates shall have an inside diameter of 30” and a flange to match the pipe flange. Flap Gates for the discharge shall be as manufactured by the pump manufacturer (MWI/Couch) or Engineer approved equal. The gate hinges shall be enclosed in Schedule 80 steel pipe, complete with iolite bushings and a grease fitting. The vent pipe shall be Schedule 80 steel pipe, threaded one end for connection to the threaded opening welded to the top of the assembly. All gate seats shall be machined.
- B. Discharge Piping: Flanged discharge piping and fittings as shown on the Drawings shall be supplied by the pump manufacturer. Pump discharge piping and fittings shall be manufactured from ASTM A242 “COR-TEN” steel. Flanges shall safely withstand all operating heads without distortion or leakage. The pump manufacturer shall supply two (2) loose 30” flanges with hardware to be field welded to the discharge pipe. One flange will connect to the pump elbow and the other flange will connect to the flap gate. Anti-seepage rings shall be welded to the discharge piping at the locations shown on the Drawings. Field welded joints shall be cleaned and coated in the field as specified below.
- C. All steel piping, fittings, and valves shall be cleaned by sandblasting according to method SSPC-SP10 “Bare White Metal” before applying two coats of 4-8 mils DFT each of Sherwin Williams Dura-Plate 235 or approved equal.

2.06 FACTORY TESTS

- A. Prior to shipment, pumps shall be full size factory tested in an open sump at the manufacturer’s place of business by a registered Professional Engineer. Each pump bowl assembly shall have a non-witnessed factory test with a Standard Performance Test as described in Hydraulic Institute Test Standards, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests – 14.6 and all test data submitted for approval by the Engineer prior to shipment. Certified copies of the calculated pump performance curves from the Standard Performance Test shall be submitted including anticipated head, capacity, bowl efficiency, total brake horsepower. Typical NPSHR and required submergence values typical for this pump shall be provided and certified by the pump manufacturer.
- B. Each pump shall guarantee and meet all conditions to achieve an Acceptance Grade of “1U” as outlined in Table 14.6.3.4 of the Hydraulic Institute Test Standards, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests – 14.6.
- C. Pump and motor test results as specified in Section 01300 shall be submitted for approval by the Engineer prior to shipment.

2.07 SURFACE PREPARATION AND SHOP PRIME PAINTING

- A. Each piece of equipment in the pumping system including pump, support system and motor shall be prepared and shop-primed as specified in Section 09900 and per

Manufacturer's recommendations. The shop primer shall be compatible with the finish paint.

- B. Each pump and associated equipment shall be shop-primed and any manufacturer's standard practice finished-coating shall be applied prior to shipment. Color shall be selected by the Engineer and an adequate supply of touch-up paint shall be supplied by the manufacturer.
- C. All interior and exterior wetted surfaces of pump columns and discharge elbows and the exterior of the bowl assemblies shall be cleaned of all rust and mill scale.
- D. All column pipe shall be supplied with a protective coating both inside and outside. Surface preparation shall conform to the coating manufacturer's recommendations.
- E. Discharge head shall be supplied with a protective coating both inside and outside. Surface preparation shall conform to the coating manufacturer's recommendations.

2.08 CONTROL PANEL

- A. General: One (1) UL approved control panel shall be supplied for the pump station; containing all the electrical and mechanical equipment necessary to provide for the operation of designated number of electric pumps. The panel shall be wall-mounted type and provide remote control from a telemetry system.
- B. Operation Requirements:
 - 1. The control panel shall consist of a main circuit breaker and a motor circuit protector and magnetic starter for each pump motor, and 15-ampere, 120-volt circuit breakers as required. Motor space heater power and control.
 - 2. Construction and Materials: The control panel shall be NEMA 3R 316 stainless steel dead front construction with welded double locking hasps and dead front aluminum inner door, and oriented as shown on the Drawings. The control panel shall include thirty percent (30%) extra mounting space for additional equipment. The enclosure shall allow a minimum 8 inches (8") of clear space above the main circuit breakers and 10 inches (10") below the motor starters for making wire terminations. The control panel enclosure shall have a minimum 6 inches (6") of clear space along each side with bracing to allow strapping of the incoming power feeder from the electric service. The control panel enclosure shall be Underwriters Laboratories (US) 50 Type 3R listed.
 - 3. Panel Exterior:
 - a. Panel shall have stainless steel heavy-duty key locking door handle and three-point latch.
 - b. All exterior mounted accessories shall be constructed of corrosion proof materials such as stainless steel or aluminum.
 - 4. Panel Inner Door:
 - a. The inner aluminum door mounted on a continuous hinge, two pivot handles shall be furnished for protection against exposed wiring and

shall have cutouts for access to all of the circuit breakers. The inner door shall include a restraining mechanism to fix the inner door in the open position. Mounted on the inner door will be pump run lights, hand-off automatic switches, elapsed time meters for each pump, a 20-ampere ground fault duplex receptacle, motor overload resets and alarm reset, duplex receptacle breaker.

- b. A permanently affixed 11 inch by 17 inch (minimum), laminated panel wiring schematic and pump data sheet shall be installed on the interior of the enclosure door. In addition, there shall be permanently affixed to the interior side of the exterior enclosure door both a nameplate and a 10" x 12" pocket for log sheet storage. The nameplate shall contain the voltage, phase, rated horsepower, speed, date of manufacture, pump and panel manufacturer's name, address, and telephone number, pump data, including impeller data, operating point and head, KW input, amps at the operating point and at least two (2) other points on the pump curve.

5. Panel Components:

- a. Main and Branch Circuit Breakers: All circuit breakers shall be heavy-duty industrial service molded case breakers with amperage rating as required. All circuit breakers shall have an appropriate locking device to meet OSHA lockout and tag-out rules. Circuit breakers shall be thermo-magnetic as manufactured by Square D.
- b. The control relays shall operate from a 24-volt circuit. The relays shall be enclosed, eight-pin and/or eleven-pin plug-in type. The control relays shall contain test button and neon or LED energized indicator. The plug base shall be keyed to allow for proper pin alignment. Control relay sockets shall be octal-style with clamp on screw terminals. These sockets shall be mounted on DIN railing and 600 VAC rating. All relay sockets shall be keyed to allow for proper pin alignment. The control panel shall include an adjustable time delay relay to prevent both pumps from starting simultaneously. Relays shall be Paragon Electric Company, Series JS, or equal.
- c. Duplex Service Receptacle: A duplex service receptacle supplying 20 amps at 115 volts shall be provided on the panel door. The duplex receptacle shall be provided with ground fault protection.
- d. Elapsed Time Meters: Elapsed time meters shall be 115-volt non-reset types and shall indicate pump running time in hours and tenths of hours to 99999.9 hours.

6. Motor Starters:

- a. Across the Line: An open frame, across-the-line, NEMA rated, magnetic motor-starter, as manufactured by Square-D, shall be furnished for each pump motor. All motor starters shall be equipped to provide under-voltage release and individual overload protection on all three phases. Motor starter contacts shall be easily replaceable

without removing the motor starter from its mounted position. Overload reset push-buttons shall be located on the exterior of the inner compartment door.

- b. Each pump motor shall be protected by a 3-pole motor circuit protector. The motor circuit protector shall be operated by a toggle-type handle and contain a quick-make, quick-break, over center switching mechanism mechanically trip-free from the handle so contacts cannot be held closed against a short circuit and abnormal currents causing the motor circuit protector to trip. Tripping shall be clearly indicated by the handle automatically assuming a position midway between the normal "ON" and "OFF" positions. All latch surfaces shall be ground and polished. All poles shall be constructed to open, close, and trip simultaneously. The motor circuit protector shall be completely enclosed in a high-strength glass polyester molded case. Ampere ratings shall be clear and visible. Contacts shall be non-welding silver alloy. A manual push to trip button shall be provided for manual exercising of the trip mechanism. Each pole of these motor circuit protectors shall provide instantaneous short circuit protection by means of an adjustable magnetic-only element.
7. Phase Monitor: A 3-phase monitor shall be installed and wired to disconnect control power from the motor starters in the event of loss of power, phase reversal, loss of any phase or phase balance, or low voltage. The phase monitor shall automatically reset upon removal of any and all of the preceding conditions.
 8. Indicator Lights: Indicator lamps shall be mounted in NEMA 4X, as manufactured by Allen-Bradley, or equal. Lamp modules shall use LED lamps and be equipped to operate at 120-volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position.
 9. Power Meter: The panel shall include CTs and power monitor per Square-D PM800 series. The panel shall monitor one leg of the incoming power and pump motors.
 10. Identification Markers:
 - a. All circuit breakers, control switches, indicator lights, relays, and other control devices shall be identified with permanently affixed legend plates and lamicoïd-type engraved nameplates where applicable. A black and red on white label stating "DANGER<HIGH VOLTAGE<240 or 480 (use applicable) VOLTS" shall be affixed to the face of the inner door unit.
 - b. Install nameplates using stainless steel drive pins or machine screws. Dymo type labels and labels fastened with adhesive only will not be accepted.

- c. Install conductor identification markers on conductors at terminations and in junction and pull boxes through which the conductors pass. Color code power conductors by insulation or tape and identifies by markers in junction and pull boxes to indicate the conductor's panel and circuit number. Identify control conductors by markers at all locations.
 - d. Identification markers that are not preprinted, such as panelboard indexes, terminal block marking strips, and special cable markers, shall be typewritten or otherwise mechanically printed, not hand lettered.
11. Spare Parts:
- a. The manufacturer shall furnish the following parts for each panel supplied:
 - i. Phase Monitor
 - ii. Fuses of each size and type used
 - iii. Contact renewal kits
12. Telemetry Interface:
- a. Pump Run Status (Each pump)
 - b. Pump In Auto (Each pump)
 - c. Pump OL Fail (Each pump)
 - d. Motor High Temperature
 - e. Pump Remote Command (Each Pump)
 - f. Incoming Amps
 - g. Pump 1 Amps
 - h. Pump 2 Amps

PART 3 - EXECUTION

3.01 PREPARATION

- A. Coordinate with other trades, equipment and systems to the fullest extent possible.
- B. Take all necessary measurements in the field to determine the exact dimensions for all work and the required sizes of all equipment under this Contract. All pertinent data and dimensions shall be verified.

3.02 INSTALLATION

- A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the pump drawings. Anchor bolts shall be set in accordance with the pump manufacturer's recommendations and setting plans.
- B. The Contractor shall supply the services of a qualified pump installer to supervise the pump installation and testing to the satisfaction of the Engineer. Should the Contractor fail to have a qualified engineer and/or service person on the job during

the installation, the Engineer may direct the Contractor to provide the services of a factory representative to check over the installation.

- C. Qualified supervisory services, including manufacturers' engineering representatives, shall be provided for a minimum of 2 days to ensure that the work is done in a manner fully approved by the respective equipment manufacturer. The pump manufacturer's representative shall specifically supervise the installation and alignment of the pump with the driver, the grouting, the alignment of the connecting piping, and the installation of the field installed packing. If there are difficulties in the start-up or operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no additional cost to the District. Services of the manufacturer's representatives and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.
- D. Connection of piping to pumps shall be done in the presence of the District or Engineer. All piping connections to the pump shall be done without bending and/or twisting the piping to mate with the pump flange connections.
- E. A certificate from the equipment manufacturer shall be submitted stating that their installation of their equipment is satisfactory, that the equipment is ready for operation, and that the District's operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.03 FIELD TESTS

- A. In the presence of the District or Engineer, the Contractor shall conduct such tests as necessary to indicate that the pumps and motors conform to the efficiencies and operating conditions specified. A 7-day operating period of the pumps will be required before acceptance. If pump performance does not meet the specified requirements, corrective measures shall be taken or the pump shall be removed and replaced with a pump which satisfies the conditions specified. All test procedures shall be in accordance with factory test procedures specified above and HI standards for testing for these pump types. Manufacturer certified results of tests shall be submitted to the District and Engineer. Provide, calibrate and install all temporary gauges and meters, make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the Engineer for approval a minimum of 30 days prior to testing.
- B. After installation and as soon as conditions permit full speed operation, and in the presence of the District or Engineer, the Contractor shall retain the services of a qualified independent mechanical testing firm or the pump manufacturer to perform a detailed vibration signature analysis of each unit, including both "Bump Tests" and X-Y vibration profiles, to (a) prove compliance with the specified vibration limitations and (b) prove there are no field installed resonant conditions due to misalignment, the foundation, or the connecting piping and its supports, when operating at any speed within the specified operating range. A written report shall be submitted including a sketch of the unit indicating on where and in which direction the vibration readings were taken and recorded showing (a) peak-to-peak

displacement, in mils, (b) frequency and (c) peak velocity level, in inches per second. The report shall contain a complete analysis of their findings, describing any problems encountered, if any, probable cause and specific recommendations for any required corrective action.

- C. If required, take corrective action and have the units retested to ensure full compliance with the specified requirements. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.

TABLE 11261-A Canal Transfer Pump Design Criteria

Criteria	
Tag	CTP-1 and CPT-2
Quantity of Pumps	2
Pump Type	Angled Line Shaft, Axial Flow Impeller
Liquid	Surface Water
Motor Rating (HP)	50
Design Point Capacity (cfs)	25
Design Point Total Dynamic Head (TDH) (ft)	7
Secondary Design Point Capacity (cfs)	21.5
Secondary Design Point TDH (ft)	11
Maximum Design TDH (ft)	13
Minimum bowl efficiency at Design Points (ft)	70
Maximum NPSHR (ft)	23
Nominal Pump Speed (rpm)	675
Impeller Diameter (in)	20
Pump Discharge Diameter (in)	30

END OF SECTION

**SECTION 16100
ELECTRICAL WORK**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to complete the Electrical Work.
- B. Coordination:
 - 1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the walls, partitions, ceilings and panels.
- C. Intent:
 - 1. Drawings show the principal elements of the electrical installation. They are not intended as detailed working drawings for the electrical Work but as a complement to the Specifications to clarify the principal features of the electrical systems for bidding purposes only.
 - 2. Rough-in of conduits and equipment to be based upon approved shop drawings.
 - 3. It is the intent of this Section that all equipment and devices, furnished and installed under this and other Sections, be properly connected and interconnected with other equipment to render the installations complete for successful operation, regardless of whether all the connections and interconnections are specifically mentioned in the Specifications or shown.
- D. Grounding: Ground all equipment in conformance with the National Electrical Code.
- E. Temporary Power:
 - 1. CONTRACTOR shall provide temporary light and power for construction purposes to be utilized by all trades on the project.
- F. Utilities:
 - 1. It is the Contractor's responsibility to contact the power company during bidding and within 10 days of notice to proceed. Contact Derek Carr at Derek.Carr@duke-energy.com or 407-359-4824 for service location and details.

1.02 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:

1. Permits: Obtain all permits required to commence.
 2. Codes: Material and equipment shall be installed in accordance with the current standards and recommendations of the National Electrical Code, the National Electrical Safety Code and with local codes which apply. Where discrepancies arise between codes, the most restrictive regulation shall apply.
 3. Tests by Independent Regulatory Agencies: Electrical material and equipment shall be new and shall bear the label of the Underwriters' Laboratories, Inc., or other nationally-recognized, independent testing laboratory, wherever standards have been established and label service regularly applies.
 4. Utilities:
 - a. Power Company: Work in connection with the electric service and utility metering shall be done in strict conformance with the requirements of the Power Company.
- B. Reference Standards: Electrical material and equipment shall conform in all respects to the latest approved standards of the following:
1. National Electrical Manufacturers Association (NEMA).
 2. The American National Standards Institute (ANSI).
 3. The Institute of Electrical and Electronic Engineers (IEEE).
 4. Insulated Cable Engineers Association (ICEA).
 5. National Electrical Code (NEC).
 6. National Electrical Safety Code (NESC).
 7. National Fire Protection Association (NFPA).
 8. Instrumentation Society of America (ISA).
 9. Underwriters' Laboratories, Inc. (UL).

1.03 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
1. Manufacturer's name and product designation or catalog number.
 2. Electrical ratings.
 3. Dimensioned plan, section, and elevations showing means for mounting, conduit connection, and grounding.
 4. Materials and finish specification, including paints.
 5. List of components including manufacturer's names and catalog numbers.
 6. Internal wiring diagrams indicating all connections to components and numbered terminals for external connections.

1.04 AREA CLASSIFICATIONS

- A. Wet Locations: The following areas shall be considered wet locations:
1. All outdoor areas.
 2. All indoor areas below grade unless otherwise specified.
 3. Indoor areas above grade where designated and shown.
 4. Materials, equipment and incidentals in areas identified as wet locations shall meet NEC and NEMA requirements for wet locations. Enclosures shall meet NEMA 4X requirements as a minimum and NEMA 4X requirements where specified. Conduits shall be terminated at enclosures with watertight, threaded hubs.

PART 2 - PRODUCTS

2.01 RACEWAY SYSTEMS

- A. General:
1. The types of raceways required include the following:
 - a. Schedule 40 PVC for all conduit runs.
 - b. Flexible conduit for connections to motors and equipment.
 2. Coordination:
 - a. Conduit runs shown are diagrammatic.
 - b. Coordinate conduit installation with piping, ductwork, lighting fixtures and other systems and equipment and locate to avoid interferences.
- B. Conduit Fittings and Outlet Bodies:
1. Material and Construction: Malleable iron and covers. Outdoor units to be gasketed and watertight. Gaskets to be of an approved type designed for the purpose. Improvised gaskets not acceptable. All units to be threaded type with five full threads. Material to conform to be listed by UL. The use of "LB" fittings shall be avoided and type "LBD" fittings applied wherever the use of fittings is unavoidable. All hardware shall be stainless steel.
 2. Manufacturer: Provide metallic conduit fittings and outlet bodies of one of the following:
 - a. Crouse-Hinds Company.
 - b. Appleton Electric Company.
 - c. Or equal.
- C. PVC Conduit:

1. Material: Schedule 40 PVC plastic, NEMA Type EPC-40-PVC, 90 C rated, conforming to UL No. 651.
 2. Fittings: Form elbows, bodies, terminations, expansions and fasteners of same material and manufacturer as base conduit. Provide cement by same manufacturer as base conduit.
 3. Manufacturer: Provide PVC conduit of one of the following:
 - a. Amoco Chemicals Corporation.
 - b. Carlon, Division of Indian Head, Incorporated.
 - c. Or equal.
- D. Conduit Hubs:
1. Material: Threaded conduit hub, vibration proof, weather proof with captive O-ring seal, aluminum with insulated throat.
 2. Use: Provide for all conduit terminations to boxes, cabinets and other enclosures located in areas designated as wet locations.
 3. Manufacturer: Provide material manufactured by Myers Electrical Products Company or equal.
- E. Flexible Conduit:
1. Material: Flexible nonmetallic core with smooth, abrasion resistant, liquid-tight, polyvinyl chloride cover. Material shall be UL listed.
- F. Flexible Conduit Fittings:
1. Material and Construction: 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. Manufacturer: Provide flexible conduit fittings of one of the following:
 - a. Crouse Hinds Company.
 - b. Appleton Electric Company.
 - c. Or equal.
 - d. Pull and Junction Boxes:
 3. Material and Construction:
 - a. Stainless Steel boxes.
 - b. Neoprene gaskets. Gaskets to be of an approved type designed for the purpose. Improvised gaskets not acceptable.
 - c. Stainless steel cover screws.
 - d. External mounting lugs.
 - e. Drilled and tapped conduit holes.
 - f. Boxes where conduits enter a building below grade shall have ¼-inch drain hole.

4. Manufacturer: Provide pull and junction boxes of one of the following:
 - a. Crouse Hinds Company.
 - b. Appleton Electric Company.
 - c. Or equal.

2.02 WIRE AND CABLE

A. 600 Volt Cable:

1. Insulated Cable in Raceways:
 - a. Material: Single conductor copper cable conforming to ASTM B3 and B8 with flame-retardant, moisture and heat resistant thermoplastic insulation rated 90 C in dry locations and 75 C in wet locations and listed by UL as THHN/THWN.
 - b. Wire Sizes: Not smaller than No. 12 AWG for power and lighting and No.14 AWG for 120-volt control circuits.
 - c. Stranding: All 600-volt cable shall be stranded.
2. Cable Connectors, Solderless Type:
 - a. For wire sizes up to #6 AWG, use compression type.
 - b. For sizes #4 AWG and above, use either compression type or bolted type with silver-plated contact faces.
 - c. Properly size connectors to fit fastening device and wire size.

B. Instrumentation Cable:

1. Single Shielded Pair:
 - a. Tinned copper, stranded conductors, #18 AWG minimum, twisted with aluminum-polyester shield, stranded tinned 20 AWG copper drain wire and overall chrome vinyl jacket. Rated for 600 volts minimum.
2. Multi-paired Shielded:
 - a. Tinned copper, 7 strand XLPE insulated conductors, #18 AWG minimum, twisted in pairs with aluminum-mylar shield over each pair, silicone rubber fiberglass fire barrier tape, tinned copper drain wire, aluminum mylar overall shield, Hypalon outer jacket.
3. Manufacturer: Provide shielded cable of one of the following:
 - a. Okonite Company.
 - b. Belden Company.
 - c. Dekoron Wire and Cable Company.
 - d. Or equal.

2.03 WIRING DEVICES

A. Outlet Boxes:

1. Material: Cast aluminum in damp, wet or exterior locations and zinc-coated sheet steel in climate-controlled locations.
2. Device Cover Plates:
 - a. Stainless steel Type 302 alloy or PVC for all areas.
 - b. Gasketed spring door type for devices designated as weatherproof.
 - c. Integral with device for hazardous locations.
 - d. Stainless steel screws and hardware.
3. Manufacturer: Provide device boxes of one of the following:
 - a. Crouse-Hinds Company.
 - b. Appleton Electric Company.
 - c. Or equal.

B. Snap Switches:

1. Switches for Non-Hazardous Locations:
 - a. Single pole AC toggle switch, quiet type, 120/277 volt AC, 20 ampere, Ivory, specification grade.
 - b. Product and Manufacturer: Provide one of the following:
 - i. Cat. #1221-I, as manufactured by Harvey Hubbel Incorporated.
 - ii. Cat. #1991-I, as manufactured by Arrow-Hart Incorporated.
 - iii. Or equal.

C. Receptacles:

1. Receptacles for Non-Hazardous Locations:
 - a. Duplex grounding receptacle, two pole, three wire, 125 volt AC, 20 ampere.
 - i. Product and Manufacturer: Provide one of the following:
 - I.* Cat. #53CM62, as manufactured by Harvey Hubbell Incorporated.
 - II.* Cat. #5362-CR, as manufactured by Arrow-Hart Incorporated.
 - III.* Or equal.

D. Safety Switch

1. Safety Switch for Non-Hazardous Locations:

- a. Heavy Duty, non-fusible, NEMA 4X, 316 grade stainless steel, 3P, 600 volts, watertight hubs.
2. Product and Manufacturer: Provide one of the following:
 - a. HU36 as manufactured by Square-D
 - b. Or equal.

2.04 GROUNDING SYSTEMS

A. Bare Ground Cable:

1. Material: Annealed, bare, stranded tinned copper, No.2/0 AWG minimum size.
2. Manufacturer: Provide ground cable of one of the following:
 - a. Cablec Corporation.
 - b. General Cable Corporation.
 - c. Rome Cable Company.
 - d. Or equal.

B. Ground Rods:

1. Material: Copperclad rigid steel rods, 1/2-inch diameter, 20 feet long.
2. Manufacturer: Provide ground rods by one of the following:
 - a. Copperweld, Bimetallics Division.
 - b. ITT Blackburn Company.
 - c. Or equal.

C. Grounding Connectors:

1. Material: Welded connections shall be by exothermic process utilizing molds, cartridges and hardware designed specifically for the connection to be made.
2. Manufacturer: Provide grounding connectors of one of the following:
 - a. Pressure Connectors:
 - i. O.Z./Gedney, Division of General Signal Corporation.
 - ii. Burndy Corporation.
 - iii. Or equal.
 - b. Welded Connections:
 - i. Cadweld by Erico Products, Incorporated.
 - ii. Therm-O-Weld by Burndy Corporation.
 - iii. Or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Mount equipment so that enough access and working space is provided for safe operation and maintenance.
2. Securely fasten enclosures to walls and other structural surfaces on which they are mounted. Provide independent supports where no walls or other structural surface exists.
3. Install in conformance with the National Electrical Code.

B. Raceway Systems:

1. Supports:

- a. Rigidly support conduits by clamps, hangers or unistrut channels.
- 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 with stainless steel horizontal members and threaded hanger rods, Kindorff or equal. Rods shall be not less than 3/8-inch diameter and shall be stainless steel.

2. Fastenings: Fasten raceway systems rigidly and neatly to supporting structures by the following methods:

- a. To Wood: Wood screws.
- b. To Hollow Masonry Units: Toggle bolts.
- c. To Brick Masonry: Price expansion bolts, or equal.
- d. To Concrete: Phillips; Hilti Corporation; or equal, anchors.
- e. To Steel: Welded threaded studs, beam clamps or bolts with lockwashers or locknuts.

3. Exposed Conduit:

- a. Install parallel or perpendicular to structural members or walls.
- b. Wherever possible, run in groups. Provide stainless steel conduit racks of suitable width, length and height and arranged to suit field conditions. Support every ten feet minimum.
- c. Install on structural members in protected locations.
- d. Locate clear of interferences.
- e. Maintain 6 inches from hot fluid lines and 1/4-inch from walls.
- f. Install vertical runs plumb. Unsecured drop length not to exceed 12 feet.

4. Conduit Embedded in Concrete:

- a. Separation: Three times outer diameter of larger conduit center to center.

- b. Minimum Slab Thickness:
 - i. With no crisscrossing of conduit, three times outer diameter of conduit.
 - ii. With crisscrossing of conduits, four times outer diameter of larger conduit.
 - c. Run conduit in center of slab.
 - d. Before concrete is placed, make the necessary location measurements of the conduit to be embedded so that the information is available to prepare record drawings.
5. Underground Conduits:
- a. Install individual underground conduits a minimum of 20 inches below grade unless otherwise indicated.
 - b. Perform all excavation, bedding, backfilling and surface restoration including pavement replacement where required.
 - c. Make conduit connections watertight.
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.
 - b. Identify each empty conduit with a durable tag showing the conduit number indicated on the Drawings.
7. Field Bends: No indentations. Diameter of conduit shall not vary more than 15 percent at any bend.
8. Joints:
- a. Apply conductive compound to all 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 damage to wire and cable.
 - e. Use full threaded couplings. Split couplings not permitted.
 - f. Use strap wrenches and vises to install conduit. Replace conduit with wrench marks.
9. Terminations:
- a. Install insulated bushings on conduits entering boxes or cabinets, except threaded hub types.
 - b. Provide locknuts on both inside and outside of enclosure for grounding.
 - c. Bushings not to be used in lieu of locknuts.
10. Moisture Protection:

- a. Plug or cap conduit ends at time of installation to prevent entrance of moisture or foreign materials.
 - b. Make underground and embedded conduit connections watertight.
 - c. Thru wall Seals: Install for conduits passing through new exterior subsurface walls or base slabs of buildings and for conduits passing through existing exterior walls. For individual exposed conduits passing through interior walls, install non-metallic sleeves to protect the conduit against action of alkaline substances which may be present.
 - d. Drainage: Pay particular attention to drainage for conduit runs. Wherever possible, install conduit runs so as to drain to one end and away from buildings. Avoid pockets or depressions in conduit runs.
11. Corrosion Protection:
- a. Conduit Curb:
 - i. In concrete slabs or floors, provide a four-inch-high curb extending two inches from the outer surface of the conduit penetrating the floor, to prevent corrosion.
 - ii. Terminate conduit stub-ups in couplings, slightly above the finished concrete curb.
 - b. Dissimilar Metals:
 - i. Back paint aluminum in contact with masonry or concrete with two coats of aluminum-pigmented bituminous paint.
12. Flexible Conduit:
- a. Install at motors and equipment which are subject to vibration or require movement for maintenance purposes. Provide necessary reducer where equipment furnished cannot accept 3/4-inch size flexible conduit. Limit flexible conduit length to three feet maximum.
13. Pull and Junction Boxes:
- a. Install pull boxes in runs containing more than three 90 degree bends, runs exceeding 200 feet, where indicated on the Drawings and where required to conform to the National Electrical Code.
 - b. Size junction and pull boxes in accordance with the requirements of the National Electrical Code.
 - c. Provide terminal blocks in junction boxes where cable terminations.
14. Sealing Fittings: Install for hazardous and corrosive locations as required by the National Electrical Code and where shown on the Drawings.
15. Expansion/Deflection Fittings: Install fittings where conduits cross structural expansion joints.

C. Wire and Cables:

1. 600 Volt Cable:
 - a. Install all cables complete with proper terminations at both ends. Check and correct for proper phase sequence and proper motor rotation.
 - b. Pulling:
 - i. Use insulating types of pulling compounds containing no mineral oil.
 - ii. Pulling tension shall be within the limits recommended by the wire and cable manufacturer.
 - iii. Use a dynamometer where mechanical means are used.
 - iv. Cut off section subject to mechanical means.
 - c. Bending Radius: Limit to 6 times cable overall diameter.
 - d. Slack: Provide maximum slack at all terminal points.
 - e. Splices:
 - i. Install cable continuous, without splice, from termination to termination.
 - ii. Splices in conduits not allowed.
 - f. Identification: Identify all conductors by circuit number and phase at each terminal or splice location.
 - g. Color code power cables in accordance with the District's standards.
2. Instrumentation Cable:
 - a. Install in conduit separate from power cables unless otherwise noted.
 - b. Ground shield on shielded cables at one end only.
 - c. Terminate stranded conductors with pre-insulated crimp type spade or ring torque terminals properly sized to fit fastening device and wire size.
 - d. Install and terminate vendor furnished cable in accordance with vendor equipment requirements.

D. Wiring Devices:

1. Outlet Boxes:
 - a. Fasten boxes rigidly and neatly to supporting structures.
 - b. For units mounted on masonry or concrete walls, provide suitable ½-inch spacers to prevent mounting back of box directly against wall.
 - c. Leave no open conduit holes in boxes. Close unused openings with capped bushings.
 - d. Label each circuit in boxes and identify with durable tag.
2. Snap Switches:
 - a. Install switches in outlet or device boxes in non-hazardous locations.
 - b. Install switches in rigid metallic conduit systems in hazardous locations.

- c. Mount wall switches 4 feet 6 inches above finished floor unless otherwise noted.

3. Receptacles:

- a. Install receptacles in outlet or device boxes in non-hazardous locations.
- b. Install receptacles in rigid metallic conduit systems in hazardous locations.
- c. Install receptacles with ground pole in the down position.
- d. Mount receptacles 18 inches above finished floor in non-hazardous locations and 4 feet 6 inches above finished floor in hazardous locations unless otherwise noted.

- E. Grounding Systems:

1. Equipment Grounding:

- a. Ground all electrical equipment in compliance with the National Electrical Code.
- b. Equipment grounding conductors shall be stranded copper cable of adequate size installed in conduit where necessary for mechanical protection. Ground conductors, pulled into conduits with non-grounded conductors, shall be insulated. Color of insulation shall be green.
- c. Connect ground conductors to conduit with copper clamps, straps or with grounding bushings.
- d. Connect to piping by welding or brazing. Use copper bonding jumpers on all gasketed joints.
- e. 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 holddown bolts. Where grounding provisions are not included, drill suitable holes in locations designated by ENGINEER.
- f. Connect to motors by bolting directly to motor frames, not to sole plates or supporting structures.
- g. Connect to service water piping by means of copper clamps. Use copper bonding jumpers on all gasketed joints.
- h. Scrape bolted surfaces clean and coat with a conductive oxide-resistant compound.

- F. Service and Distribution:

1. Lighting and Distribution Panelboards:

- a. Mounting: Install panelboards at locations shown on Drawings. Set cabinets so that top branch circuit breaker is not over 6 feet from the floor.
 - b. Directory: Complete typewritten directory indicating items controlled by each circuit breaker and the size of feeder serving the panel.
 - c. Arrange circuits to balance the loads on the panelboards.
2. Lighting Fixtures:
- a. General: 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. Suspended Fixtures: Pendant mount using ½-inch conduit stems. Ground to outlet box. Attach mounting to building structure with expansion anchors. Fixtures shall not be dependent on the outlet box cover screws for support.
 - c. Surface Mounted Fixtures: Attach to appropriate outlet box.
 - d. Boxes and Fixtures:
 - i. For units mounted against masonry or concrete walls, provide suitable ½-inch spacers to prevent mounting back of box directly against wall.
 - ii. Bolt units rigidly to building with expansion anchors, toggle bolts, hangers or Unistrut.
 - iii. No boxes shall be installed with open conduit holes.
 - iv. Cable each circuit and identify with tag.
 - e. Mounting Heights: Mounting heights or elevations are to bottom of the fixture or to centerline of device.
3. Inspections, Testing and Adjustments
- a. Inspections: Accompany the normal installation tests with inspections to demonstrate to the satisfaction of the District the following:
 - i. Connections: All circuits are properly connected in accordance with the Drawings and applicable approved Shop Drawings.
 - ii. Operation: All circuits and devices are operable.
 - iii. Identification: All conductors are properly identified at each terminal.

G. Testing:

- a. 600 Volt Cable:

- i. Test each electrical circuit after permanent cables are in place to demonstrate that the circuit and connected equipment perform satisfactorily and that they are free from improper grounds and short circuits.
 - ii. Individually test 600-volt cables for insulation resistance between phases and from each phase to ground. Test after cables are installed and before they are put in service with a Megger whose rating is suitable for the tested circuit.
 - iii. The insulation resistance for any given conductor shall not be less than 1 megohm for 600 volt and less service. Any cable not meeting this value, or which fails when tested under full load conditions shall be replaced with a new cable for the full length.
- b. Instrumentation Cable:
 - i. Test shielded instrumentation cable shields with an ohmmeter for continuity along the full length of the cable and for shield continuity to ground.
 - ii. Connect shielded instrumentation cables to a calibrated 3-20 milliamp DC signal transmitter and receiver. Test at 4, 12, and 20 milliamp transmitter settings.
- c. Grounding System:
 - i. Test the completed ground systems for continuity and for resistance to ground using an electrical ground resistance tester.
- d. Operation Tests:
 - i. Operate all circuit breakers and associated equipment to demonstrate suitability and compliance with Specifications and reference standards, except for short circuit interrupting rating or other inherent design features covered by shop tests.
 - ii. Test all motors and generators for direction of rotation and reverse connections if necessary.
 - iii. Check control circuits to determine that operation and sequence are correct and adjust limit switches, pressure switches, float switches, timers and other devices to give proper operation.
 - iv. All tests shall be witnessed by the Engineer.

END OF SECTION

Appendix A

Geotechnical Engineering Report

Lake Apopka North Shore Pumping Station
Apopka, Orange County, Florida

January 14, 2019

Terracon Project No. H1185305

Prepared for:

Reiss Engineering, Inc.
Winter Springs, Florida

Prepared by:

Terracon Consultants, Inc.
Winter Park, Florida

terracon.com

Terracon

Environmental



Facilities



Geotechnical



Materials

January 14, 2019



Reiss Engineering, Inc.
1016 Spring Villas Pt.
Winter Springs, Florida 32708

Attn: Mr. Ervin B. Myers
P: (407) 679 5358
E: ebmyers@REISSENG.com

Re: Geotechnical Engineering Report
Lake Apopka North Shore Pumping Station
McDonald/Fudge Road and Laughlin Road
Apopka, Orange County, Florida
Terracon Project No. H1185305

Dear Mr. Myers:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PH1185305 dated September 19, 2018. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork, discharge pipe subgrade, earthen dam, and a pump system for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.
Certificate of Authorization No. 8830

Shenna McMaster, P.E.
Senior Geotechnical Engineer
Florida PE #57537

Jay W. Casper, P.E.
Principal

This report has been electronically signed and sealed by Shenna McMaster, P.E. on January 14, 2019 using a Digital Signature.
Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

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REPORT SUMMARY

Topic ¹	Overview Statement ²
Project Description	New pump station and piping, possible earthen ditch plug.
Geotechnical Characterization	Surface organic soils to depths of 6 to 8 feet underlain by alternating layers of elastic silt, clay and sands. Calcareous silty sand was found in the borings in the upper 13 to 18 feet.
Earthwork	Removal of organic soils and over-excavation/replacement of soft limestone below pipe
Deep Foundations	Steel H-piles or Pipe pile installed to minimum of 50 feet below existing grade for support of new pump station.
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Geotechnical Engineering Report

Lake Apopka North Shore Pumping Station

McDonald/Fudge Road and Laughlin Road

Apopka, Orange County, Florida

Terracon Project No. H1185305
January 14, 2019

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed pump station, piping, and earthen ditch plug to be located at McDonald/Fudge Road and Laughlin Road in Apopka, Orange County, Florida. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Foundation design and construction for the pump station to be supported on a pile foundations system
- Pipe subgrade and backfill
- Slope stability for the earthen ditch plug.

The geotechnical engineering scope of services for this project included the advancement of 3 test borings to depths ranging from approximately 50 to 65 feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section of this report.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Geotechnical Engineering Report

North Shore Unit 1 Pump Station ■ Lake Apopka, Florida

January 14, 2019 ■ Terracon Project No. H1185305



Item	Description
Parcel Information	The project is located at McDonald/Fudge Road and Laughlin Road in Apopka, Orange County, Florida. Approximate Latitude 28° 41.88' N, Longitude 81° 36.53' W See Site Location
Existing Improvements	Dirt roads, drainage culverts
Current Ground Cover	Dirt roads and wetlands
Existing Topography	The USGS topographic quadrangle map "Apopka, Florida indicates existing grade at the project site near +68 feet. Site specific topographic information provided indicated that the existing canals have bottom elevations ranging from +54 to +56 feet. The top of slope of the canals are near +63 ft.

Soil Survey

The Soil Survey of Orange County, Florida as prepared by the United States Department of Agriculture (USDA), Soil Conservation Service (SCS; later renamed the Natural Resource Conservation Service - NRCS), identifies the soil type at the subject site as *Gator muck, frequently flooded, 0 to 1 percent slopes (18)*. A Soils Map is included with this [GeoReport](#), depicting the applicable Soil Survey map portion for the subject site.

18 – Gator muck. This soil map unit is nearly level and very poorly drained. It is typically found in freshwater swamps that are mainly north of Lake Apopka. Undrained areas of Gator muck are ponded for 6 to 9 months or more each year. Large ditches and canals equipped with water control structures dissect the map unit in most places. In drained areas, the water table is controlled at a depth between 10 and 36 inches (0.8 to 3.0 feet) or according to the need of the crop grown at that location. Gator muck typically exists as muck (USCS Classification symbol PT, for "peat") from the surface to a depth of 28 inches (2.3 feet). Typical organic contents of this layer range from 55 to 85 percent. From a depth of 28 inches (2.3 feet) and extending to the maximum defined depth of 80 inches (6.7 feet), Gator soil is predominantly sandy.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed in the project planning stage. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	Concept plan and SJRWMD scope document provide by Reiss via email on September 14, 2018

Geotechnical Engineering Report

North Shore Unit 1 Pump Station ■ Lake Apopka, Florida

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Item	Description
Project Description	New pump station and piping to a discharge on the southern portion of the project area (Fudge Road, just east of Laughlin Road) and an earthen ditch plug east of Laughlin Road, approximately 400 feet north of the new pump station.
Pump Station	The pump station is anticipated to be supported on a metal platform on steel piling. Anticipated loads are expected to be 12 kips per pile axial compressive load.
Discharge and Pipe	A discharge from the pump station is planned south of Fudge Road. The discharge is anticipated to consist of rip-rap.
Earthen Ditch Plug	The earthen ditch plug is anticipated to have a top width of 15 feet and side slopes of 3 Horizontal to 1 Vertical (3H:1V). A 48 inch pipe through the earthen ditch plug is planned to hydraulically connect the north and south portions of the ditch.

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options.

Generally, the borings found the following subsurface conditions:

Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
6 to 8	Surface cover of silty sand (SM) or limerock underlain by peat/muck (Pt)	Loose to medium dense sands; medium stiff to very stiff muck
13.5 to 18.5	Silty sand (calcareous)	Loose to medium dense
28.5 to 33.5	Alternating layers of elastic silt (MH), sand (SP), silty sand (SM), and clay with sand (CH) ¹	Medium stiff to stiff silts and clay; loose to medium dense sand
Boring termination depths to 50 to 65 feet	Alternating layers of sand with varying amounts of silt (SP-SM, SM) and/or clayey sand (SC) ²	Loose to medium dense

¹ Borings B-1 and B-2 found shelly sand at depths of 18.5 to 28.5 feet below existing grade.

² Boring B-1 found organic silty sand (Pt) at 38.5 to 43.5 feet below existing grade.

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types. The in-situ, the transition between materials may be gradual.

Groundwater Conditions

The borings were observed during drilling for the presence and level of groundwater. Groundwater levels were estimated to be at depths of about 7 feet to more than 10 feet below existing grade. Due to the use of driller's mud to stabilize boreholes, accurate groundwater levels could not be measured below a depth of 10 feet.

It should be recognized that fluctuations of the groundwater table will occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the boring was performed. In addition, perched water can develop within higher permeability soils overlying less permeable soils. Therefore, groundwater levels during construction or at other times in the future may be higher or lower than the levels indicated on the boring logs.

We estimate that during the normal wet season groundwater levels will predominantly be dependent on established drainage control systems. The seasonal high water table may vary from normal when affected by extreme weather changes, localized or regional flooding, karst activity, future grading, drainage improvements, or other construction that may occur on or around the site following the date of this report.

GEOTECHNICAL OVERVIEW

Borings encountered mostly sands with lenses of organic soils and silts and clays. Organic soils may cause settlement if left in place below piping and the earthen ditch plug. Unless the organic soils are removed below the piping and discharge from the pump station, and the earthen ditch plug, settlements of a few inches should be considered in design of pipe inverts.

Over-excavation of organic soils and calcareous silty sand to a depth of at least 2 feet below the bottom of pipes and replacement with adequately compacted sand is recommended.

Deep foundations for the pump station should extend past the deeper organic soil layer found at 38.4 to 43.5 feet below existing grade. Minimum pile embedment depths of 50 feet are recommended, even if capacities exceed the design capacity.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork will include clearing and grubbing, demucking, excavations and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria as necessary to render the site in the state considered in our geotechnical engineering evaluation for foundations and pipe subgrade and backfill.

General Site Preparation

The following general procedures are recommended for site preparation:

- All excavations required for pipe installation should be performed in accordance with appropriate Occupational Safety and Health Administration (OSHA) excavation standards. The presence of highly organic soils should be considered in excavations.
- If safe side slopes cannot be maintained or are not desired due to other considerations, a properly designed braced excavation, trench shield, sheet piling, or chemically grouted wall would be required for stable excavations. All shields, shoring and bracing systems, or sheet piling should be designed and reviewed by an experienced Professional Engineer registered in the State of Florida. Adjacent traffic loads, and induced vibrations among other factors should be included in the design of these stabilization systems.
- Depending on the proposed excavation depths of a water levels at the time of construction, temporary dewatering may be required to facilitate excavations, backfilling, and compaction in the dry.

Fill Material Types

Fill required to achieve design grade should be classified as general fill. Earthen materials used for general fill should meet the following material property requirements:

Soil Quality ¹	USCS Classification	Acceptable Location for Placement	Maximum Lift Thickness (in.)
Preferred ¹	SP (fines content < 5%)	All locations and elevations	12 ³
	SP-SM (fines content between 5 and 12%) ²	All locations and elevations except strict moisture control will be required during placement, particularly during the rainy season.	8 to 12 ³
Limited	SM, SC (fines content >12%)	Limited to mass fill greater than 2 feet below final grade; strict moisture control will be required during placement.	6 to 8 ⁴

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris.
2. If fines contents are greater than 12 percent, special design and construction procedures may be necessary.
3. Loose thickness when heavy compaction equipment is used in vibratory mode. Lift thickness should be decreased if static compaction is being used, typically to no more than 8 inches, and the required compaction must still be achieved. Use 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is required.
4. Static equipment should be used.

Fill Compaction Requirements

General fill should meet the following compaction requirements.

Item	Structural Fill
Minimum Compaction Requirements ¹	95 percent of the material's maximum modified Proctor dry density (ASTM D 1557).
Moisture Content ²	Within ±2 percent of optimum moisture content as determined by the Modified Proctor test, at the time of placement and compaction.
Minimum Testing Frequency	One field density test per 20,000 square feet or fraction thereof per 1-foot lift.

1. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proofrolled.

Pipe Subgrade (Bedding)

Regarding the pipe subgrade soils, we offer the following recommendations:

- Near surface organic soils to a depth of 6 to 8 feet were observed in the borings. Due to its high compressibility potential, these high organic soils may cause settlement outside of normal tolerances, if left in place below the proposed pipes or structures on shallow foundations. The presence of buried organic soils may also indicate the presence of buried stumps or trees within the organic layer. Calcareous silty sands were observed to depths of 13.5 to 18.5 feet below existing grade in the borings. Over-excavation of organic soils and the calcareous sands to a depth of at least 2 feet below the bottom of pipes and replacement with adequately compacted sand is recommended. If organic soils are left in place below the proposed pipe, settlements should be considered in design of pipe inverts.
- The bedding soil beneath the pipe should be properly shaped to completely support the pipe section and areas should be excavated to accommodate any bells or other raised portions of the pipe to help avoid point loading conditions.
- If dense or cemented soils are encountered within 1 foot below the pipe bottom, it is recommended that these soils be removed to a depth of 1 foot below the pipe bottom and replaced with clean granular fill material to avoid uneven loading (point loads) of pipes and fittings.
- A minimum separation of 2 feet between the bottom of the subgrade level and the groundwater level is recommended during construction and backfilling operations. A

properly designed temporary dewatering system may be required to maintain this minimum separation.

- After the subgrade soils have been prepared as recommended above, the pipe may be installed.

Pipe Backfill Soils

Regarding the pipe subgrade soils we offer the following recommendations:

- Once the pipe has been laid in the excavation trench and approved, backfill should be carefully deposited and compacted to the centerline of the pipe on both sides.
- Compaction of backfilled soils above the centerline of the pipe to the proposed final grade should be accomplished in lift thicknesses no thicker than 12 inches.
- All fill should be non-plastic, granular soils (clean sands) free of roots and debris. The excavated clean granular soils should be suitable for use as pipe backfill. Inorganic fine sand (SP) and fine sand with silt (SP-SM) are acceptable for this use. Silty fine sand (SM) and clayey sands (SC) materials may be used as backfill, but these soils typically retain moisture and may be difficult to dry and compact. Organic soils, the calcareous silty sand, elastic silts, and clays are not suitable for use as backfill material.
- From 1 foot above the pipe to the finished grade elevation, compaction should be accomplished with a small plate or hand-guided drum type vibratory compactor. Extreme caution should be exercised when operating vibratory equipment near existing structures. Smaller hand compactors should be utilized in all restricted areas, such as beneath pipe haunches and to 1 foot above the pipe to help provide uniform compaction around the pipe.
- At least one (1) density test per 300 lineal feet of pipe length per lift should be performed to verify that the soil has been compacted to at least 98 percent of its modified Proctor maximum dry density (ASTM D-1557). Care should be taken to also test the haunch area and to 1 foot above the pipe on this same frequency of one (1) test per 300 lineal feet of pipe installed.
- If compaction difficulties arise during construction, the Geotechnical Engineer should be consulted to provide further recommendations.

Earthen Ditch Plug

Soil conditions encountered at the boring performed near the proposed earthen ditch plug (Boring B-3) consisted of a surface cover of silty sand to a depth of about 6 feet underlain by organic peat/muck (Pt) to a depth of about 8 feet, calcareous silty sand to a depth of about 13.5 feet, and alternating layers of elastic silt (MH), silty sand (SM), shelly sand (SP), and clayey sand (SC) to

the boring termination depth of 50 feet. The bottom of the existing ditch may be below the organic soils found in the boring, performed at the top of bank. If organic soils are present below the ditch bottom and will be left in place below the ditch plug, the ditch plug should be constructed a few inches higher than required by design to account for potential settlement of the organic soils.

The ditch plug should be constructed in accordance with the following steps:

- Clear and grub the ditch plug site to remove vegetation, debris and highly organic topsoil and other deleterious materials encountered. The bottom of the existing ditch may be below the organic soils found in the boring, performed at the top of bank. Depending on the pipe installation depth, over-excavation and replacement of calcareous silty sand may need to be performed as recommended in the **Pipe Subgrade (Bedding)** section.
- Proofroll/compact the ditch plug area. These operations should be observed by a representative of the geotechnical engineer. Soils which yield excessively in the judgment of the geotechnical engineer's representative should be undercut and replaced with a clean soil compacted to 95 percent of the soil's modified Proctor maximum dry density (ASTM D-1557). The proofrolled or compacted surface should be lightly scarified prior to addition of the next lift of fill.
- Construct the ditch plug in level lifts compacted to 95 percent of the modified Proctor maximum density (ASTM D-1557) of the fill materials. Fill materials for use in ditch plug construction should consist of inorganic, non-cohesive sands free of debris and vegetative material. Clean sand fill with less than 10 percent fines may be placed in loose lifts up to 12 inches in thickness. Sands with higher fines contents should be limited to loose lift thicknesses of 8 inches or less. The surface should be lightly scarified between each lift. Compaction testing should be performed for each lift at a frequency not less than two (2) tests for each per lift of fill placed.
- The exterior berm surface should be sodded after construction.

Slope stability analyses were performed using the *STABL for Windows* computer program assuming that the water level in the ditch is +56 feet on both sides of the ditch plug. The top of the ditch plug was assumed at elevation +64 feet, the bottom of the ditch at elevation +54, and side slopes of 3H:1V. Based on our analyses, it appears that the factor of safety for the exterior slopes exceeds 1.3 assuming a minimum top width of 15 feet, which is generally considered acceptable. Analyses assume that the ditch plug is properly constructed in accordance with the recommendations in this report.

The above analysis is for global slope stability of the ditch plug, with the geometry described above. The analysis does not consider surface erosion which may occur on the slope face. Erosion control (such as sod) and routine inspection of the ditch plug and immediate repair of

eroded areas is recommended. Depending on pipe invert elevations, use of a seepage collar may be appropriate for the pipe through the ditch plug.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and top soil, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency stated in **Earthwork**.

In areas of excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. In the event unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

PUMP STATION FOUNDATION DESIGN

Based on information provided, we understand the proposed pump station will be supported on a deep foundation system. Driven steel H-piles (HP 12x53) are the preferred foundation type. A target axial compressive capacity of 12 kips per pile is desired. Due to an organic soil layer found at a depth of 38.5 to 43.5 feet below existing grade, we recommend that piles be driven to a minimum depth of 50 feet below existing grade to reduce the potential for excessive long-term settlement if piles are tipped above this organic soil layer. Driving forces and ease of handling during construction should be considered in the pile type selection.

Driven Pile Design Parameters

The following table can be used to estimate capacities for individual, driven Steel H-Piles or pipe piles. Due to organic soils observed at a depth of about 38 to 43 feet below existing grade in the pump, we recommend that piles be driven to a minimum depth of 50 feet below existing grade to minimize post-construction settlement. Although the target allowable capacity per pile is 12 kips, a greater capacity may be appropriate for the pile sections, considering the minimum embedment depth. A factor of safety of 2 was applied to these axial compressive capacities.

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Driven Pile Design Summary ^{1, 2}	
Pile Section	Allowable Axial Compressive Pile Capacity with embedment at 50 ft. below existing grade (kips) ³
HP 8 x 36	16
HP 12 x 53	25
8 inch Pipe (Open)	14

1. Design capacities are dependent upon the method of installation, and quality control parameters. The values provided are estimates and should be verified when installation protocol have been finalized.
2. Design capacities can be increased by 33% for highly transient loads
3. Applicable for compressive loading only. Reduce to 2/3 of values shown for uplift loading. Effective weight of pile can be added to uplift load capacity.

Driven piles should be spaced at least three pile widths apart (center-to-center). The capacities presented below are based on the top of pile being within 5 feet of existing grade. Pile capacities should be re-evaluated if the top of piles will be more than 5 feet below existing grade.

Driven Pile Lateral Loading

The following table lists input values for use in LPILE analyses. LPILE will estimate values of k_h and E_{50} based on strength. Since deflection or a service limit criterion will likely control lateral capacity design, no safety/resistance factor is included with the parameters.

Depth ¹		L-Pile Soil Model	S_u (psf) ²	ϕ ²	γ (pcf) ^{2,3}
Top	Bottom				
0	6	Soft Clay	100	---	70
6	13	Sand (Reese)	---	29°	105
13	23	Sand (Reese)	---	32°	110
23	28	Soft Clay	1000	---	110
28	38	Sand (Reese)	---	32°	110
38	43	Soft Clay	250	---	90
43	60	Sand (Reese)	---	30°	110

1. Below existing grade
2. Definition of Terms:
 S_u : Undrained shear strength
 ϕ : Internal friction angle
 γ : Moist unit weight
3. Buoyant unit weight values should be used below water table.

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Lateral pile analysis included two assumptions for the pile head fixity; free and fixed. Limiting lateral deflections of 0.25 and 0.5 inch at the top of pile were evaluated. The following scenarios for lateral pile loading were evaluated:

- (1): Free Head condition, Displacement = 0.25"
- (2): Fixed Head condition, Displacement = 0.25"
- (3): Free Head condition, Displacement = 0.5"
- (4): Fixed Head condition, Displacement = 0.5"

The table below summarized the lateral pile capacity for individual piles:

Lateral Load (tons) for Varying Deflections (inches)				
Pile Type	Lateral Displacement = 0.25"		Lateral Displacement = 0.5"	
	Free Head (1)	Fixed Head (2)	Free Head (3)	Fixed Head (4)
HP 8 x 36	1	4	2	7
HP 12 x 53	2	8	4	14
8" Pipe (open end)	1	2	1	4

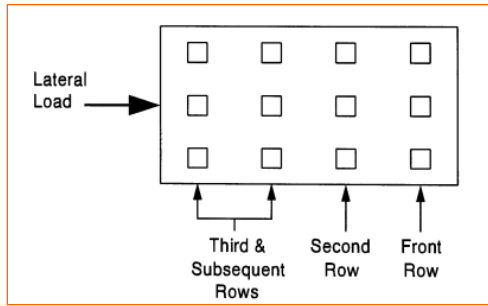
Below are the maximum moments in the piles for the above conditions:

Corresponding Ultimate Moment (in-lbs)								
Type	Lateral Displacement = 0.25"				Lateral Displacement = 0.5"			
	Free Head (1)		Fixed Head (2)		Free Head (3)		Fixed Head (4)	
	Pile Cap Interface	Pile Only	Pile Cap Interface	Pile Only	Pile Cap Interface	Pile Only	Pile Cap Interface	Pile Only
	HP 8 x 36	0	92,478	-256,037	102,775	0	170,816	-469,968
HP 12 x 53	0	212,169	-594,838	236,497	0	395,323	-1,092,513	436,303
8" Pipe (open end)	0	47,308	-132,698	54,152	0	87,501	-241,372	100,427

When piles are used in groups, the lateral capacities of the piles in the second, third, and subsequent rows of the group should be reduced as compared to the capacity of a single, independent pile. Guidance for applying p-multiplier factors to the p values in the p-y curves for each row of pile foundations within a pile group are as follows:

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- Front row: $P_m = 0.8$;
- Second row: $P_m = 0.4$
- Third and subsequent row: $P_m = 0.3$.

The load capacities provided herein are based on the stresses induced in the supporting soil strata. The structural capacity of the piles should be checked to assure they can safely accommodate the combined stresses induced by axial and lateral forces. Lateral deflections of piles should be evaluated using an appropriate analysis method, and will depend upon the pile's diameter, length, configuration, stiffness and "fixed head" or "free head" condition. We can provide additional analyses and estimates of lateral deflections for specific loading conditions upon request. The load-carrying capacity of piles may be increased by increasing the section (for H-piles), diameter (for pipe piles) and/or length.

Driven Pile Construction Considerations

The contractor should select a driving hammer and cushion combination which can install the selected piling without overstressing the pile material. The hammer should have a rated energy in foot-pounds at least equal to 15 percent of the design compressive load capacity in pounds. The contractor should submit the pile driving plan and the pile hammer-cushion combination to the engineer for evaluation of the driving stresses in advance of pile installation. During driving a maximum of 10 blows per inch is recommended to reduce the potential of damage to the piles.

Consideration should be given to using protective points and/or flange stiffening if difficult driving is encountered. Splicing of piles should be in accordance with specifications provided by the project Structural Engineer.

Pile driving conditions, hammer efficiency, and stress on the pile during driving could be better evaluated during installation using a Pile Driving Analyzer (PDA). A Terracon representative should observe pile driving operations. Each pile should be observed and checked for buckling, crimping and alignment in addition to recording penetration resistance, depth of embedment, and general pile driving operations.

The pile driving process should be performed under the direction of the Geotechnical Engineer. The Geotechnical Engineer should document the pile installation process including soil/rock and

groundwater conditions encountered, consistency with expected conditions, and details of the installed pile.

CORROSIVITY

The table below lists the results of laboratory soluble sulfate, soluble chloride, electrical resistivity, and pH testing. The values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Corrosivity Test Results Summary					
Boring	Sample Depth (feet)	Soluble Sulfate	Soluble Chloride	Electrical Resistivity (Ω-cm)	pH
B-1	6-10	Below Detection	15 ppm	3,800	8.5
B-2	8-13.5	15 ppm	15 ppm	4,300	8.6

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our scope of services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Geotechnical Engineering Report

North Shore Unit 1 Pump Station ■ Lake Apopka, Florida

January 14, 2019 ■ Terracon Project No. H1185305



Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Location
3	50 to 65	Pump Station (B-1) Pipe and Discharge (B-2) Earthen Dam (B-3)

Boring Layout: Terracon personnel provide the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ± 20 feet).

Subsurface Exploration Procedures: We advanced the borings with an ATV-mounted rotary drill rig using rotary drilling techniques. Five samples are obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. For safety purposes, all borings are backfilled with auger cuttings after their completion.

The sampling depths, penetration distances, and other sampling information are recorded on the field boring logs. The samples are placed in appropriate containers and taken to our soil laboratory for testing and classification by a geotechnical engineer. Our exploration team prepares field boring logs as part of the drilling operations. These field logs include visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs are prepared from the field logs. The final boring logs represent the geotechnical engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviews the field data and assigns various laboratory tests to better understand the engineering properties of the various soil strata as necessary for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods are applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Geotechnical Engineering Report

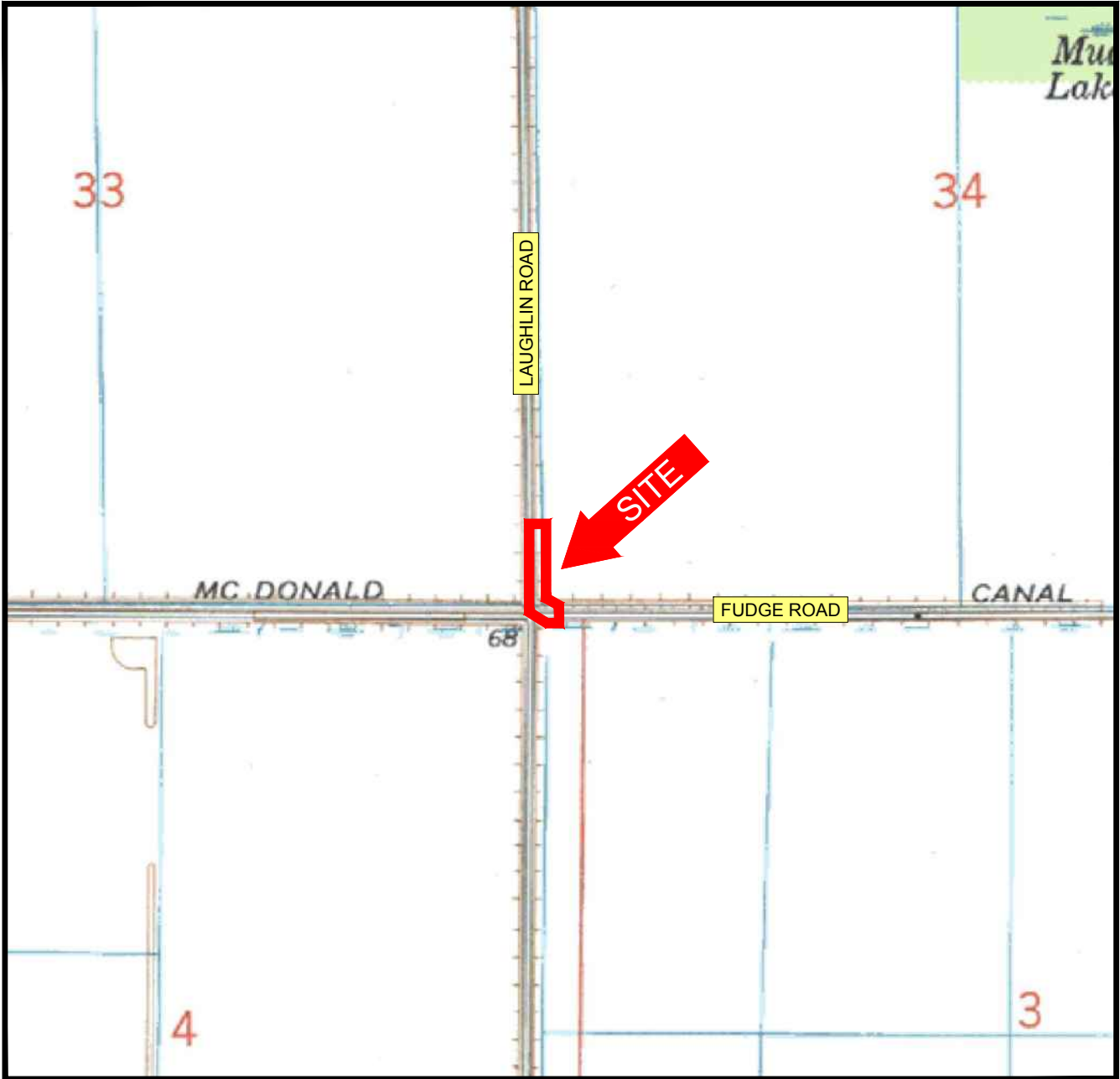
North Shore Unit 1 Pump Station ■ Lake Apopka, Florida
January 14, 2019 ■ Terracon Project No. H1185305



- ASTM D1140-17 Standard Test Method for Amount of Material in Soils Finer than No. 200 (75- μ m) Sieve
- ASTM D2974-14 Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

The laboratory testing program often includes examination of soil samples by an engineer. Based on the material's texture and plasticity, we describe and classify the soil samples in accordance with the Unified Soil Classification System.

SITE LOCATION AND EXPLORATION PLANS



SCALE 1"=1000'



APOPKA, FLORIDA
 ISSUED: 1980
 7.5 MINUTE SERIES (QUADRANGLE)



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Project Mngr:	SM	Project No.	H1185305
Drawn By:	AS	Scale:	AS SHOWN
Checked By:	SM	File No.	H1185305
Approved By:	JWC	Date:	11-26-18

Terracon
 Consulting Engineers and Scientists

1675 LEE ROAD WINTER PARK, FLORIDA 32789
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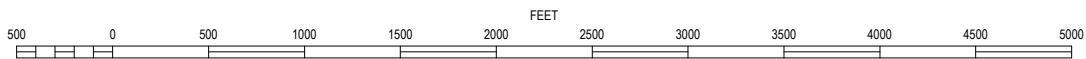
TOPOGRAPHIC VICINITY MAP
 GEOTECHNICAL ENGINEERING REPORT
 LAKE APOPKA NORTH SHORE UNIT 1 PUMP STATION
 LAUGHLIN ROAD AND FUDGE ROAD
 APOPKA, ORANGE COUNTY, FLORIDA

EXHIBIT

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SCALE 1"=1000'



U.S.D.A. SOIL SURVEY FOR ORANGE COUNTY, FLORIDA

SOIL LEGEND

18 GATOR MUCK, FREQUENTLY FLOODED, 0 TO 1 PERCENT SLOPES



Project Mngr:	SM
Drawn By:	AS
Checked By:	SM
Approved By:	JWC

Project No.	H1185305
Scale:	AS SHOWN
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SOILS MAP


GEOTECHNICAL ENGINEERING REPORT
LAKE APOPKA NORTH SHORE UNIT 1 PUMP STATION

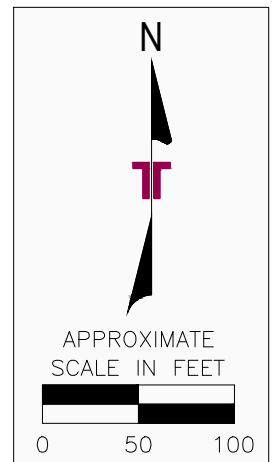
LAUGHLIN ROAD AND FUDGE ROAD
APOPKA, ORANGE COUNTY, FLORIDA

EXHIBIT



LEGEND

 APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING



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Project Mngr:	SM	Project No.	H1185305
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Checked By:	SM	File No.	H1185305
Approved By:	JWC	Date:	11-26-18

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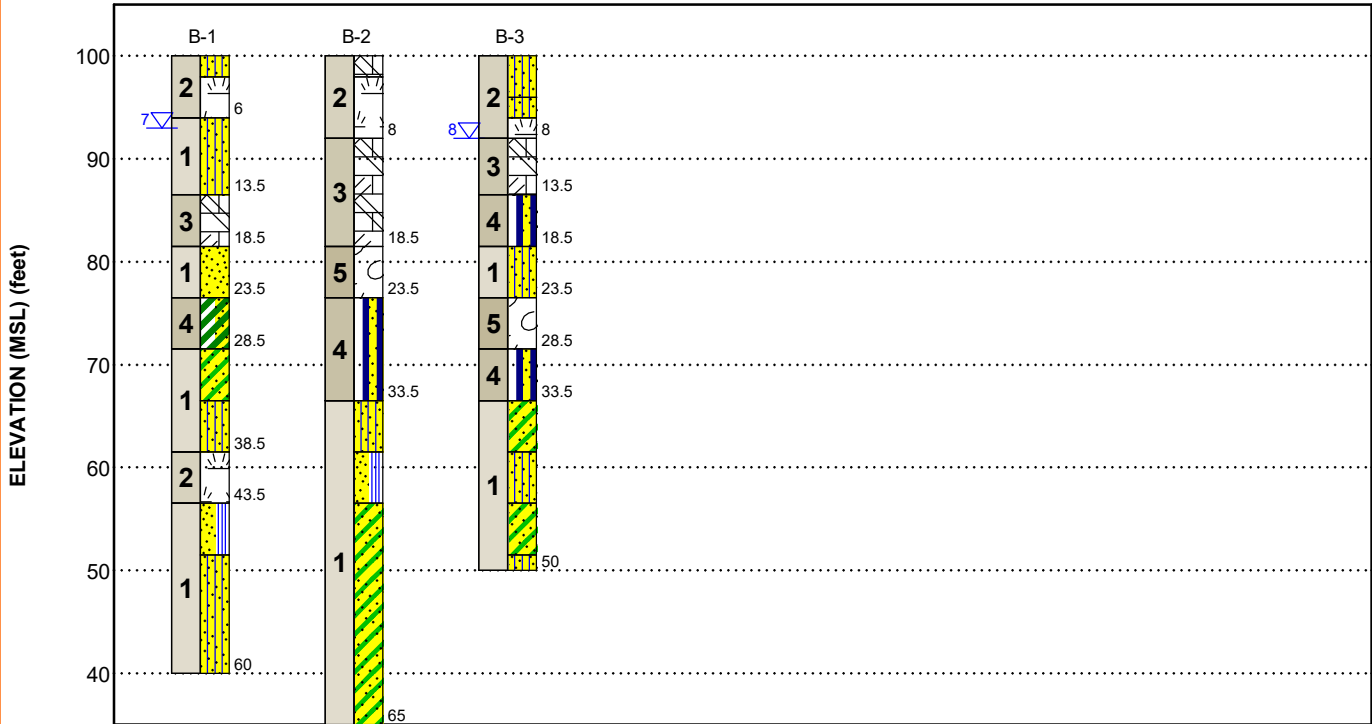
LOCATION PLAN
GEOTECHNICAL ENGINEERING REPORT
LAKE APOPKA NORTH SHORE UNIT 1 PUMP STATION
 LAUGHLIN ROAD AND FUDGE ROAD
 APOPKA, ORANGE COUNTY, FLORIDA

EXHIBIT

EXPLORATION RESULTS

GEOMODEL

North Shore Unit 1 Pump Station ■ Apopka, FL
 1/15/2019 ■ Terracon Project No. H1185305



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Silty/clayey sand	Sands with varying amounts of silt and/or clay (SP-SM, SM, SC)
2	Peat/Muck	Peat/Muck with varying amounts of sand and limestone, occassional sand overlay
3	Calcareous Silty Sand	Calcareous Silty Sand
4	Silts and Clay	Elastic Silt and Sandy Clay
5	Shelly Sand	Shelly sand

LEGEND

- Silty Sand
- Poorly-graded Sand
- Poorly-graded Sand with Silt
- Peat
- Fat Clay with Sand
- Shell
- Weathered Limestone
- Clayey Sand
- Elastic Silt with Sand

- First Water Observation
- Second Water Observation
- Final Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
 Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
 Numbers adjacent to soil column indicate depth below ground surface.

BORING LOG NO. B-1

PROJECT: North Shore Unit 1 Pump Station

CLIENT: Reiss Engineering, Inc.
Winter Springs, FL

SITE: McDonald/Fudge Road and Laughlin Road
Apopka, FL

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_H1185305 NORTH SHORE UNIT_GPJ_MODEL LAYER.GPJ 1/15/19

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 28.6981° Longitude: -81.6088°	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	PERCENT FINES	WATER CONTENT (%)	ATTERBERG LIMITS	
										LL-PL-PI	ORGANIC CONTENT (%)
2		SILTY SAND (SM) , orange-brown	2.0				3-3-3-4 N=6				
		SANDY PEAT/MUCK (PT) , dark brown	6.0				4-4-4-5 N=8	64			16
				5	▽		2-2-2-3 N=4	387			88
1		SILTY SAND (SM) , with limestone fragments, light brown	13.5				2-2-2-3 N=4				
		CALCAREOUS SILTY SAND , very light brown	18.5				1-1-4-2 N=5				
3			18.5				11-8-7 N=15	36	41		
1		SAND (SP) , with limestone fragments, light brown	23.5				4-4-7 N=11				
4		CLAY WITH SAND (CH) , gray	28.5				1-1-2 N=3	88	82	126-42-84	
		CLAYEY SAND (SC) , gray	33.5				8-7-8 N=15				
1		SILTY SAND (SM) , trace clay, light brown	38.5				4-5-5 N=10	18	26		
2		ORGANIC SILTY SAND (PT) , dark brown	43.5				1-2-2 N=4		121		35
		SAND WITH SILT (SP-SM) , gray-brown	48.5				4-6-11 N=17	10	22		
1		SILTY SAND (SM) , light gray to light greenish-gray	60.0				3-3-4 N=7				
				55			3-5-5 N=10	42	28		
				60			5-5-5 N=10				
Boring Terminated at 60 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:	See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (if any).	Notes:	
Abandonment Method:	See Supporting Information for explanation of symbols and abbreviations.		
WATER LEVEL OBSERVATIONS			
Water observed at 7 ft.			
<p>1675 Lee Rd Winter Park, FL</p>			
		Boring Started: 12-05-2018	Boring Completed: 12-05-2018
		Drill Rig: CME 45	Driller: T. Brundridge
		Project No.: H1185305	

BORING LOG NO. B-2

PROJECT: North Shore Unit 1 Pump Station

CLIENT: Reiss Engineering, Inc.
Winter Springs, FL

SITE: McDonald/Fudge Road and Laughlin Road
Apopka, FL

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_H1185305 NORTH SHORE UNIT.GPJ MODEL LAYER.GPJ 1/15/19

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 28.698° Longitude: -81.6088°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	PERCENT FINES	WATER CONTENT (%)	ATTERBERG LIMITS	
									LL-PL-PI	ORGANIC CONTENT (%)
		DEPTH								
2		2.0	LIMEROCK WITH PEAT/MUCK (PT) , very light brown/dark brown			3-4-4-4 N=8				
			PEAT/MUCK (PT) , dark brown			4-4-3-4 N=7		554		92
		8.0	CALCAREOUS SILTY SAND , very light brown			4-3-3-4 N=6		525		91
3						3-3-4-4 N=7				
						2-2-3-3 N=5				
		18.5	SHELLY SAND WITH SILT (SP-SM) , light brown			24-8-3 N=11				
5		23.5	ELASTIC SILT (MH) , with shell and sand, dark gray to light gray			1-2-1 N=3	89	104	128-50-78	
4						7-5-6 N=11				
						2-2-2 N=4	16	25		
		33.5	SILTY SAND (SM) , trace clay, light brown			1-2-3 N=5				
		38.5	SAND WITH SILT (SP-SM) , dark gray-brown			7-7-8 N=15				
		43.5	CLAYEY SAND (SC) , gray-brown to light gray			2-3-3 N=6				
1						3-4-4 N=8				
						4-5-6 N=11				
		65.0	Boring Terminated at 65 Feet			3-3-6 N=9				

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:	See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (if any).	Notes:	
Abandonment Method:	See Supporting Information for explanation of symbols and abbreviations.		
WATER LEVEL OBSERVATIONS			
Water not observed at 10 ft.			
1675 Lee Rd Winter Park, FL		Boring Started: 12-04-2018	Boring Completed: 12-04-2018
		Drill Rig: CME 45	Driller: T. Brundridge
		Project No.: H1185305	

BORING LOG NO. B-3

PROJECT: North Shore Unit 1 Pump Station

CLIENT: Reiss Engineering, Inc.
Winter Springs, FL

SITE: McDonald/Fudge Road and Laughlin Road
Apopka, FL

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_H1185305 NORTH SHORE UNIT_GPJ_MODEL LAYER.GPJ 1/15/19

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 28.7014° Longitude: -81.609°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	PERCENT FINES	WATER CONTENT (%)	ATTERBERG LIMITS	
									LL-PL-PI	ORGANIC CONTENT (%)
		DEPTH								
2		SILTY SAND (SM) , light orange-brown	4.0			4-7-7-8 N=14				
			6.0			10-12-14-17 N=26				
		PEAT/MUCK with LIMESTONE (PT) , dark brown/light brown	8.0	▽		8-8-8-6 N=16		244		80
3		CALCAREOUS SILTY SAND , very light brown	13.5			4-5-5-10 N=10				
			15.0			8-4-4-3 N=8				
4		ELASTIC SILT WITH SAND (MH) , gray	18.5			5-2-1 N=3	62	75	121-60-61	
1		SILTY SAND (SM) , light gray	23.5			5-3-6 N=9				
5		SHELLY SAND (SP) , light gray	28.5			2-2-2 N=4				
4		ELASTIC SILT WITH SAND (MH) , gray	33.5			2-1-2 N=3	55	62	119-62-57	
		CLAYEY SAND (SC) , light gray-brown	38.5			5-8-9 N=17				
1		SILTY SAND (SM) , light gray-brown	43.5			3-2-3 N=5				
		CLAYEY SAND (SC) , light brown	48.5			3-6-6 N=12	25	18		
		SILTY SAND (SM) , trace clay, light gray	50.0			3-4-5 N=9				
Boring Terminated at 50 Feet										










Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:	See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (if any).	Notes:	
Abandonment Method:	See Supporting Information for explanation of symbols and abbreviations.		
WATER LEVEL OBSERVATIONS			
▽ Water observed at 8 ft.			
1675 Lee Rd Winter Park, FL			
		Boring Started: 12-04-2018	
		Boring Completed: 12-04-2018	
		Drill Rig: CME 45	
		Driller: T. Brundridge	
		Project No.: H1185305	

SUPPORTING INFORMATION

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING	 Auger Cuttings  Grab Sample  Shelby Tube	 Rock Core  No Recovery  Standard Penetration Test	WATER LEVEL	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	FIELD TESTS	(HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer
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DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS	RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
	Descriptive Term (Density)	Automatic Hammer SPT N-Value (Blows/Ft.)	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (psf)	Automatic Hammer SPT N-Value (Blows/Ft.)
	Very Loose	< 3	Very Soft	less than 500	< 1
	Loose	3 - 8	Soft	500 to 1,000	1 - 3
	Medium Dense	8 - 24	Medium Stiff	1,000 to 2,000	3 - 6
	Dense	24 - 40	Stiff	2,000 to 4,000	6 - 12
	Very Dense	> 40	Very Stiff	4,000 to 8,000	12 - 24
		Hard	> 8,000	> 24	

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification		
				Group Symbol	Group Name ^B	
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F	
			$Cu < 4$ and/or $1 > Cc > 3$ ^E	GP	Poorly graded gravel ^F	
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}	
			Fines classify as CL or CH	GC	Clayey gravel ^{F, G, H}	
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand ^I	
			$Cu < 6$ and/or $1 > Cc > 3$ ^E	SP	Poorly graded sand ^I	
		Sands with Fines: More than 12% fines ^D	Fines classify as ML or MH	SM	Silty sand ^{G, H, I}	
			Fines classify as CL or CH	SC	Clayey sand ^{G, H, I}	
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	$PI > 7$ and plots on or above "A" line	CL	Lean clay ^{K, L, M}	
			$PI < 4$ or plots below "A" line ^J	ML	Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K, L, M, N}
			Liquid limit - not dried			Organic silt ^{K, L, M, O}
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above "A" line	CH	Fat clay ^{K, L, M}	
			PI plots below "A" line	MH	Elastic Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K, L, M, P}
			Liquid limit - not dried			Organic silt ^{K, L, M, Q}
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat	

^A Based on the material passing the 3-inch (75-mm) sieve

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

$$E \quad Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

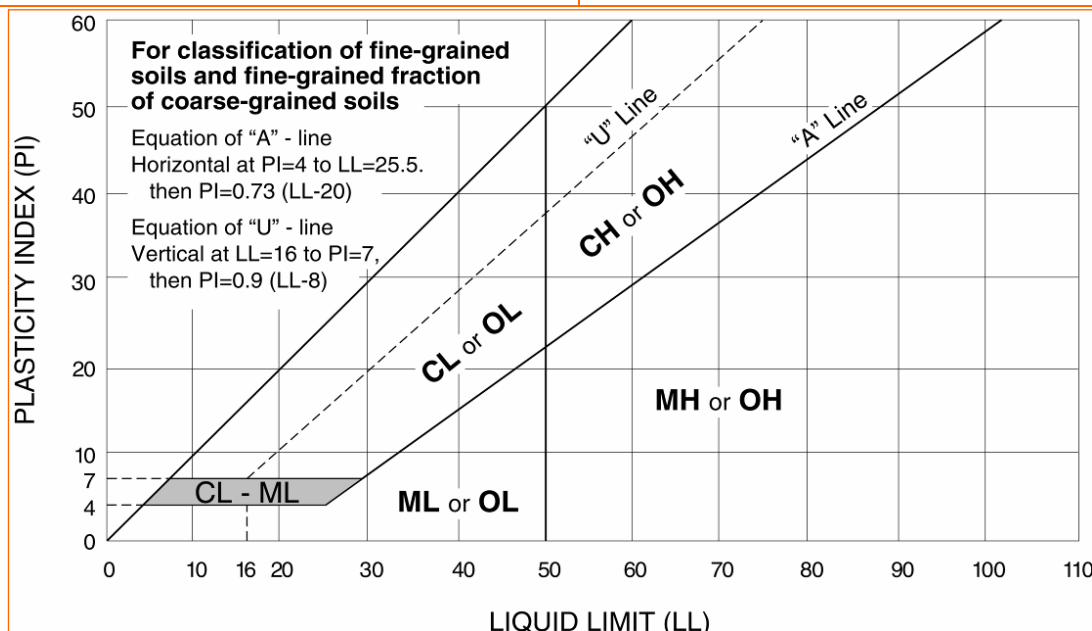
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

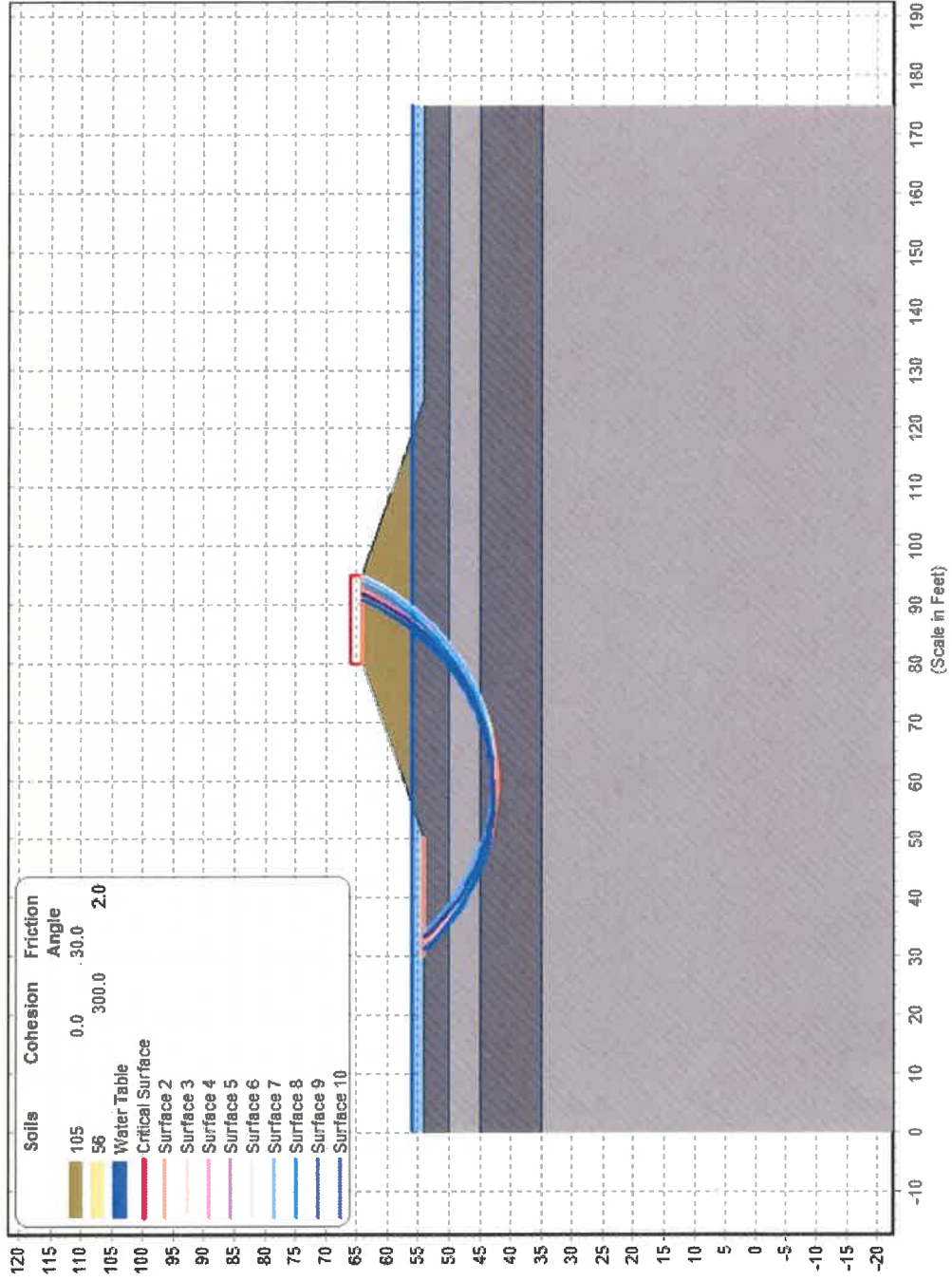
^P PI plots on or above "A" line.

^Q PI plots below "A" line.



EARTHEN DITCH PLUG SLOPE STABILITY

Problem: North Shore Unit 1 Pump Station - FS Min-Bishop = 1.371



result
** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION North Shore Unit 1 Pump Station

BOUNDARY COORDINATES

3 Top Boundaries
8 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	54.00	50.00	54.00	1
2	50.00	54.00	80.00	64.00	1
3	80.00	64.00	95.00	64.00	1
4	95.00	64.00	125.00	54.00	1
5	125.00	54.00	175.00	54.00	1
6	0.00	50.00	175.00	50.00	2
7	0.00	45.00	175.00	45.00	1
8	0.00	35.00	175.00	35.00	2

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ISOTROPIC SOIL PARAMETERS

result

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	105.0	115.0	0.0	30.0	0.00	0.0	1
2	0.0	1.0	300.0	2.0	0.00	56.0	175

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1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	56.00
2	175.00	56.00

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BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (psf)	Deflection (deg)
1	80.00	95.00	225.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

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result

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.

20 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between $X = 30.00$ ft.
and $X = 50.00$ ft.

Each Surface Terminates Between $X = 80.00$ ft.
and $X = 95.00$ ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is $Y = 0.00$ ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

PILE AXIAL CAPACITY

General Information:

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Input file:ects\2018\H1185305\Working Files\Calculations-Analyses\B-1.spc
 Project number: H1185305
 Job name: Lake Apopka North Shore Pump Station
 Engineer: McMaster
 Units: English

Analysis Information:

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Analysis Type: SPT

Soil Information:

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Boring date: 12/5/18, Boring Number: B-1
 Station number: Offset:

Ground Elevation: 0.000(ft)

Hammer type: Safety Hammer

ID	Depth (ft)	No. of Blows (Blows/ft)	Soil Type
1	0.00	0.00	5- Cavity layer
2	6.00	0.00	5- Cavity layer
3	7.00	4.00	2- Clay and silty sand
4	8.00	4.00	2- Clay and silty sand
5	10.00	5.00	2- Clay and silty sand
6	13.50	15.00	4- Lime Stone/Very shelly sand
7	18.50	11.00	3- Clean sand
8	23.50	3.00	1- Plastic Clay
9	28.50	15.00	2- Clay and silty sand
10	33.50	10.00	2- Clay and silty sand
11	38.50	4.00	2- Clay and silty sand
12	43.50	17.00	1- Plastic Clay
13	48.50	7.00	2- Clay and silty sand
14	53.50	10.00	2- Clay and silty sand
15	58.50	10.00	2- Clay and silty sand
16	60.00	0.00	5- Cavity layer

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Blowcount Average Per Soil Layer

Layer Num.	Starting Elevation (ft)	Bottom Elevation (ft)	Thickness (ft)	Average Blowcount (Blows/ft)	Soil Type
1	0.00	-7.00	7.00	0.00	5-Void
2	-7.00	-13.50	6.50	4.54	2-Clay and Silty Sand
3	-13.50	-18.50	5.00	15.00	4-Limestone, Very
Shelly Sand					
4	-18.50	-23.50	5.00	11.00	3-Clean Sand
5	-23.50	-28.50	5.00	3.00	1-Plastic Clay
6	-28.50	-43.50	15.00	9.67	2-Clay and Silty Sand
7	-43.50	-48.50	5.00	17.00	1-Plastic Clay
8	-48.50	-60.00	11.50	8.70	2-Clay and Silty Sand
9	-60.00	-60.00	0.00	0.00	5-

Driven Pile Data:

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Pile unit weight = 489.00(pcf), Section Type: H-Section

Pile Geometry:

Width (in)	Length (ft)	Tip Elev. (ft)	Depth (in)
8.02	40.00	-40.00	8.16
8.02	41.00	-41.00	8.16
8.02	42.00	-42.00	8.16
8.02	43.00	-43.00	8.16
8.02	44.00	-44.00	8.16
8.02	45.00	-45.00	8.16
8.02	46.00	-46.00	8.16
8.02	47.00	-47.00	8.16
8.02	48.00	-48.00	8.16
8.02	49.00	-49.00	8.16
8.02	50.00	-50.00	8.16
8.02	51.00	-51.00	8.16
8.02	52.00	-52.00	8.16
8.02	53.00	-53.00	8.16
8.02	54.00	-54.00	8.16
8.02	55.00	-55.00	8.16

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Driven Pile Capacity:

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Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
40.00	8.0	20.34	0.72	21.06	10.53	22.51
41.00	8.0	21.35	0.80	22.15	11.08	23.76
42.00	8.0	22.68	0.86	23.54	11.77	25.27
43.00	8.0	24.34	0.89	25.23	12.62	27.01
44.00	8.0	26.26	0.88	27.14	13.57	28.91
45.00	8.0	27.98	0.87	28.86	14.43	30.60
46.00	8.0	29.43	0.86	30.29	15.15	32.02
47.00	8.0	30.61	0.87	31.48	15.74	33.22
48.00	8.0	31.51	0.91	32.42	16.21	34.25
49.00	8.0	32.17	0.95	33.12	16.56	35.02
50.00	8.0	32.78	1.01	33.79	16.89	35.80
51.00	8.0	33.44	1.12	34.56	17.28	36.79
52.00	8.0	34.37	1.18	35.56	17.78	37.92
53.00	8.0	35.21	1.21	36.42	18.21	38.84
54.00	8.0	36.09	1.21	37.30	18.65	39.73
55.00	8.0	36.98	1.21	38.19	19.10	40.62

NOTES

1. MOBILIZED END BEARING IS 1/3 OF THE ORIGINAL RB-121 VALUES.
2. DAVISSON PILE CAPACITY IS AN ESTIMATE BASED ON FAILURE CRITERIA, AND EQUALS ULTIMATE SIDE FRICTION PLUS MOBILIZED END BEARING.
3. ALLOWABLE PILE CAPACITY IS 1/2 THE DAVISSON PILE CAPACITY.
4. ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 3 x THE MOBILIZED END BEARING.
EXCEPTION: FOR H-PILES TIPPED IN SAND OR LIMESTONE, THE ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 2 x THE MOBILIZED END BEARING.

General Information:

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Input file:ects\2018\H1185305\Working Files\Calculations-Analyses\B-1.spc
 Project number: H1185305
 Job name: Lake Apopka North Shore Pump Station
 Engineer: McMaster
 Units: English

Analysis Information:

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Analysis Type: SPT

Soil Information:

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Boring date: 512/5/18, Boring Number: B-1
 Station number: Offset:

Ground Elevation: 0.000(ft)

Hammer type: Safety Hammer

ID	Depth (ft)	No. of Blows (Blows/ft)	Soil Type
1	0.00	0.00	5- Cavity layer
2	6.00	0.00	5- Cavity layer
3	7.00	4.00	2- Clay and silty sand
4	8.00	4.00	2- Clay and silty sand
5	10.00	5.00	2- Clay and silty sand
6	13.50	15.00	4- Lime Stone/Very shelly sand
7	18.50	11.00	3- Clean sand
8	23.50	3.00	1- Plastic Clay
9	28.50	15.00	2- Clay and silty sand
10	33.50	10.00	2- Clay and silty sand
11	38.50	4.00	2- Clay and silty sand
12	43.50	17.00	1- Plastic Clay
13	48.50	7.00	2- Clay and silty sand
14	53.50	10.00	2- Clay and silty sand
15	58.50	10.00	2- Clay and silty sand
16	60.00	0.00	5- Cavity layer

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Blowcount Average Per Soil Layer

Layer Num.	Starting Elevation (ft)	Bottom Elevation (ft)	Thickness (ft)	Average Blowcount (Blows/ft)	Soil Type
1	0.00	-7.00	7.00	0.00	5-Void
2	-7.00	-13.50	6.50	4.54	2-Clay and Silty Sand
3	-13.50	-18.50	5.00	15.00	4-Limestone, Very Shelly Sand
4	-18.50	-23.50	5.00	11.00	3-Clean Sand
5	-23.50	-28.50	5.00	3.00	1-Plastic Clay
6	-28.50	-43.50	15.00	9.67	2-Clay and Silty Sand
7	-43.50	-48.50	5.00	17.00	1-Plastic Clay
8	-48.50	-60.00	11.50	8.70	2-Clay and Silty Sand
9	-60.00	-60.00	0.00	0.00	5-

Driven Pile Data:

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Pile unit weight = 489.00(pcf), Section Type: H-Section

Pile Geometry:

Width (in)	Length (ft)	Tip Elev. (ft)	Depth (in)
12.05	10.00	-10.00	11.78
12.05	11.00	-11.00	11.78
12.05	12.00	-12.00	11.78
12.05	13.00	-13.00	11.78
12.05	14.00	-14.00	11.78
12.05	15.00	-15.00	11.78
12.05	16.00	-16.00	11.78
12.05	17.00	-17.00	11.78
12.05	18.00	-18.00	11.78
12.05	19.00	-19.00	11.78
12.05	20.00	-20.00	11.78
12.05	21.00	-21.00	11.78
12.05	22.00	-22.00	11.78
12.05	23.00	-23.00	11.78
12.05	24.00	-24.00	11.78
12.05	25.00	-25.00	11.78
12.05	26.00	-26.00	11.78
12.05	27.00	-27.00	11.78
12.05	28.00	-28.00	11.78

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12.05	29.00	-29.00		11.78
12.05	30.00	-30.00		11.78
12.05	31.00	-31.00		11.78
12.05	32.00	-32.00		11.78
12.05	33.00	-33.00		11.78
12.05	34.00	-34.00		11.78
12.05	35.00	-35.00		11.78
12.05	36.00	-36.00		11.78
12.05	37.00	-37.00		11.78
12.05	38.00	-38.00		11.78
12.05	39.00	-39.00		11.78
12.05	40.00	-40.00		11.78
12.05	41.00	-41.00		11.78
12.05	42.00	-42.00		11.78
12.05	43.00	-43.00		11.78
12.05	44.00	-44.00		11.78
12.05	45.00	-45.00		11.78
12.05	46.00	-46.00		11.78
12.05	47.00	-47.00		11.78
12.05	48.00	-48.00		11.78
12.05	49.00	-49.00		11.78
12.05	50.00	-50.00		11.78
12.05	51.00	-51.00		11.78
12.05	52.00	-52.00		11.78
12.05	53.00	-53.00		11.78
12.05	54.00	-54.00		11.78
12.05	55.00	-55.00		11.78

Driven Pile Capacity:

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Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
10.00	12.0	1.15	4.52	5.67	2.84	14.71
11.00	12.0	1.65	6.99	8.64	4.32	22.62
12.00	12.0	3.18	7.78	10.96	5.48	26.51
13.00	12.0	3.77	7.85	11.62	5.81	27.32
14.00	12.0	4.34	7.32	11.66	5.83	18.98
15.00	12.0	4.92	6.69	11.60	5.80	18.29
16.00	12.0	5.50	5.95	11.45	5.73	17.40
17.00	12.0	6.10	5.10	11.20	5.60	16.29
18.00	12.0	6.70	4.13	10.83	5.41	14.96
19.00	12.0	7.31	3.05	10.37	5.18	13.42

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20.00	12.0	7.92	2.03	9.95	4.98	11.98
21.00	12.0	8.53	1.40	9.93	4.96	11.32
22.00	12.0	9.13	1.22	10.35	5.18	11.57
23.00	12.0	9.74	1.49	11.22	5.61	12.71
24.00	12.0	10.32	1.88	12.20	6.10	15.95
25.00	12.0	10.95	2.57	13.52	6.76	18.66
26.00	12.0	12.33	3.31	15.64	7.82	22.25
27.00	12.0	13.70	3.53	17.23	8.62	24.30
28.00	12.0	15.32	3.51	18.84	9.42	25.87
29.00	12.0	17.15	3.28	20.44	10.22	27.00
30.00	12.0	18.92	3.02	21.94	10.97	27.97
31.00	12.0	20.57	2.74	23.31	11.66	28.80
32.00	12.0	22.11	2.45	24.56	12.28	29.47
33.00	12.0	23.54	2.15	25.69	12.84	29.99
34.00	12.0	24.85	1.84	26.68	13.34	30.36
35.00	12.0	26.00	1.54	27.54	13.77	30.61
36.00	12.0	26.99	1.35	28.34	14.17	31.03
37.00	12.0	27.82	1.28	29.10	14.55	31.66
38.00	12.0	28.49	1.34	29.83	14.91	32.50
39.00	12.0	29.08	1.50	30.58	15.29	33.59
40.00	12.0	30.07	1.68	31.75	15.88	35.11
41.00	12.0	31.56	1.81	33.36	16.68	36.98
42.00	12.0	33.53	1.89	35.41	17.71	39.19
43.00	12.0	35.99	1.91	37.90	18.95	41.73
44.00	12.0	38.83	1.90	40.72	20.36	44.52
45.00	12.0	41.37	1.88	43.25	21.62	47.01
46.00	12.0	43.51	1.90	45.41	22.71	49.22
47.00	12.0	45.25	1.97	47.22	23.61	51.16
48.00	12.0	46.58	2.08	48.66	24.33	52.83
49.00	12.0	47.55	2.17	49.72	24.86	54.05
50.00	12.0	48.46	2.24	50.70	25.35	55.18
51.00	12.0	49.41	2.37	51.78	25.89	56.53
52.00	12.0	50.47	2.53	53.00	26.50	58.05
53.00	12.0	52.05	2.62	54.67	27.34	59.92
54.00	12.0	53.36	2.63	55.98	27.99	61.24
55.00	12.0	54.67	2.57	57.24	28.62	62.38

NOTES

1. MOBILIZED END BEARING IS 1/3 OF THE ORIGINAL RB-121 VALUES.
2. DAVISSEON PILE CAPACITY IS AN ESTIMATE BASED ON FAILURE CRITERIA, AND EQUALS ULTIMATE SIDE FRICTION PLUS MOBILIZED END BEARING.
3. ALLOWABLE PILE CAPACITY IS 1/2 THE DAVISSEON PILE CAPACITY.
4. ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 3 x THE MOBILIZED END BEARING.
EXCEPTION: FOR H-PILES TIPPED IN SAND OR LIMESTONE, THE

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ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS
2 x THE MOBILIZED END BEARING.

B-1 pipe

Florida Bridge Software Institute
Shaft and Pile Analysis (FB-Deep v.2.05)

Date: January 14, 2019
Time: 11:42:15

General Information:

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Input file:2018\H1185305\Working Files\Calculations-Analyses\B-1 pipe.spc
Project number: H1185305
Job name: Lake Apopka North Shore Pump Station
Engineer: McMaster
Units: English

Analysis Information:

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Analysis Type: SPT

Soil Information:

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Boring date: 5/12/18, Boring Number: B-1
Station number: Offset:

Ground Elevation: 0.000(ft)

Hammer type: Safety Hammer

ID	Depth (ft)	No. of Blows (Blows/ft)	Soil Type
1	0.00	0.00	5- Cavity layer
2	6.00	0.00	5- Cavity layer
3	7.00	4.00	2- Clay and silty sand
4	8.00	4.00	2- Clay and silty sand
5	10.00	5.00	2- Clay and silty sand
6	13.50	15.00	4- Lime Stone/Very shelly sand
7	18.50	11.00	3- Clean sand
8	23.50	3.00	1- Plastic Clay
9	28.50	15.00	2- Clay and silty sand
10	33.50	10.00	2- Clay and silty sand
11	38.50	4.00	2- Clay and silty sand
12	43.50	17.00	1- Plastic Clay
13	48.50	7.00	2- Clay and silty sand
14	53.50	10.00	2- Clay and silty sand
15	58.50	10.00	2- Clay and silty sand
16	60.00	0.00	5- Cavity layer

B-1 pipe

Blowcount Average Per Soil Layer

Layer Num.	Starting Elevation (ft)	Bottom Elevation (ft)	Thickness (ft)	Average Blowcount (Blows/ft)	Soil Type
1	0.00	-7.00	7.00	0.00	5-Void
2	-7.00	-13.50	6.50	4.54	2-Clay and Silty Sand
3	-13.50	-18.50	5.00	15.00	4-Limestone, Very
Shelly Sand					
4	-18.50	-23.50	5.00	11.00	3-Clean Sand
5	-23.50	-28.50	5.00	3.00	1-Plastic Clay
6	-28.50	-43.50	15.00	9.67	2-Clay and Silty Sand
7	-43.50	-48.50	5.00	17.00	1-Plastic Clay
8	-48.50	-60.00	11.50	8.70	2-Clay and Silty Sand
9	-60.00	-60.00	0.00	0.00	5-

Driven Pile Data:

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Pile unit weight = 489.00(pcf), Section Type: Pipe

Pile Geometry:

Width (in)	Length (ft)	Tip Elev. (ft)	Thickness (in)	Pile End
8.00	10.00	-10.00	0.25	OPEN
8.00	11.00	-11.00	0.25	OPEN
8.00	12.00	-12.00	0.25	OPEN
8.00	13.00	-13.00	0.25	OPEN
8.00	14.00	-14.00	0.25	OPEN
8.00	15.00	-15.00	0.25	OPEN
8.00	16.00	-16.00	0.25	OPEN
8.00	17.00	-17.00	0.25	OPEN
8.00	18.00	-18.00	0.25	OPEN
8.00	19.00	-19.00	0.25	OPEN
8.00	20.00	-20.00	0.25	OPEN
8.00	21.00	-21.00	0.25	OPEN
8.00	22.00	-22.00	0.25	OPEN
8.00	23.00	-23.00	0.25	OPEN
8.00	24.00	-24.00	0.25	OPEN
8.00	25.00	-25.00	0.25	OPEN
8.00	26.00	-26.00	0.25	OPEN
8.00	27.00	-27.00	0.25	OPEN
8.00	28.00	-28.00	0.25	OPEN

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8.00	29.00	-29.00	0.25 OPEN
8.00	30.00	-30.00	0.25 OPEN
8.00	31.00	-31.00	0.25 OPEN
8.00	32.00	-32.00	0.25 OPEN
8.00	33.00	-33.00	0.25 OPEN
8.00	34.00	-34.00	0.25 OPEN
8.00	35.00	-35.00	0.25 OPEN
8.00	36.00	-36.00	0.25 OPEN
8.00	37.00	-37.00	0.25 OPEN
8.00	38.00	-38.00	0.25 OPEN
8.00	39.00	-39.00	0.25 OPEN
8.00	40.00	-40.00	0.25 OPEN
8.00	41.00	-41.00	0.25 OPEN
8.00	42.00	-42.00	0.25 OPEN
8.00	43.00	-43.00	0.25 OPEN
8.00	44.00	-44.00	0.25 OPEN
8.00	45.00	-45.00	0.25 OPEN
8.00	46.00	-46.00	0.25 OPEN
8.00	47.00	-47.00	0.25 OPEN
8.00	48.00	-48.00	0.25 OPEN
8.00	49.00	-49.00	0.25 OPEN
8.00	50.00	-50.00	0.25 OPEN
8.00	51.00	-51.00	0.25 OPEN
8.00	52.00	-52.00	0.25 OPEN
8.00	53.00	-53.00	0.25 OPEN
8.00	54.00	-54.00	0.25 OPEN
8.00	55.00	-55.00	0.25 OPEN

Driven Pile Capacity:

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Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
10.00	8.0	2.15	0.20	2.35	1.17	2.74
11.00	8.0	3.03	0.31	3.34	1.67	3.96
12.00	8.0	3.84	0.42	4.26	2.13	5.10
13.00	8.0	4.57	0.49	5.06	2.53	6.03
14.00	8.0	5.94	0.51	6.45	3.22	7.48
15.00	8.0	6.54	0.53	7.06	3.53	8.12
16.00	8.0	7.17	0.55	7.73	3.86	8.83
17.00	8.0	7.91	0.57	8.47	4.24	9.61
18.00	8.0	4.51	4.46	8.96	4.48	17.88
19.00	8.0	4.99	3.22	8.20	4.10	14.64

B-1 pipe						
20.00	8.0	5.35	2.78	8.13	4.06	13.68
21.00	8.0	5.61	2.20	7.81	3.90	12.21
22.00	8.0	5.78	1.72	7.50	3.75	10.94
23.00	8.0	5.87	1.51	7.38	3.69	10.39
24.00	8.0	5.91	0.73	6.64	3.32	8.11
25.00	8.0	6.11	1.11	7.22	3.61	9.45
26.00	8.0	6.53	1.50	8.03	4.01	11.02
27.00	8.0	7.17	1.83	9.00	4.50	12.66
28.00	8.0	8.03	2.01	10.05	5.02	14.07
29.00	8.0	9.15	2.02	11.17	5.59	15.22
30.00	8.0	10.12	2.10	12.22	6.11	16.43
31.00	8.0	11.07	2.19	13.27	6.63	17.65
32.00	8.0	12.01	2.17	14.18	7.09	18.52
33.00	8.0	12.90	2.06	14.96	7.48	19.07
34.00	8.0	13.73	1.88	15.60	7.80	19.36
35.00	8.0	14.47	1.67	16.14	8.07	19.48
36.00	8.0	15.14	1.46	16.60	8.30	19.51
37.00	8.0	15.72	1.27	16.99	8.49	19.52
38.00	8.0	16.22	1.15	17.37	8.68	19.66
39.00	8.0	16.66	1.10	17.76	8.88	19.96
40.00	8.0	17.27	1.08	18.35	9.18	20.52
41.00	8.0	18.07	1.10	19.17	9.58	21.37
42.00	8.0	19.06	1.14	20.20	10.10	22.48
43.00	8.0	20.24	1.18	21.43	10.71	23.79
44.00	8.0	21.67	1.37	23.04	11.52	25.77
45.00	8.0	22.91	1.36	24.26	12.13	26.98
46.00	8.0	23.99	1.34	25.33	12.67	28.02
47.00	8.0	24.92	1.34	26.26	13.13	28.95
48.00	8.0	25.70	1.37	27.07	13.53	29.80
49.00	8.0	26.35	1.39	27.75	13.87	30.54
50.00	8.0	26.99	1.44	28.43	14.21	31.30
51.00	8.0	27.65	1.54	29.19	14.59	32.26
52.00	8.0	28.39	1.62	30.01	15.01	33.26
53.00	8.0	29.18	1.69	30.86	15.43	34.24
54.00	8.0	30.00	1.74	31.74	15.87	35.22
55.00	8.0	30.82	1.78	32.61	16.30	36.18

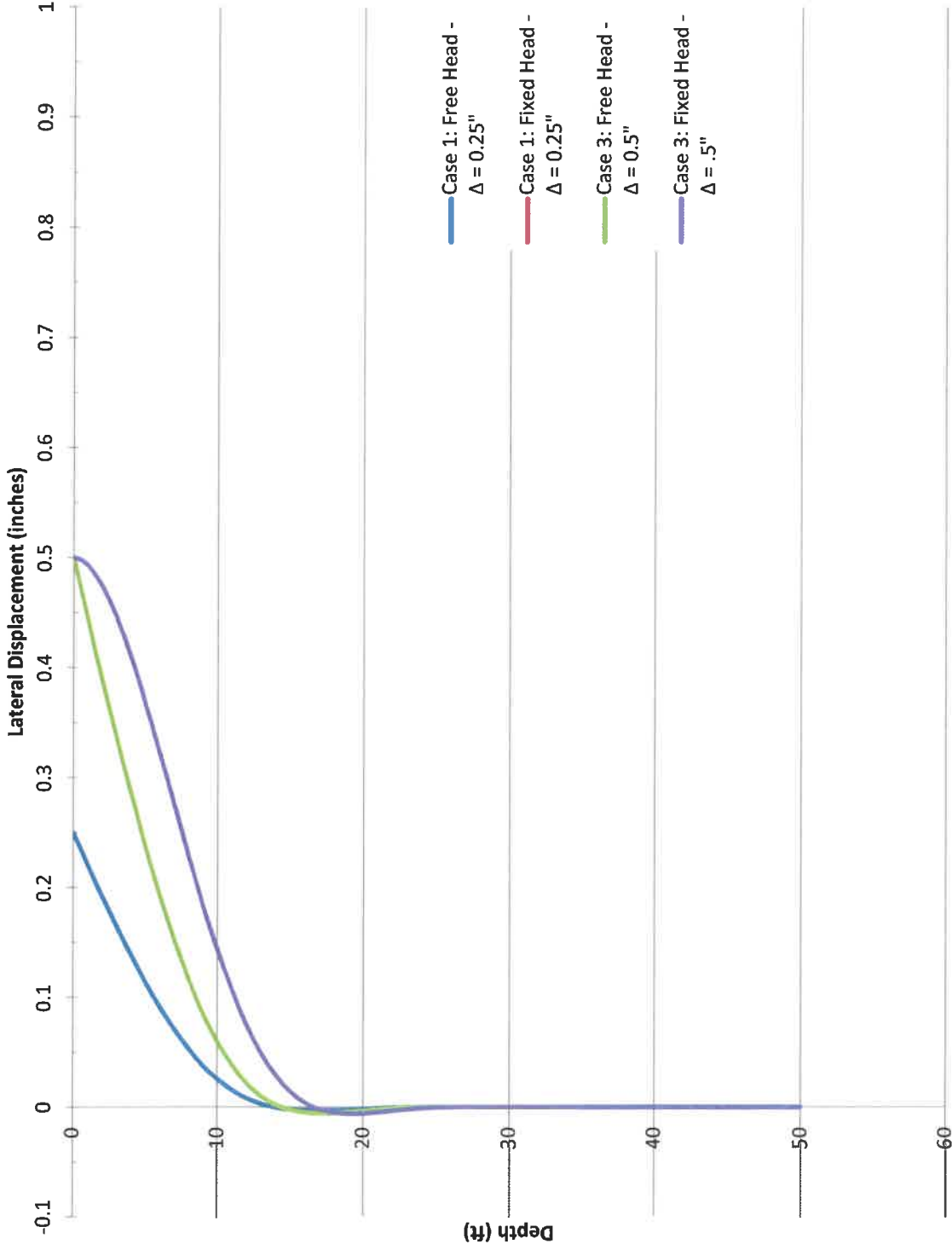
NOTES

1. MOBILIZED END BEARING IS 1/3 OF THE ORIGINAL RB-121 VALUES.
2. DAVISSON PILE CAPACITY IS AN ESTIMATE BASED ON FAILURE CRITERIA, AND EQUALS ULTIMATE SIDE FRICTION PLUS MOBILIZED END BEARING.
3. ALLOWABLE PILE CAPACITY IS 1/2 THE DAVISSON PILE CAPACITY.
4. ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 3 x THE MOBILIZED END BEARING.
EXCEPTION: FOR H-PILES TIPPED IN SAND OR LIMESTONE, THE

B-1 pipe
ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS
2 x THE MOBILIZED END BEARING.

PILE LATERAL CAPACITY

Lateral Displacement vs Depth



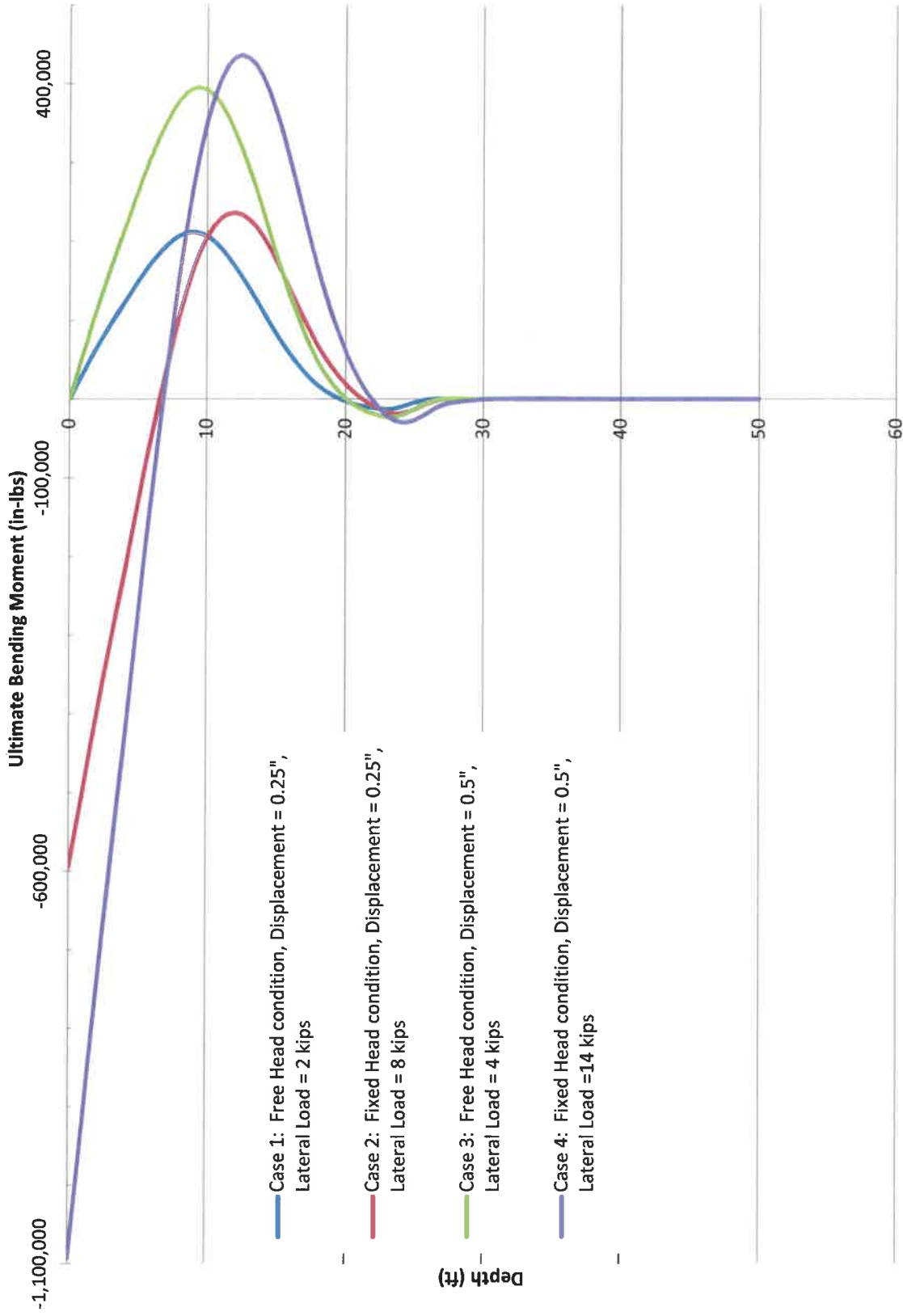
Project Mgr:	SM
Prepared by:	SM
Checked by:	JWC
Approved by:	JWC

Project No.:	H1185305
Project Name:	
Scale:	n/a
Date:	1/14/2019



Lateral Pile Analysis - HP 12 x 53	
N. Shore Unit 1 Pump Station	
Apopka, Florida	

Corresponding Bending Moment vs Depth

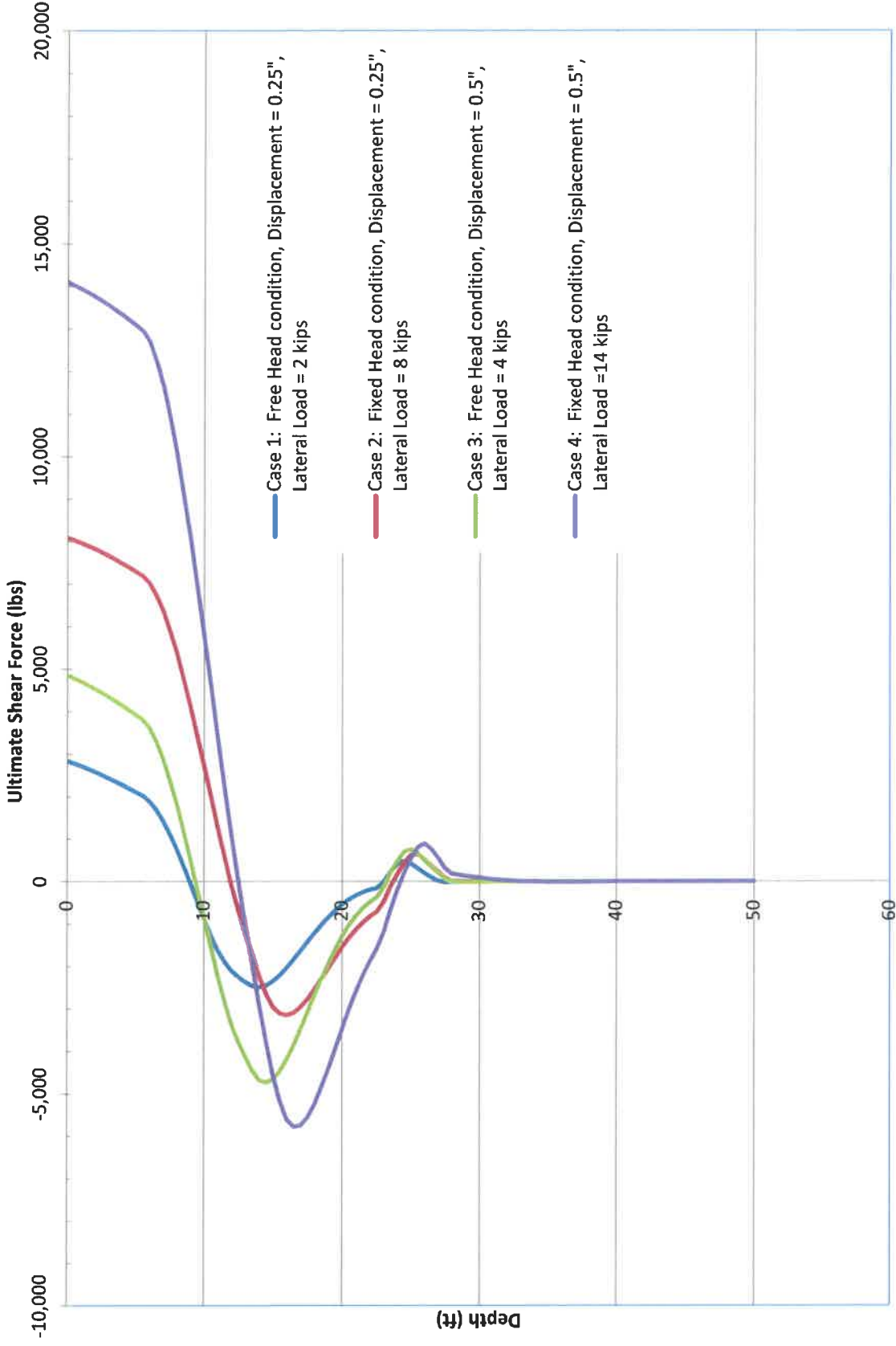


Project Mgr:	SM	Project No.:	H1185305
Prepared by:	SM	Project Name:	
Checked by:	JWC	Scale:	n/a
Approved by:	JWC	Date:	1/14/2019



Lateral Pile Analysis - HP 12 x 53	
N. Shore Unit 1 Pump Station	
Apopka, Florida	

Corresponding Shear Force vs Depth

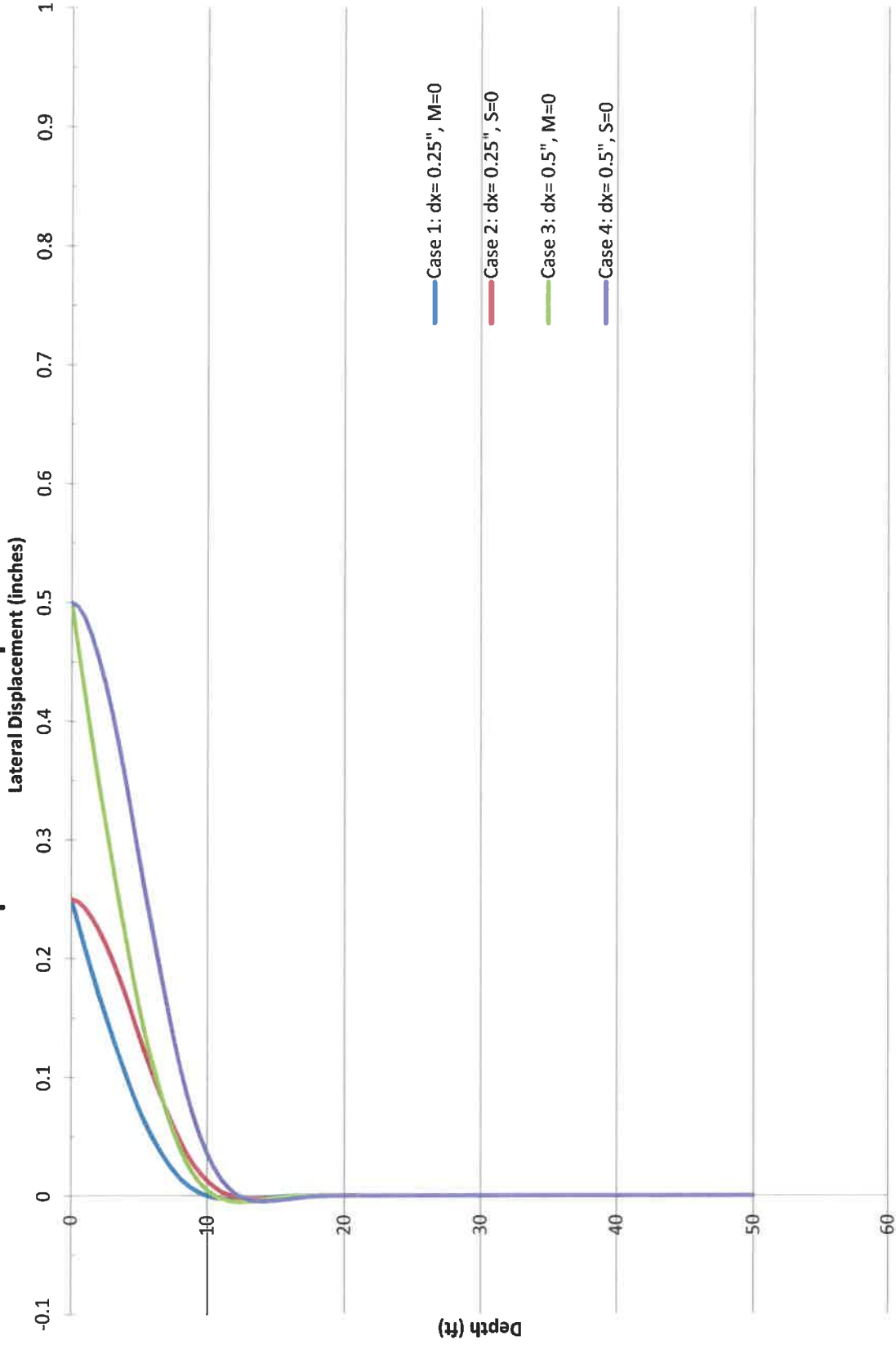


Project Mgr:	SM	Project No.:	H1185305
Prepared by:	SM	Project Name:	
Checked by:	JWC	Scale:	n/a
Approved by:	JWC	Date:	1/14/2019



Lateral Pile Analysis - HP 12 x 53	
N. Shore Unit 1 Pump Station	
Apopka, Florida	

Lateral Displacement vs Depth



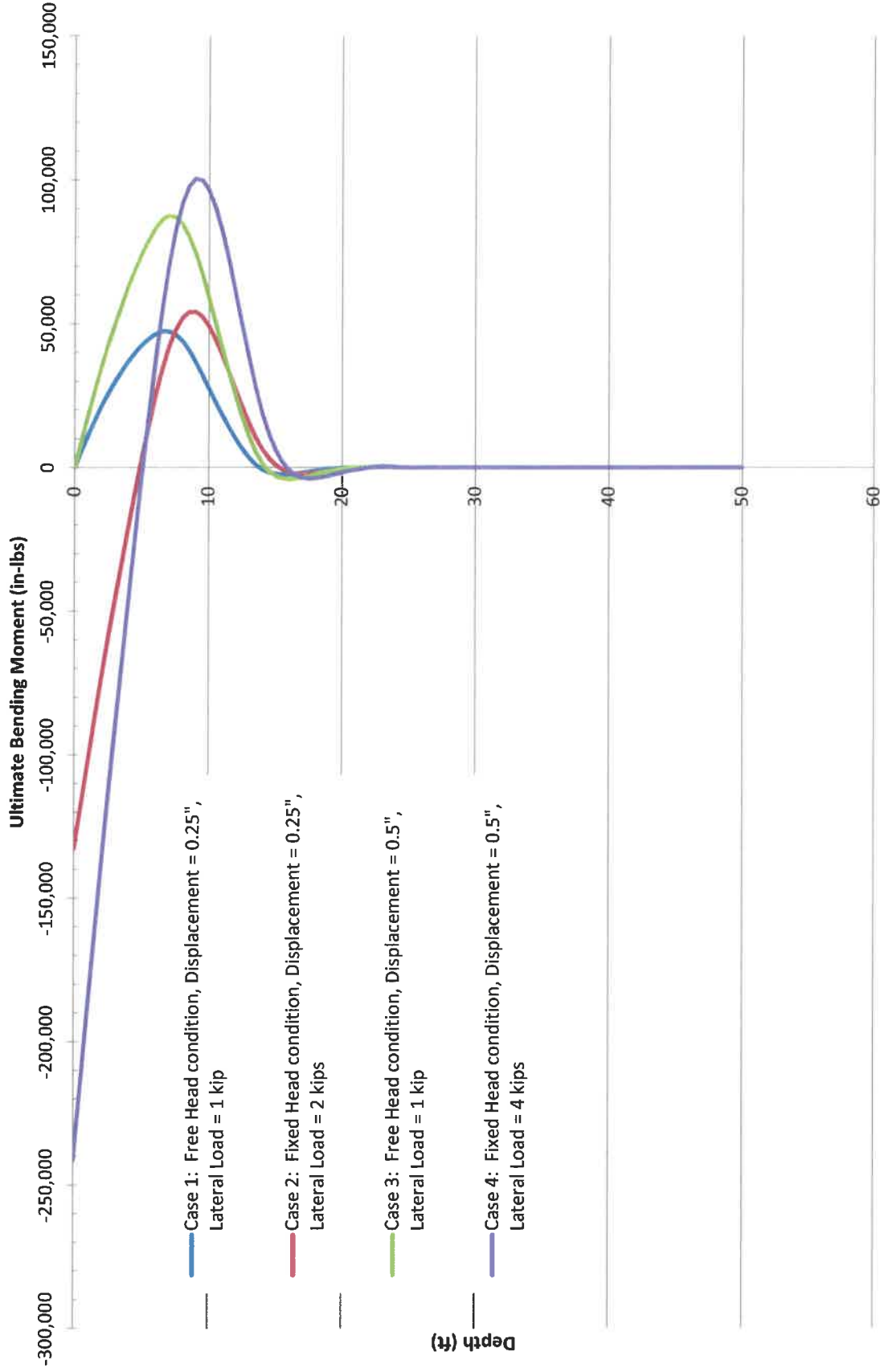
Project Mgr:	SM
Prepared by:	SM
Checked by:	JWC
Approved by:	JWC

Project No:	H1185305
Project Name:	Project Panther
Scale:	n/a
Date:	1/14/2019



Lateral Pile Analysis - 8" Pipe Pile (Open End)	
N. Shore Unit 1 Pump Station	
Cape Canaveral Air Force Station, Brevard Co., Fla	

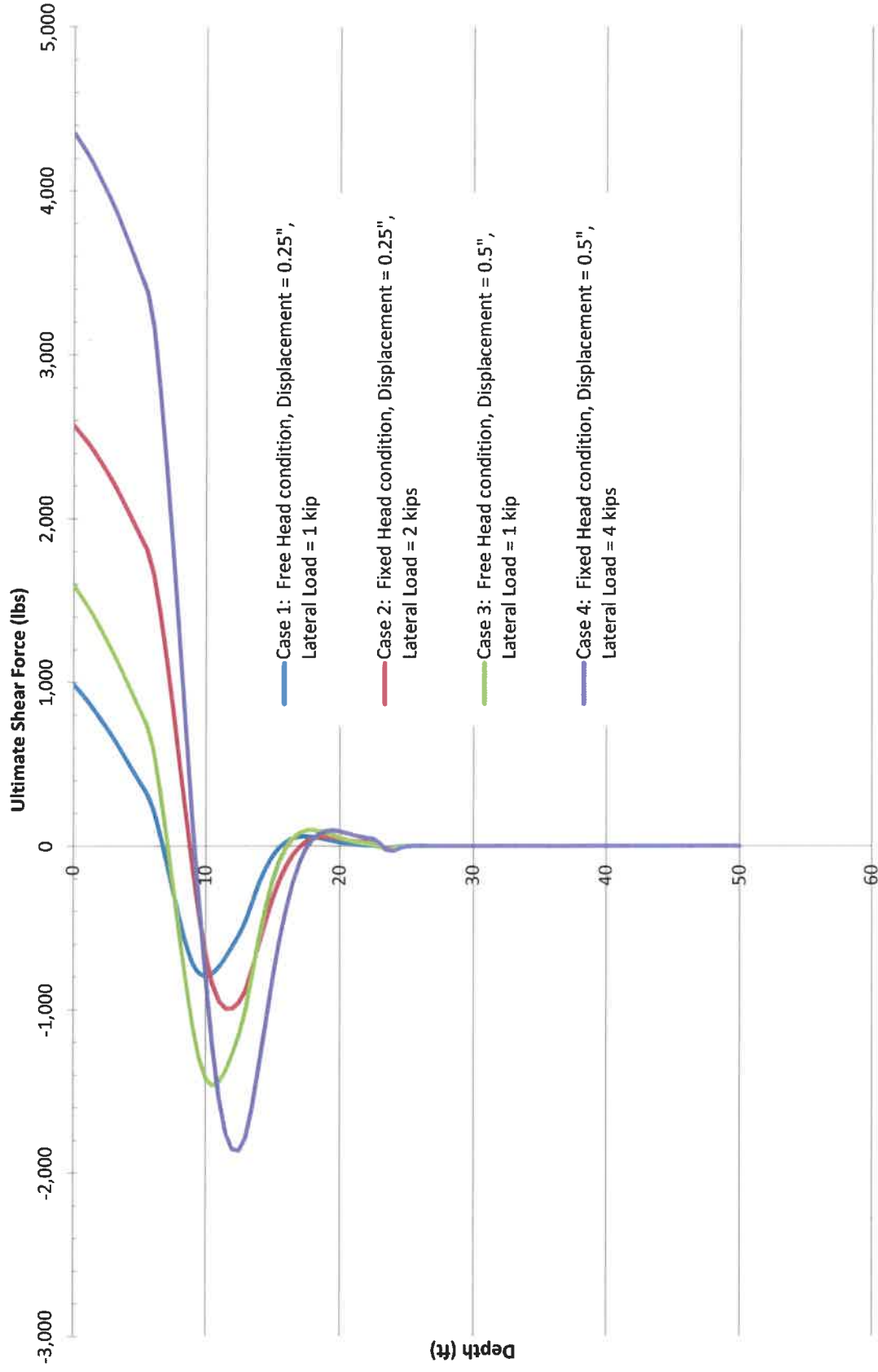
Corresponding Bending Moment vs Depth



Project Mgr:	SM	Project No.:	H1185305
Prepared by:	SM	Project Name:	Project Panther
Checked by:	JWC	Scale:	n/a
Approved by:	JWC	Date:	1/14/2019

Terracon	
Lateral Pile Analysis - 8" Pipe Pile (Open End)	
N. Shore Unit 1 Pump Station	
Apopka, Florida	

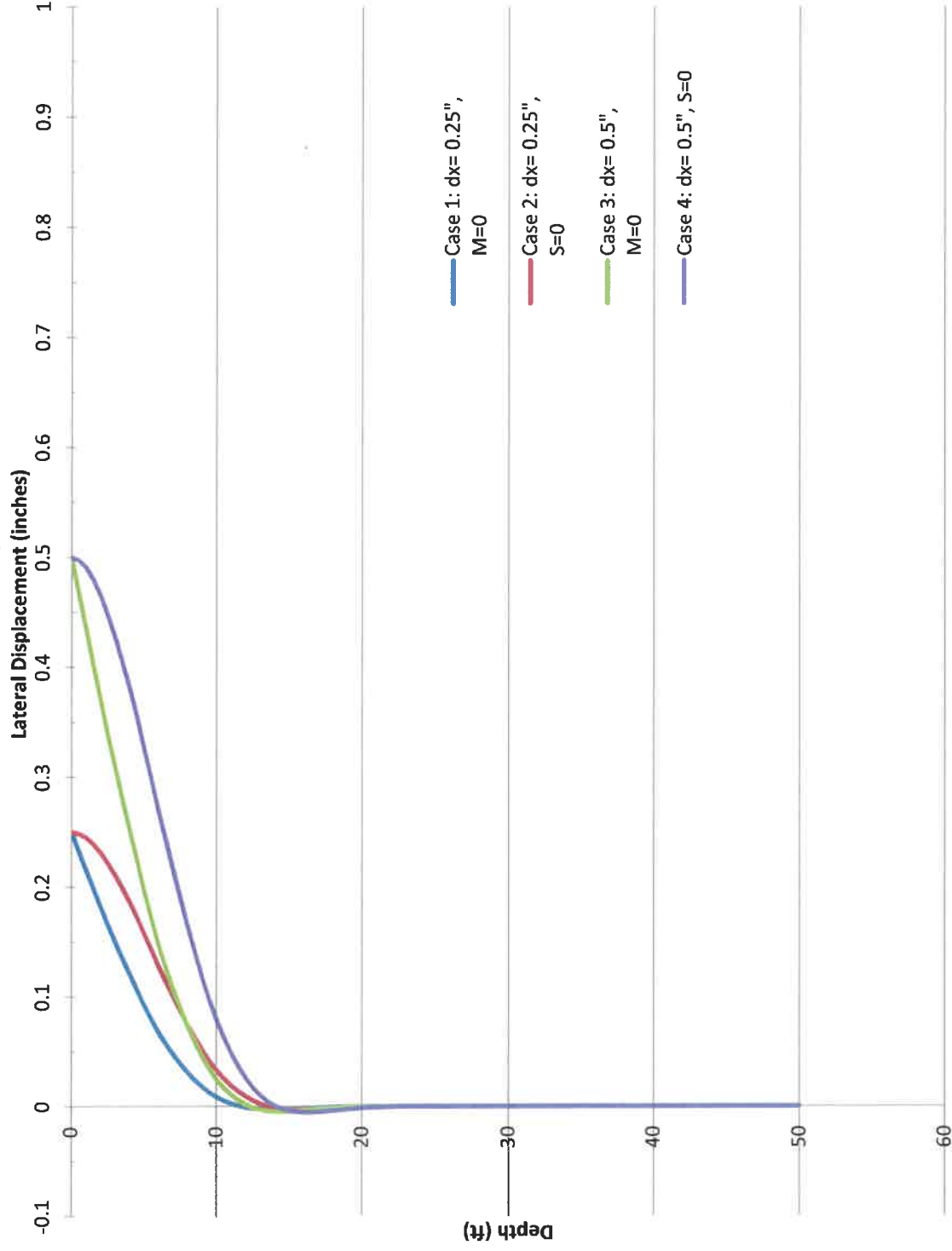
Corresponding Shear Force vs Depth



Project Ngr:	SM	Project No.:	H1185305
Prepared by:	SM	Project Name:	
Checked by:	JWC	Scale:	n/a
Approved by:	JWC	Date:	1/14/2019

Lateral Pile Analysis - 8" Pipe Pile (Open End)
N. Shore Unit 1 Pump Station
Apopka, Florida

Lateral Displacement vs Depth



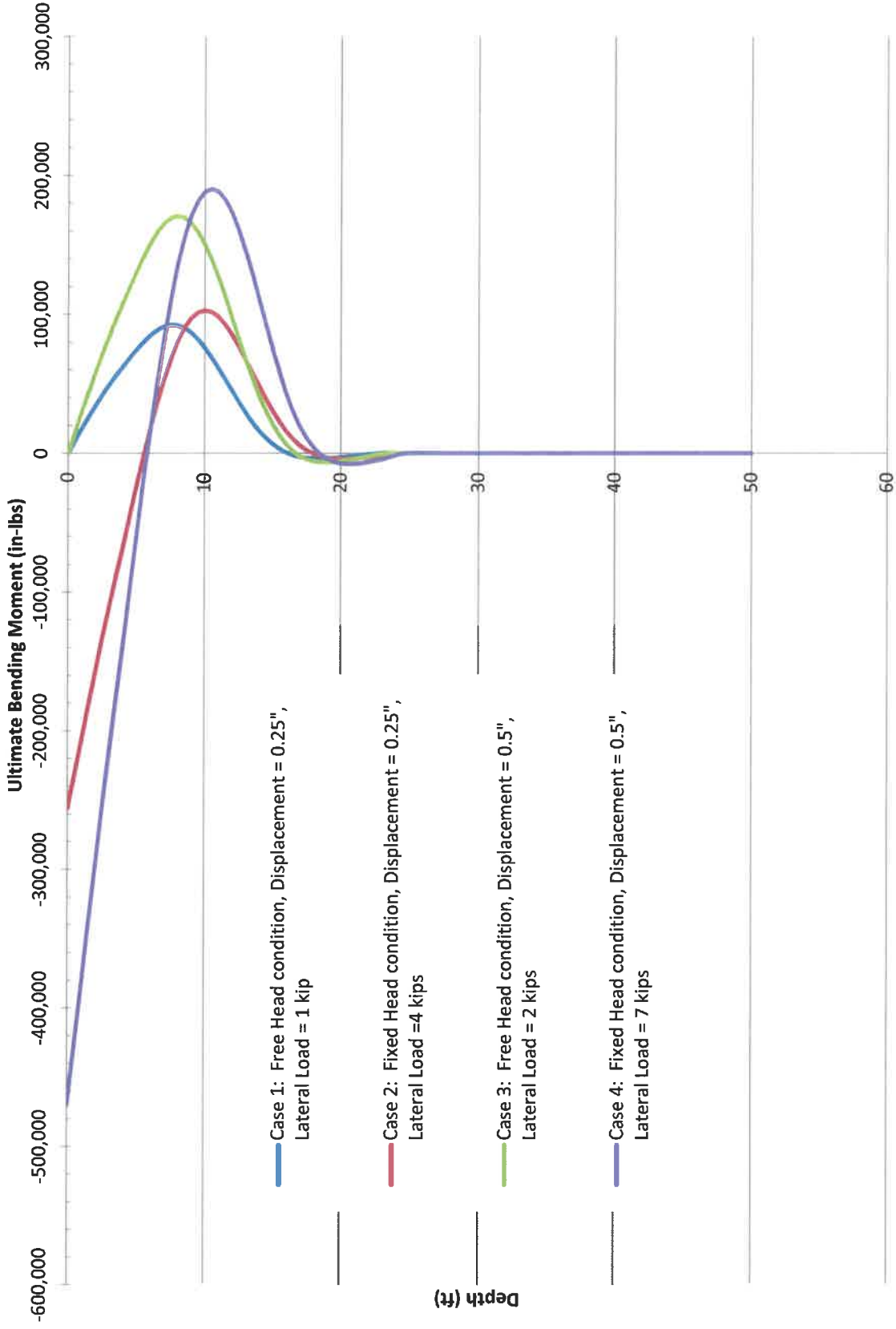
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Checked by:	JWC
Approved by:	JWC

Project No.	H1185305
Project Name:	
Scale:	n/a
Date:	1/14/2019



Lateral Pile Analysis - HP 8 x 36	
N. Shore Unit 1 Pump Station	
Apopka, Florida	

Corresponding Bending Moment vs Depth

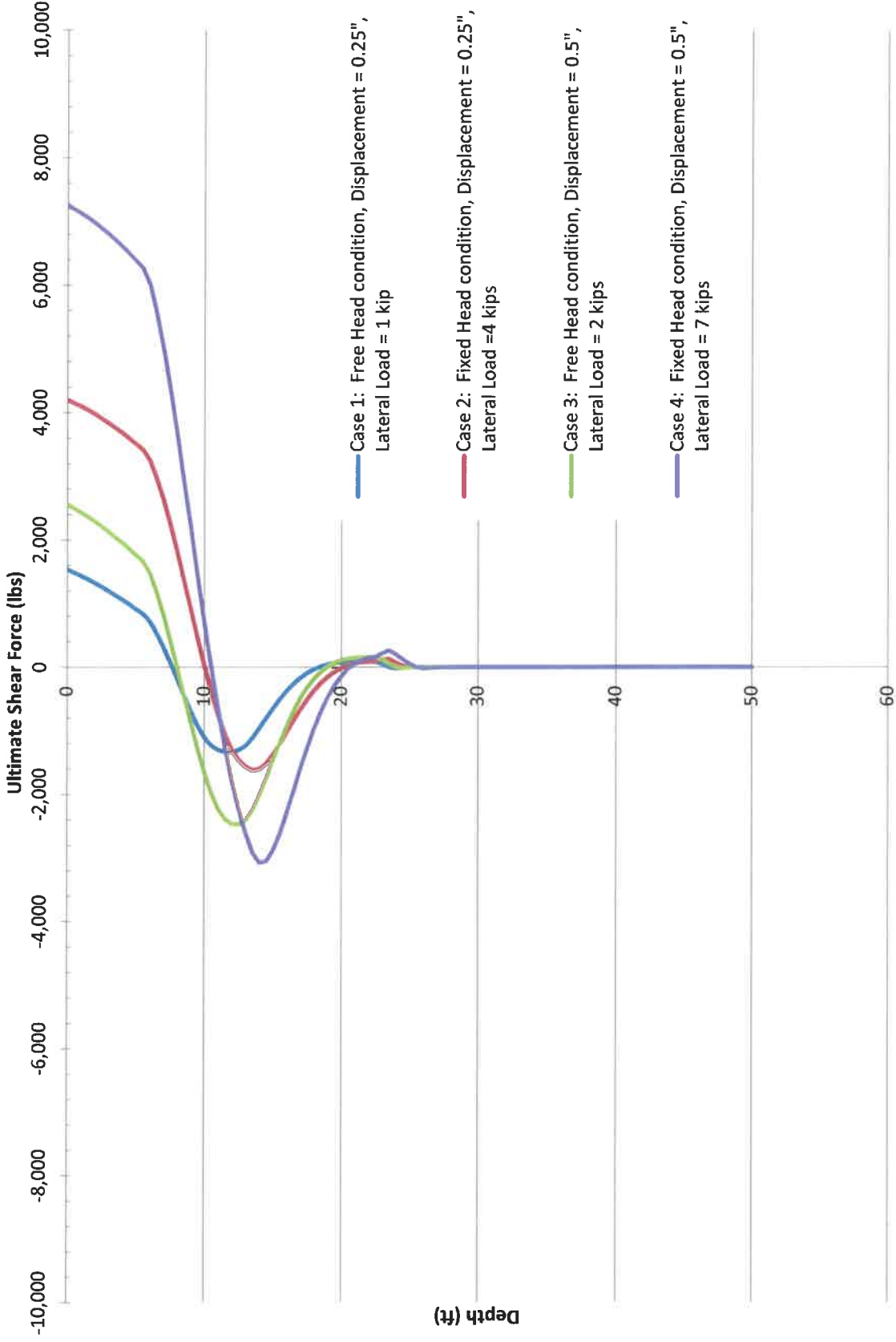


Project Mgr:	SM	Project No.:	H1185305
Prepared by:	SM	Project Name:	
Checked by:	JWC	Scale:	n/a
Approved by:	JWC	Date:	1/14/2019



Lateral Pile Analysis - HP 8 x 36	
N. Shore Unit 1 Pump Station	
Apopka, Florida	

Corresponding Shear Force vs Depth



Project Mgr:	SM	Project No.:	H1185305
Prepared by:	SM	Project Name:	Project Panther
Checked by:	JWC	Scale:	n/a
Approved by:	JWC	Date:	1/14/2019



Lateral Pile Analysis - HP 8 x 36	
N. Shore Unit 1 Pump Station	
Apopka, Florida	